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Effect of Distance to Schooling on Home Prices*

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Abstract: This paper uses hedonic analysis of home transactions in the Denver Public School District to estimate the effect of distance to schooling on sales price. This study considers all three levels of public location based schooling: elementary, middle and high school. While most studies examining the relationship between schooling and home price investigate the change in home value based on the quality of schooling, this paper controls for school quality differences and focuses on the value of distance to schools. Results indicate that as distance to schooling increases, home price decreases. Despite the overall inverse relationship, the study finds a congestion effect near all levels of schooling; homes 1,000 feet from a school have a higher price than homes less than 500 feet. In addition, results suggest that homes just inside the cutoff distance for walking to elementary school (1,320 feet) are priced lower than homes just outside this cutoff.

Keywords: distance to school, hedonic, home values, geographic information systems

JEL Codes: H41, I20, R21

1. INTRODUCTION

Over the past 15 years, several studies have examined the impact of public schooling on home prices. The location of a home is tied to local public schooling, and the value of this schooling is capitalized into the home price. Starting with Black (1999), numerous studies have examined the effect of school quality on home price. But homeowner value for schooling is not solely based on its quality; it is also related to distance from the home. Studies of local public goods, such as open space, have long examined how the value for an amenity changes with distance from the home.[1] In the context of schooling, the value for distance has received little attention (Des Rosiers, Lagana, and Theriault, 2001; Kane, Riegg, and Staiger, 2006; Owusu-Edusei, Espey, and Lin, 2007; Gibbons, Machin, and Silva, 2013). This paper uses hedonic analysis of home transactions in the Denver Public School District to estimate the effect of distance to schooling on sales price. This paper adds to the overall literature concerning school and home price, while its main contribution is to expand the small strand of literature focused on distance.

As far as the literature on schooling and home price is concerned, we first discuss school quality to give an overall context for this paper's contribution, and then highlight the differences between this paper and previous papers which focus on distance to school. Black (1999) and

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[1] See McConnell and Walls (2005) for a review on valuing open space. Also see Waltert and Schläpfer (2010) for a more recent review of hedonic pricing studies focused on local amenities.

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Bogart and Cromwell (2000) were the first to use school boundaries and regression discontinuity design to estimate the value for school quality. Since these initial works, several studies have examined the capitalization of school quality into home prices (Epple and Romano, 2003; Cheshire and Sheppard, 2004; Clapp, Nanda, and Ross, 2008; Dhar and Ross, 2012; Frack and Grenet, 2010; Gibbons and Machlin, 2006; Gibbons, Machin, and Silva, 2013; Machin, 2011). These papers vary in their methodology for handling neighborhood effects (e.g. instrumental variables, geographic fixed effects, or matching), as well as in how they measure school quality (e.g., test scores, spending per student, or student-teacher ratio). The general consensus is that an improvement in school quality is reflected in higher home prices. A complete review of the school quality capitalization literature can be found in Gibbons and Machin (2008) and Nguyen-Hoang and Yinger (2011).

There are a few studies examining the impact of school quality that do include a control variable for distance from the home to the school (Kane, Riegg, and Staiger, 2006; Gibbons, Machin, and Silva, 2013). These papers recognize that it is important to control for distance when estimating the impact of school quality on home price but pay little attention to this result and the possible nonlinear nature of value for distance between home and school.[2] But, Des Rosiers, Lagana, and Theriault (2001) and Owusu-Edusei, Espey, and Lin (2007) focus exclusively on distance to schooling, and its nonlinear relationship with home price.

Des Rosiers, Lagana, and Theriault (2001) study the impact of distance to elementary schooling on home value and allow for nonlinear effects of distance. Their study finds a congestion effect very close to schools. Homes less than 1000 feet from a school experience a disamenity due to traffic and noise associated with the school and thus are valued less than homes further away. They find that the optimal distance, in terms of home value, between home and elementary school is between 1,000 and 1,500 feet. Owusu-Edusei, Espey, and Lin (2007) expand upon the work by Des Rosiers, Lagana, and Theriault (2001) to include distance to all levels of schooling: elementary, middle, and high school. They also allow for a nonlinear relationship between distance and home price. They find a congestion effect for high school, but not for elementary or middle school.

While similar to Des Rosiers, Lagana, and Theriault (2001) and Owusu-Edusei, Espey, and Lin (2007), the current study aims to improve upon their work in several key respects. First, it uses a much larger data set, approximately 22,000 homes compared to the near 4,000 in the previous studies. A data set of this much greater size allows for substantial variation in the distance to schooling variable; this, in turn, should lead to the more accurate study on the nonlinear value for distance. Second, I am able to implement an empirical model using catchment-area fixed effects, which allows me to better control for school quality. Des Rosiers, Lagana, and Theriault (2001) does not control for school quality, while Owusu-Edusei, Espey, and Lin (2007) uses a school-quality measure constructed from test scores. Catchment-area fixed effects are aimed at controlling for unobservable school quality that typical measures such as test scores miss. Additionally, this geographic fixed effect controls for neighborhood unobservables.

While both this study and Owusu-Edusei, Espey, and Lin's (2007) examine distance to all three levels of schooling, I argue that this paper uses improved distance dummies to uncover

[2] For studies on valuing school quality using boundary discontinuities, it may be quite important to recognize the nonlinear value for distance from a school. Homes at a school boundary could be quite near or far from an assigned school, and thus the difference in home price across a boundary could be due to distance from the assigned school and not necessarily the difference in school quality.

the relationship between distance and value. Their distance dummy intervals are selected for seemingly arbitrarily-chosen ranges, which may be the reason they find no congestion effect for elementary and middle school. For example, with elementary schools the dummy intervals are: less than 800 feet (430 observations), between 800 and 10,780 feet (2,925 observations), and greater than 10,780 feet (377 observations). When they omit the category 800 to 10,780 feet, it is no surprise that homes within 800 feet of a school are more valuable than homes located 800 to 10,780 feet, since this is an extremely large range. As this study will show, homeowners generally value being within one mile (5,280 feet) of a school, while being outside of this range has little impact on the value for a home. I find that the benefit of location from a school has almost completely dissipated within a mile of homes, which helps to explain the lack of a result from Owusu-Edusei, Espey, and Lin (2007) given their range of distance dummies. Additionally, they find a congestion effect for high schools because they use distance dummy categories of smaller ranges near the school. For high schools, they use a dummy interval of less than 800 feet, followed by an interval from 800 to 1,600 feet. With this categorization, it is no surprise that they find a negative (congestion) effect for homes within 800 feet of a high school.

The results of our analysis provide evidence of a congestion effect for homes located very close (500-1,000 feet) to all three levels of schooling. I also find a dip in the value of elementary schools with homes just inside the walking distance to school cutoff of 1,320 feet. By using a larger sample size, catchment-area fixed effects and more-disaggregated distances, I am able to expand upon the results of earlier studies on this topic.

2. DATA AND SUMMARY STATISTICS

To estimate the impact of distance to schooling on housing sales, data were collected on school locations and their catchment areas, housing characteristics, and land use near schools for 2002-2004. The area of study is the Denver Public School District, which coincides with both the County and City of Denver. The housing data consist of 22,264 single-family home sales from Metrolist Inc. for 2002-2004 and includes several home characteristics. The housing summary statistics are provided in Table 1.[3] In addition to characteristics on the houses themselves, data are also included on proximity to nearby amenities such as open space and the central business district (CBD).

Figure 1 contains the boundaries for the 2002-2003 school-year catchment areas. Each catchment area has a unique elementary, middle, and high school combination tied to homes inside of its boundaries. Each catchment area is a geographic fixed effect in the analysis. These areas are chosen for two reasons. First, the catchment areas are used to control for school and neighborhood quality. All of the homes in a catchment area have the same elementary, middle, and high school tied to their location. When I make distance to school comparisons within these geographic areas, I will obtain the Denver School District average value for distance to location based public schooling, holding quality constant. Additionally, in an effort to control for school quality, I have controlled for other neighborhood unobservable characteristics. Second, catchment area fixed effects are preferable to individual school fixed effects due to collinearity concerns. In many cases, an elementary school boundary is completely contained within a

[3] The sample data from Metrolist is limited to home sales under $1 million.

Table 1: Summary Statistics

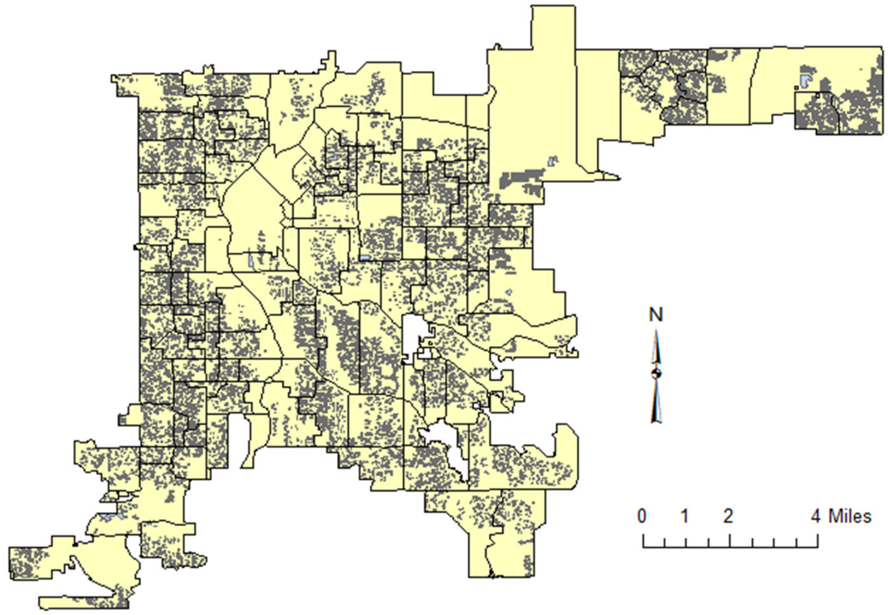
Housing Characteristics	mean	std. dev.	min.	max.
Sale Price (2002 dollars)	247,720	126,172	29,828	999,681
Lot Size (acres)	0.15	0.06	0.02	0.92
# of Baths	1.99	0.82	0.50	9.00
Home Size (sq ft)	3,406	647	273	6,514
Age of House (years)	52	33	0	129
A/C in Home (Yes =1)	0.91	0.28	0	1
Garage Attached to Home (Yes =1)	0.46	0.50	0	1
Fireplace (Yes =1)	0.51	0.50	0	1
Basement (Yes =1)	0.68	0.47	0	1
Proximity to Housing Amenities				
Adjacent to Protected Open Space with Access (Yes =1)	0.01	0.09	0	1
Adjacent to Protected Open Space without Access (Yes =1)	0.03	0.16	0	1
Adjacent to Unprotected Open Space without Access (Yes =1)	0.09	0.28	0	1
Distance to CBD (1,000 feet)	29.52	18.77	2.60	294.50
Distance to Assigned School (1,000 feet)				
Elementary	2.24	1.85	0	13.75
Middle	5.34	3.97	0.00	24.12
High	8.43	5.71	0.00	24.97
% Proficient Reading, Writing, and Math				
Elementary	0.36	0.18	0.03	0.82
Middle	0.23	0.12	0.09	0.63
High	0.28	0.16	0.10	0.70
Non-Public Schools within a Mile of Home				
Charter	0.73	1.02	0	7
Private	1.09	1.33	0	6

middle school boundary; the same is true for some middle schools within high school boundaries. If all three levels of schooling are included in a single regression, then individual school fixed effects will cause perfect collinearity for many observations and make it difficult to identify the key relationship.

Data on school catchment areas were provided by the Planning Department of the Denver Public School (DPS) District. The data on home sales span multiple years, so there is a concern that catchment areas have changed over this time. While catchment areas are adjusted each year, there were very few adjustments to school boundaries from 2002-2004.[4] Since the housing in the sample underwent very little school boundary change, we opted to use 2002-year boundaries for

[4] There were two geographically noticeable adjustments between 2002 and 2004, both for elementary school boundaries. One change occurred near downtown Denver where there are fewer than 50 single-family homes that changed catchment areas. The other change occurred in a growing suburban area with planned future residential development and this change did not impact any of the housing observations.

Figure 1: Location of 22,264 Home Sales for 2002-2004 in the Denver School District



Note: 116 catchment areas with unique combinations of elementary, middle, and high schools for 2002-2003 school year.

simplicity. While home sale data are from 2002-2004, most buyers in this time frame are likely making decisions based on 2002 boundaries as opposed to 2004. This lack of change to school boundaries is a key element in the identification strategy as well. I am able to compare homes within the same catchment over the 2002-2004 time frame, knowing that the identifying variation for distance to school value is made by homes whose residents attend the same school, and thus have the same school quality.

While the catchment areas seen in Figure 1 are used to control for school and neighborhood quality differences, Figures 2, 3, and 4 show the location of schools and their boundaries for elementary, middle and high school respectively. Further the same figures indicate that distance to each level of schooling varies dramatically based on the number of schools in each level and the size of the boundaries. Using a continuous distance measure for all three levels assumes that value for distance behaves in a linear manner when plausibly this relationship may not. For this reason, distance dummies are used to investigate how value to schooling changes with distance.[5]

While the preferred model uses catchment-area fixed effects to control for school quality, the DPS collects testing data that can be used as an alternative measure. The testing places students into four categories: unsatisfactory, partially proficient, proficient, and advanced. Successful outcomes for students are proficient or advanced. While DPS tests on many subjects, the most common subjects for schools in the sample are reading, writing, and math. Schools with a higher percentage of students "proficient" indicate higher quality schooling and thus more

[5] Figures 2, 3, and 4 also show that school boundaries are often not drawn to place the school in the middle of its school attendance area. Studies which focus on school quality using boundary discontinuities should be aware that homes near both sides of a school boundary may have dramatically different distances to their schools and the value for distance to school may have a nonlinear relationship.

Figure 2: 85 Elementary Schools in DPS and their Boundaries

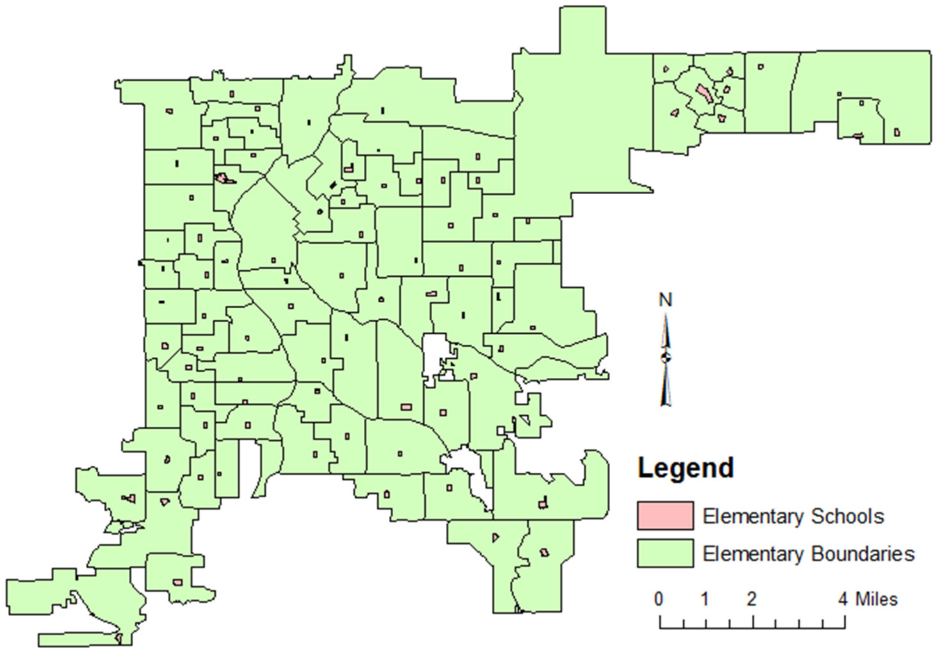


Figure 3: 21 Middle Schools in DPS and their Boundaries

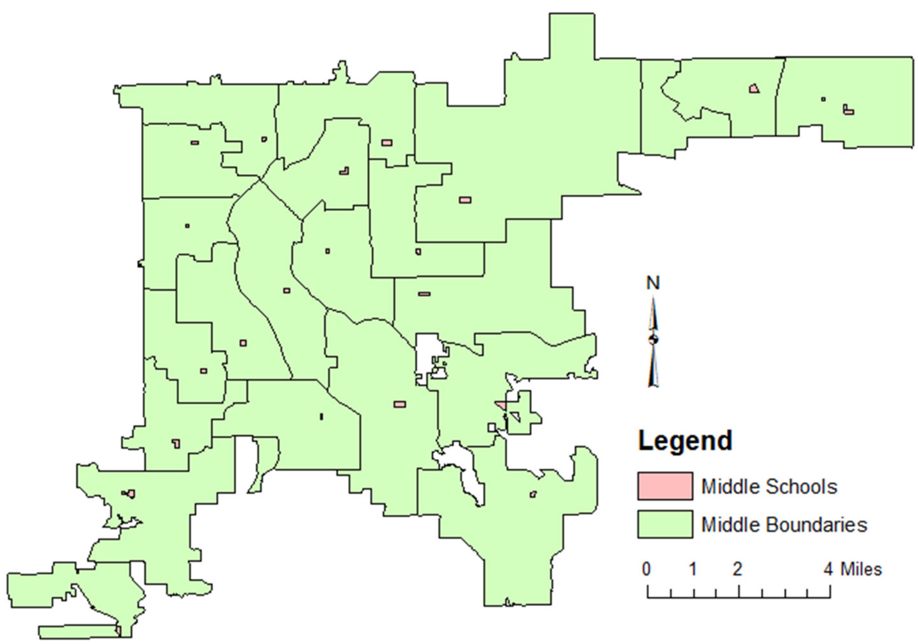
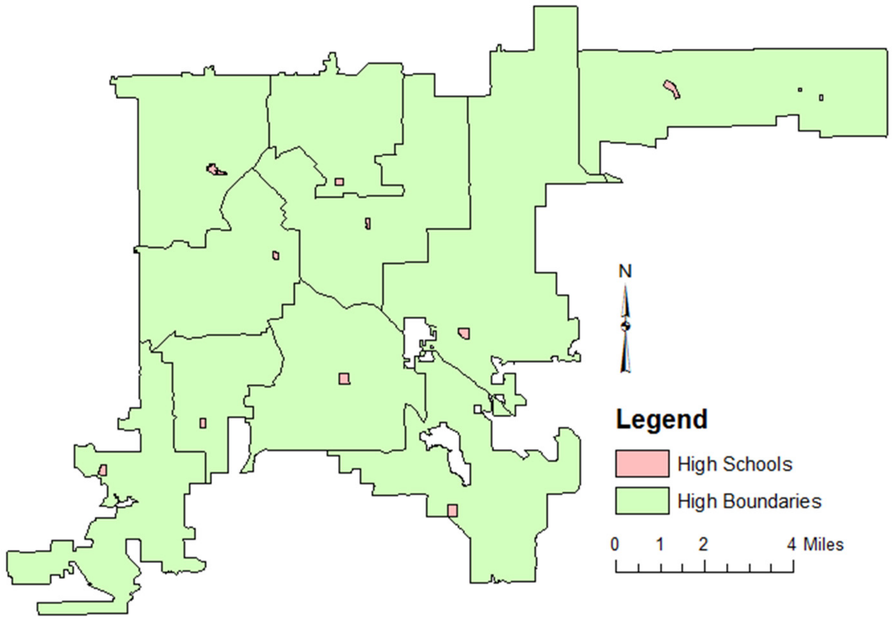


Figure 4: 10 High Schools in DPS and their Boundaries



desirable schools. Distance effects (to schooling) are expected to be greater in areas that have higher-quality schools, and so this measure is used to control for differences in school quality.[6] Testing data were obtained from DPS for the 2002-2003 school year. Table 1 contains summaries for the percentage of proficient students for reading, writing, and math in each school level for the DPS.

Outside schooling options, such as charter and private schools, could affect the value for residence-based schooling. Fack and Grenet (2010) indicate that the availability of private schooling reduces the premium paid by homeowners to live in school areas with higher quality schools. As the number of outside schooling options near a home increases, it may weaken the value for distance to schooling. Thus, I include controls for outside schooling options in my analysis. The DPS area of study contains 27 charter and 31 private schools. Table 1 contains a summary on the number of charter and private schools within a mile radius of each home in the sample.

3. ECONOMETRIC MODEL

The model uses standard hedonic theory (Rosen, 1974); a home is viewed as having a bundle of attributes that consist of several different characteristics. The combination of these characteristics determine the sale price of the home. The hedonic price schedule is based on households maximizing their utility facing a budget constraint. Household i maximizes utility subject to the budget constraint:

(1) $$u^i = U^i(c, \mathbf{z}) \quad \text{s.t.} \; y^i = P(\mathbf{z}) + c$$

[6] Thought was given to using the percentage of student net transfers for a school area as a proxy for school quality. While this measure plausibly captures differences in school quality, it may also be capturing the ability (or lack thereof) of residents to transfer their children between schools.

where y is income, c is a numeraire good with price normalized to 1, and $\boldsymbol{z}$ is a vector of housing characteristics. The relationship between a home's sale price and its characteristics is represented by the hedonic price function:

$$P(\mathbf{z}) = P(\mathbf{s}, \mathbf{n}, \mathbf{sch}) \tag{2}$$

where $\mathbf{s}$ is a vector of structural housing characteristics, $\mathbf{n}$ is a vector of neighborhood characteristics, and $\mathbf{sch}$ is a vector of schooling characteristics. The $\mathbf{sch}$ vector contains distance to elementary, middle, and high school variables.

Theory does not provide guidance for selecting an appropriate functional form for the hedonic price function, there are several forms in the literature: linear, semi-log, log-log, and Box-Cox. This paper uses a semi-log form in order to examine the effect of housing characteristics on the percentage change in house price. A hedonic function of the following form is estimated:

$$lnP_{ic} = \alpha\, ln\mathbf{x}_{ic} + \beta\mathbf{y}_{ic} + \sum_{a\in A}\left(\rho_a \mathbf{w}_{a,ic}\right) + \delta_c + \theta_t + \varepsilon_{ic} \tag{3}$$

where P_{ic} is the sale price of home i in school catchment area c. $\mathbf{x}_{ic}$ is a vector of continuous home structural characteristics. $\mathbf{y}_{ic}$ is a vector of dummy and discrete home structural characteristics. α and β are parameter vectors for home characteristics that are estimated. A is the set of distance to schooling variables, $\mathbf{w}_{a,ic}$ is a vector of distance to schooling of category a, and ρ_a is a parameter vector of distance to schooling of category a. δ_c is a school catchment-area fixed effect, and θ_t is a year and quarter of sale dummy.

The focus of the study is on estimating the parameters on the distance to schooling variables for all three levels of schooling. Different forms of the model are estimated to investigate possible nonlinearity in the relationship between distance and home price. Specifically, we vary between a continuous distance measure and distance dummies to investigate the nonlinearity in the relationship between distance and home price. As previously mentioned in the data section, school catchment areas are used as geographic fixed effects to control for differences in school quality and isolate the change in home value due to distance from public schooling. This fixed effect approach is favored over using tests scores as a way to control for school quality. While test scores are a frequently used indicator of school quality, they may miss some aspects of quality that cannot be reflected in test scores (e.g., facilities, teacher quality, and spending per student). Fixed effects allow us to control for the quality of the school as well as other neighborhood characteristics associated with the location of the school catchment area. These neighborhood effects may be quite important especially given the sizeable diverse urban environment in our sample. When controlling for school quality through catchment area fixed effects, school test scores cannot be included in our model as they are at the same level as a catchment area.[7]

[7] Thought was also given to using a spatial error model as studies have indicated that spatial fixed effects can lead to biased estimates compared to a spatial model (Koschinsky, Lozano-Gracia, and Piras, 2012). But Gibbons and Overman (2012) point out that the application of spatial models may not always be warranted given the aim of the research. Also, Anselin and Arribas-Bel (2013) note that if spatial correlation takes on a groupwise structure, such as within school catchment areas, then spatial fixed effects are a more appropriate model choice. As outlined above, my aim was to control for school quality, and thus used the spatial fixed-effects approach in the body of the paper. While the use of a spatial error model might lead to more-accurate estimates of housing characteristics, due to its better control of neighborhood unobservables, it would be problematic in the estimates for distance to school. A model with a spatial weighting matrix would not allow us to control for school quality with catchment areas. For example, if two homes are located near each other but in different catchment areas that have different school qualities and discontinuous differences in distance to schooling, a spatial error model would weight these nearby homes

4. RESULTS

Several specifications are estimated to explore the relationship between distance to assigned public schooling and home price. The first group of specifications is estimated using a semi-log model with a continuous measure for distance. The second group is the same as the first group in all aspects, but instead use distance dummies to investigate its nonlinear value. In all results tables, robust standard errors are displayed in brackets.

4.1 Continuous Measure for Distance to Schooling

Table 2 contains the estimates of the hedonic price equation using a continuous distance measure as an explanatory variable. The models presented in each column differ on their method to control for school quality. Model 1 uses a test score metric to control for school quality, similar to previous literature (Owusu-Edusei, Espey, and Lin, 2007). Model 2 has the same explanatory variables as Model 1 but adds census tract fixed effects to control for neighborhood characteristics. Model 3 is the preferred specification as it uses school catchment area fixed effects to control for school quality and neighborhood characteristics.[8] As previously discussed, the use of catchment-area fixed effects is arguably a mehodoligical improvement over prior studies. I chose to include the results in Model 1 and 2 to demonstrate how the catchment-area controls impact the results in relation to other methods typically used to control for school and neighborhood quality. As a note, both Model 1 and 2 have approximately 2,000 fewer observations as compared to Model 3. This loss in data is due to school areas with incomplete testing data for their students.

The estimates for a few housing characteristics from Model 1 are quite surprising. In Model 1 the coefficients on *Age of House* and *Garage Attached to Home* are significant and the opposite sign from theirequivalents in Models 2 and 3. The positive sign on *Age of House* indicates that as a home gets older its value increases, which is not expected.[9] A similar argument can be made for the negative sign on *Garage Attached to Home* in Model 1. These items alone raise suspicions about the specification in Model 1, but they are not as concerning as the significant positive coefficient for distance to elementary school. This result indicates that, as one moves further from an elementary school, home price increases. All of these peculiar results are most likely due to omitted variable bias from neighborhood-level unobserved variables. Model 2 attempts to aleviate this issue by adding Census-tract fixed effects.

The results from Model 2 indicate a possible improvement over the specification in Model 1. The estimates for housing characteristics now have expected signs (e.g., *Age of House*

inappropriately. This is because of our interest in controlling for school quality while estimating the parameters for distance to assigned school. But, given that spatial correlations exists, I also tried a spatial error model (see the Appendix) for just one catchment area—the largest with 1,589 homes—where there can be no concern for differences in public-school quality. Results from that model are similar in sign, magnitude, and significance (except for middle schools, which is not surprising given the results from later checks) to those using catchment-area fixed effects presented in sections of the paper that follow.

[8] While I wanted to conduct a likelihood ratio test to statistically confirm a preference for the specification in Model 3, the difference in observations between specifications weakens the usefulness of such a test. I, instead, had to rely upon a theoretical justification—that in the text below, in which I prefer school catchment areas to Census-tract controls. A likelihood ratio test can be performed to compare Model 1 and 2, since they have the same number of observations. This test confirms that the inclusion of Census-tract fixed effects in Model 2 results in a statistically preferred specification.

[9] In Models 2 and 3 the coefficient for *Age of House* is negative, which matches previous research using the same housing data (Metz, 2010).

Table 2: Distance to School Continuous Measure

Independent Variables	Model (1)	Model (2)	Model (3)
ln(Lot Size)	0.0375***	0.1030***	0.1040***
	(0.0064)	(0.0063)	(0.0060)
# of Baths	0.0833***	0.0739***	0.0713***
	(0.0031)	(0.0029)	(0.0027)
Ln(Home Size)	0.4360***	0.3990***	0.3980**
	-0.0066	-0.0061	-0.0058
Age of House	0.0014***	-0.0010**	-0.0013***
	(0.0001)	(0.0004)	(0.0004)
(Age of House)^2	0.0000	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)
A/C in Home	0.0190	0.0157	0.0215
	(0.0155)	(0.0141)	(0.0139)
*Age of House*A/C*	-0.0007***	-0.0006***	-0.0006*
	(0.0002)	(0.0002)	(0.0002)
Garage Attached to Home	-0.0228***	0.0061	0.0119***
	(0.0047)	(0.0038)	(0.0037)
Fireplace	0.0598***	0.0443***	0.0436***
	(0.0031)	(0.0028)	(0.0026)
Basement	0.1350***	0.1120***	0.1080***
	(0.0033)	(0.0031)	(0.0030)
Median Income by Census Tract	0.0065***	0.0093***	0.0047***
	(0.0001)	(0.0010)	(0.0002)
Distance to CBD	-0.0067***	-0.0011	-0.0009***
	(0.0005)	(0.0009)	(0.0002)
Adjacent to Open Space with Access	-0.0313***	0.0155	0.0153
	(0.0134)	(0.0118)	(0.0115)
Adjacent to Open Space without Access	0.0558***	0.0291**	0.0421***
	(0.0148)	(0.0139)	(0.0140)
Adjacent to Unprotected Open Space without Access	0.0009	0.0148***	0.0073**
	(0.0051)	(0.0046)	(0.0043)
Distance to Elementary School	0.0016**	-0.0012	-0.0073***
	(0.0008)	(0.0010)	(0.0008)
Distance to Middle School	-0.0023***	-0.0016*	-0.0017***
	(0.0004)	(0.0009)	(0.0048)
Distance to High School	-0.0024***	-0.0019**	-0.0040***
	(0.0006)	(0.0009)	(0.0047)
# of Charter Schools within a Mile of Home	-0.0136***	-0.0184***	-0.0121***
	(0.0019)	(0.0032)	(0.0027)
# of Private Schools within a Mile of Home	0.0097***	-0.0056**	-0.0063***
	(0.0016)	(0.0022)	(0.0020)
% of Students Proficient in R,W,M for Elementary	0.0032***	0.0010***	
	(0.0001)	(0.0002)	
% of Students Proficient in R,W,M for Middle	0.0003*	0.0022***	
	(0.0002)	(0.0005)	
% of Students Proficient in R,W,M for High	-0.0001	-0.0014**	
	(0.0001)	(0.0005)	
Census-tract FE	NO	YES	NO
School-catchment FE	NO	NO	YES
Observations	19,961	19,961	22,264
R^2	0.773	0.831	0.837

Notes: Results from estimating hedonic model with a continuous distance measure where the dependent variable is the natural log of home sale price in 2002 dollars. Each model includes year and quarter of sale dummies. Robust standard errors displayed in brackets. *** indicates significance at the 1 percent level, ** indicates significance at the 5 percent level, * indicates significance at the 10 percent level.

and *Garage*) and are in line with estimates from previous research (Metz, 2010).[10] But the coefficient on *Distance to Elementary School* is insignificant and the coefficient for *% Students Proficient in High School* is negative and statistically significant. These strange results on education may be due to the ad hoc selection of Census-tract fixed effects as well as the use of test scores, a partial quality measure, to control for school quality. The use of Census-tract fixed effects in this setting warrants further discussion.

I begin by discussing open-space studies that focus on distance and use geographic fixed effects, an approach similar to that used in the present paper. In such studies, Census-tract fixed effects are used to control for neighborhood unobservables when estimating the value for distance to open space using home prices (Anderson and West, 2006). Abbott and Klaiber (2011) raise the issue that bias is introduced in hedonic price studies that use spatial fixed effects to control for omitted variables (e.g., neighborhood characteristics). The emphasis of Abbott and Klaiber (2011) is to point out how the size of the spatial fixed effect can bias open-space studies since open space can capitalize into home prices at scales larger than the fixed effect. For this study, it is likely that the geographic scale of the Census-tract fixed effect biases estimates in Model 2. Census tracts tend to be smaller than school catchment areas and, hence, are more numerous. The benefits of a school, whether through its quality or the household's distance to it, should only capitalize into the homes that are located within its catchment area. Thus, school catchment areas are the most appropriate geographic scale for fixed effects for housing. The use of a smaller geographic area, such as a Census tract, creates bias as indicated by Abbott and Klaiber (2011). School quality capitalizes into home prices at an area larger than a census tract, and so the use of a Census-tract fixed effect biases results. Model 3 uses school catchment areas as a spatial fixed effect to alleviate this problem. But as previously mentioned, the use of catchment-area fixed effects comes at a cost: school test scores cannot be included in the specification as they are perfectly collinear with catchment area.

The results from the specification in Model 3 indicate a more accurate and sensible outcome as compared to both Models 1 and 2. The estimates for housing characteristics are similar in sign and magnitude with a prior hedonic study using the same data (Metz, 2010). An interpretation of the distance to school results indicate a 1,000-foot increase in the distance to an elementary school from the mean of 2,400 feet decreases home price by approximately 0.7 percent and is statistically significant. For middle schools, a 1,000-foot increase in distance from the mean of 5,800 feet decreases home price by approximately 0.2 percent and is statistically significant. For high schools, a 1,000-foot increase in distance from the mean of 8,500 feet drops home prices by an average of approximately 0.4 percent and is statistically significant. These results are as anticipated; the decrease in home price over distance is most severe for elementary schools, followed by high schools, and then middle schools. Out of the three levels of schooling, middle school has the shortest stay (three years for a student) and in this regard is possibly the least important level of schooling when it comes to home values. Thus, the value for the change in distance to middle school is expected to be the lowest. Distance to an elementary school is

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[10] While not particularly important to the study, an initial analysis yielded a seemingly perverse result for *A/C*. That is, when *A/C* is naïvely employed, its coefficient is negative. *Ceteris paribus* this suggests that air-conditioned homes tend to have lower home prices. But often older, high-quality homes do not have central air conditioning units. To test if this might be the problem, I added a term that interacts *Age of Home* and *A/C*. The coefficient for *A/C* in this case was statistically insignificant, while the interaction term is negative and significant. This fits the story that older homes without central air conditioning command a higher price. This result is likely due to the higher-quality construction (thicker walls, better roofing, etc.) and setting (tree coverage, swimming pool, etc.) that are associated with such older homes.

likely much more important for parents than at any other time in their child's schooling (e.g., young children can walk home and they are easier to pick up and drop off).

4.2 Dummies as Measure for Distance to Schooling

Previous research has indicated that the value for distance to schooling does not behave linearly (Des Rosiers, Lagana, and Theriault , 2001; Owusu-Edusei, Espey, and Lin, 2007). To investigate this nonlinearity, the preferred specification from Model 3 of Table 2 is used, but in this case the linear distance measure is replaced by a set of distance dummies. A distance dummy specification should give a more complete picture of the value for distance to schooling. For simplicity, the estimates for the housing characteristics and other control variables are not reported, as they are nearly the exact same values as in Model 3 of Table 2.[11] The results using distance dummies are displayed graphically for elementary, middle, and high schools in Figures 5, 6, and 7, respectively.

Figures 2, 3, and 4 were used as guides to select the distance dummy intervals. At each school level, the interval width varies so there are a similar number of observations in each interval for each school level. For example, elementary schools have a majority of observations within 5,000 feet, whereas middle schools do not reach a majority until 13,000 feet, this difference causes me to use varying distance interval ranges for dummy variables between elementary and middle schools. At each school level, an distance interval has approximately 3,000 observations, for elementary schools this number of observations occurs within 500 feet but for middle schools this does not happen until 1,000 feet.[12]

Figures 5, 6, and 7 show the mean distance dummy coefficient values along with their 95 percent confidence intervals for each level of schooling. Figure 5 shows the Distance to Elementary Schools where homes more than 4,000 feet away are used as the comparison group. Figure 6 shows the Distance to Middle Schools where homes more than 11,000 feet away are used as the comparison group. Figure 7 shows the Distance to High Schools where homes more than 16,000 feet away are used as the comparison group. The *y*-axis in Figures 5, 6, and 7 shows the price premium for homes located in their respective distance interval relative to the comparison group for each level of schooling.[13]

In examining these figures as a group, one notices that the homes closest to the school are not valued the highest. This is most likely due to the disamenity of congestion and noise near a school. Homes just a bit further away are still easily within walking distance but avoid the congestion near schools and consequently these homes are valued relatively higher than those directly next to schools.[14] Also of interest is the relative drop in home prices at a distance of 1,000-1,500 feet from an elementary school. This drop is most likely due to the quarter-mile (1,320 feet) cutoff for walking to elementary school. Homes within 1,320 feet of a school cannot

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[11] The use of distance dummies requires the omission of one distance category. The estimates for the distance dummies are relative to the omitted category which is the category of homes furthest away from school. The omission of a distance category has a minor impact on the coefficients for the control variables; this slight change is only due to the omission of a distance category. It is for simplicity of viewing the results that we choose not to report the coefficients for the control variables.

[12] The exact interval range was chosen arbitrarily, as nice round distances are preferred over ones that break the sample into exactly equal numbers of observations.

[13] A Chow test was conducted and verified the value for included home distances are significantly different from the omitted benchmark distance categories for each level of schooling.

[14] Des Rosiers, Lagana, and Theriault (2001) found a congestion effect for only elementary schools. My results show a congestion effect is occurring at all three levels of schooling.

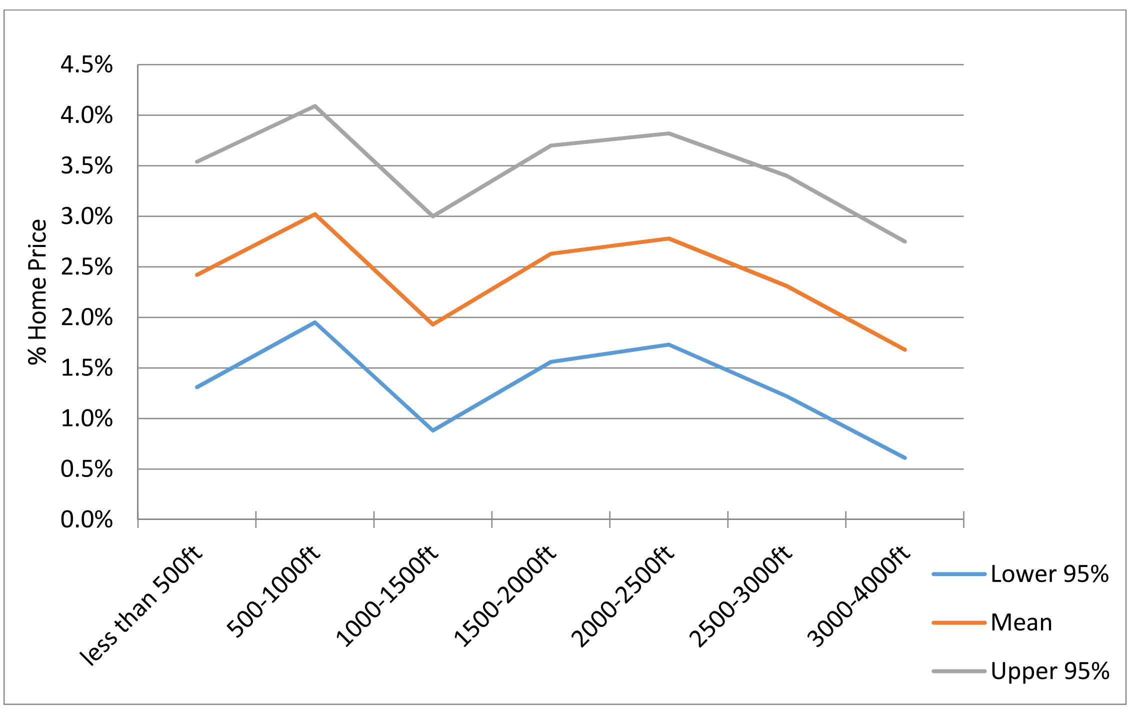
receive bus service for their children, and so they must walk. Parents may view longer walks as unsafe and so the price of homes just inside this cutoff will take a hit. Homes closer in from this cutoff (e.g., 500-1,000 feet) will have a shorter walk and so they will be valued relatively higher than homes just inside the cutoff (1,000-1,320 feet). Homes on the outside of the cutoff do not have to worry about walking, they can take the bus, and so homes just outside the cutoff (greater than 1,320 feet) will be valued relatively higher than homes just inside (less than 1,320 feet). Another interesting result is that homes more than two miles (approximately 10,500 feet) from a middle or high school have a similar value for distance to schooling. This result indicates that after two miles, home price is not affected by distance to schooling in an urban area. Suprisingly, between 1,000 feet and a mile the curves for both middle and high schools are relatively flat with a positive value. This suggests that homeowners prefer to locate within a mile of schools as opposed to further away, but there is little difference in value from being 1,000 feet or a mile away from a middle or high school.

5. ROBUSTNESS CHECKS

There may be concern that the coefficients for the distance to schooling variables are not giving an accurate value for proximity to school, but instead picking up the value for desirable lands located near schools. Specifically, open space and commercial areas may be located near a school and it is the proximity to these amenities that is valued, not necessarily the school. If this is the case, our conclusions regarding the value of distance to school may be overstated.

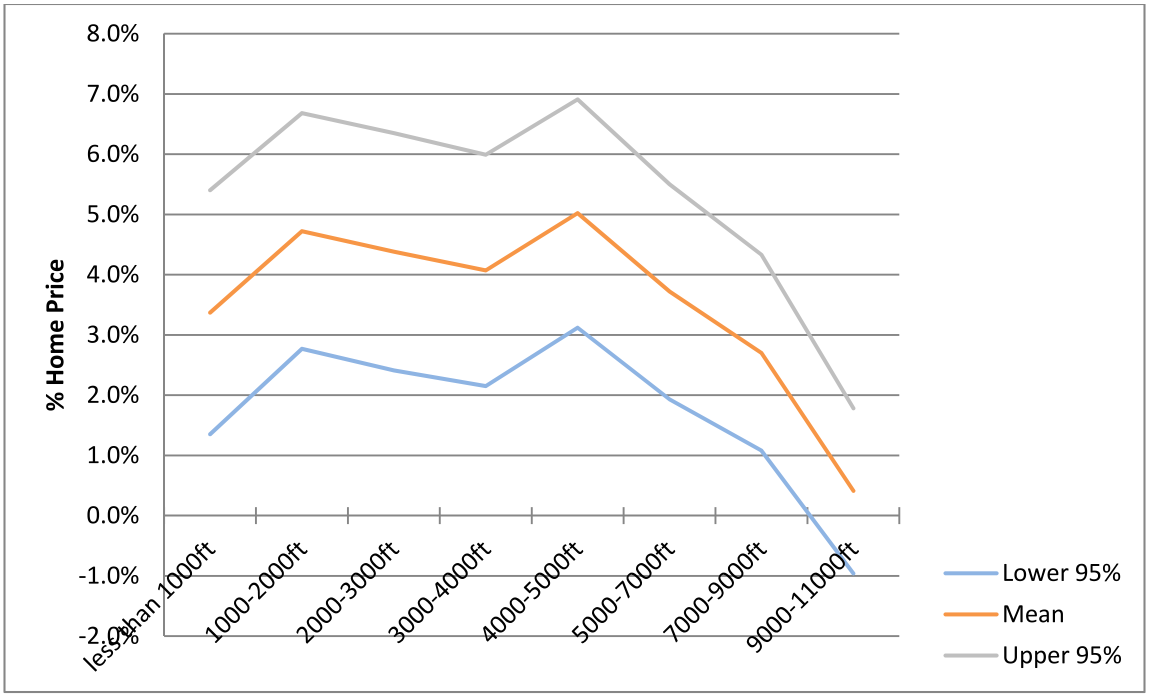
To address this concern, data was collected on the percentage of open space and commercial land within an eighth of a mile (660 feet) of a school, as well as the percentage of

Figure 5: Mean Value and 95 Percent Confidence Interval for Distance Dummies (Elementary School)



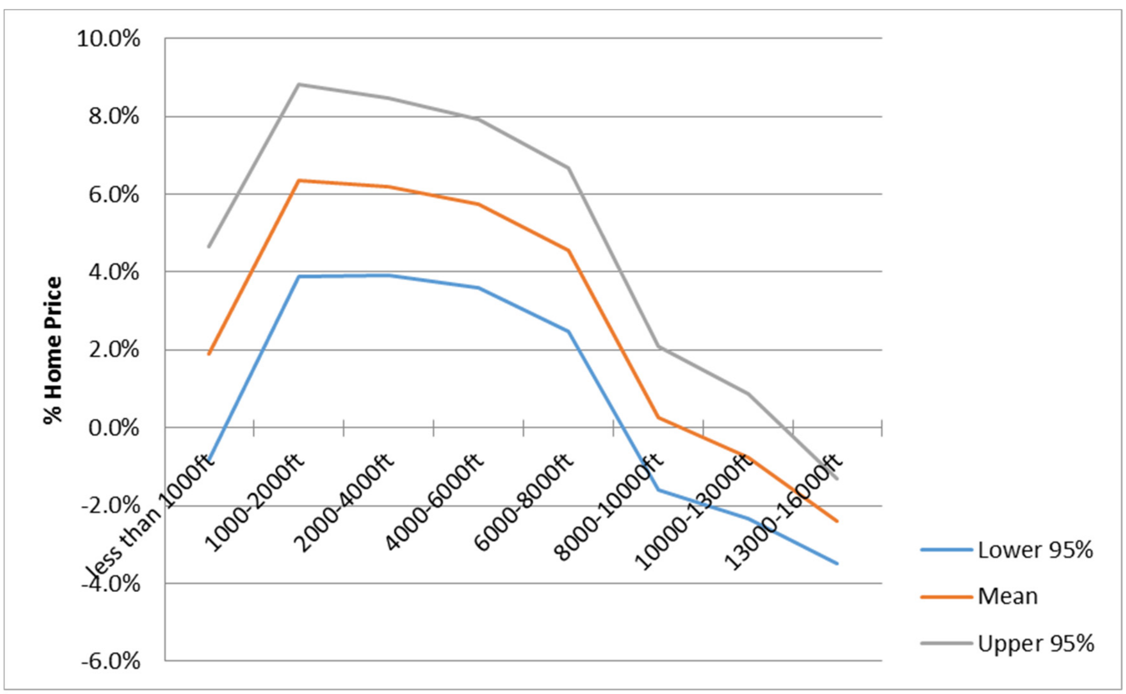
Note: Results are compared to homes greater than 4,000 feet from an elementary school

Figure 6: Mean Value and 95 Percent Confidence Interval for Distance Dummies (Middle School)



Note: Results are compared to homes greater than 11,000 feet from a middle school

Figure 7: Mean Value and 95 Percent Confidence Interval for Distance Dummies (High School)



Note: Results are compared to homes greater than 16,000 feet from a high school

Table 3: Summary Statistics for Difference in Percent of Land Use within the School Catchment Area vs. 1/8 Mile from the School

School Level	Land Use	mean	std. dev.	min.	max.
Elementary	*Commercial*	-4.0%	5.9%	-44.8%	16.7%
	Protected Open Space with Access	-1.3%	10.1%	-34.8%	31.2%
	Protected Open Space without Access	-1.0%	10.4%	-51.1%	20.9%
	Unprotected Open Space without Access	-5.8%	10.9%	-40.5%	3.4%
Middle	*Commercial*	-4.4%	6.2%	-14.6%	19.3%
	Protected Open Space with Access	-1.6%	8.0%	-19.1%	19.7%
	Protected Open Space without Access	-5.4%	10.4%	-36.2%	2.7%
	Unprotected Open Space without Access	-7.4%	11.6%	-32.0%	11.5%
High	*Commercial*	1.5%	10.0%	-11.1%	21.8%
	Protected Open Space with Access	6.8%	11.0%	-5.2%	23.1%
	Protected Open Space without Access	-5.6%	6.9%	-19.9%	-0.6%
	Unprotected Open Space without Access	-11.1%	14.0%	-39.5%	-0.8%

open space and commercial land within a school catchment area.[15] The difference between the percentage land use near a school and within its catchment area is calculated for each type of land use. The percentage difference indicates whether or not these lands are clustered near schools. A negative percentage difference indicates the land is *not* clustered near schools. A positive percentage difference indicates the land *is* clustered near schools.

Table 3 summarizes the percentage differences for each type of land use by school level. Open space is divided into three categories: protected with access (e.g., public park), protected without access (e.g., private park or conservation land), and unprotected without access (e.g., agricultural or vacant land).[16] The summary statistics show most of the land uses are not clustered near schools. This should alleviate some concerns about what the distance to schooling measure is picking up. But there are a couple of exceptions: *Commercial* and *Protected Open Space with Access* appear to be weakly clustered near high schools.[17] The clustering of desirable land near a high school may be troublesome to our previous results. Thus, controls for commercial and protected open space with access near high schools are included in an additional specification, presented in Table 4, to investigate their impacts.

As previously mentioned, the preferred specification is Model 3 of Table 2. However, any school level control variable (i.e., land near a high school) cannot be added to this specification, as it is measured at the same level as the catchment area fixed effects. High school land use controls must be added to the specification in Model 2 of Table 2 which uses Census-tract fixed effects. While this is not the preferred specification, it allows for comparison of the

[15] Other buffer radii were investigated as well: a quarter and half mile radii showed very little change in results as compared to one of an eighth mile.

[16] These open space categories follow the approach used by Metz (2010).

[17] In addition to the land use check, the correlation between distance to the nearest open space from a home and the distance to schooling from a home was examined. The correlations by type of open space and school level were all less than .081, except for high schools and protected lands with access, for which it was .658. These correlations are in line with the summary statistics from Table 3, giving additional evidence that the distance to high school measure could be picking up the value for distance to protected open space with access.

Table 4: Distance to School Continuous Measure, Robustness Checks

Independent Variables	Model 1	Model 2
Ln of Lot Size (acres)	0.1030***	0.1040***
	(0.0063)	(0.006)
# of Baths	0.0737***	0.0713***
	(0.0029)	(0.0027)
Ln of Home Size (sq.ft.)	0.3990***	0.3990***
	(0.0061)	(0.0058)
Age of House (years)	-0.0010**	-0.0013***
	(0.0004)	(0.0004)
Age of House Squared	0.0000***	0.0000***
	(0.0000)	(0.000)
A/C in Home	0.016	0.0214
	(0.0141)	(0.0139)
*Age of House*A/C*	-0.0006***	-0.0006***
	(0.0002)	(0.00020)
Garage Attached to Home	0.0061	0.0122***
	(0.0038)	(0.0037)
Fireplace	0.0438***	0.0434***
	(0.0028)	(0.0026)
Basement	0.1120***	0.1080***
	(0.0031)	(0.0030)
Median Income by Census Tract ($1000's)	0.0080***	0.0047***
	(0.0011)	(0.0002)
Distance to CBD (1,000 ft)	-0.0008	0.0008***
	(0.0009)	(0.0002)
Adjacent to Protected Open Space with Access	0.0151	0.0162
	(0.0118)	(0.0115)
Adjacent to Protected Open Space without Access	0.0289**	0.0433***
	(0.0139)	(0.0140)
Adjacent to Unprotected Open Space without Access	0.0146***	0.0074*
	(0.0046)	(0.0043)
Distance to Elementary School (1,000 ft)	-0.0012	-0.0074***
	(0.0010)	(0.0009)
Distance to Middle School (1,000 ft)	-0.0019**	-0.0015*
	(0.0009)	(0.0009)
Distance to High School (1,000 ft)	-0.0016*	-0.0032***
	(0.0009)	(0.0008)
# of Charter Schools Within l Mile of Home	-0.0173***	-0.0121***
	(0.0032)	(0.0028)
# of Private Schools Within 1 Mile of Home	-0.0057**	-0.0064***
	(0.0022)	(0.0020)
% of Students Proficient in R,W,M for Elementary	0.0009***	
	(0.0002)	
% of Students Proficient in R,W,M for Middle	0.0023***	
	(0.0005)	
% of Students Proficient in R,W,M for High	0.0004	
	(0.0007)	
% Commercial Area within 1/8 mile of High	0.2170***	
	(0.0634)	
% Protected/Access Land within 1/8 mile of High	0.0064	
	(0.0474)	

Table 4: Distance to School Continuous Measure, Robustness Checks (Cont'd)

Independent Variables	Model 1	Model 2
Distance to Nearest Unassigned Elem School (1,000 ft)		-0.001
		(-0.0011)
Distance to Nearest Unassigned Mid School (1,000 ft)		-0.0023***
		(-0.0009)
Distance to Nearest Unassigned High School (1,000 ft)		0.0009
		(-0.0008)
Census-tract fixed effects	YES	NO
School-catchment fixed effects	NO	YES
Observations	19,961	22,264
R^2	0.831	0.837

Notes: Results from estimating hedonic model with a continuous distance measure where the dependent variable is the natural log of home sale price in 2002 dollars. Each model includes year and quarter of sale dummies. Robust standard errors displayed in brackets. *** indicates significance at the 1 percent level, ** indicates significance at the 5 percent level, * indicates significance at the 10 percent level.

results from Model 1 of Table 4 which includes land use measures near a high school to Model 2 of Table 2 which does not include land use measures near a high school.

The results from Model 1 in Table 4 indicate that the inclusion of desirable land near high schools (e.g., *Commercial* and public parks) does not substantially alter the results as compared with Model 2 in Table 2. Estimates for the housing characteristics and other previously used controls are very similar, with no loss of significance and very minimal change in magnitude. The coefficient on percent commercial area within an eighth of a mile of a high school is positive as homeowners value commercial land near a high school. But the coefficient on protected O*pen Space with Access* is insignificant. Additionally, the inclusion of land use controls near high school has minimal change on the significance and magnitude for the coefficients on distance to school. The coefficient for high school decreases by a small amount which is to be expected. The additional controls isolate the value for distance to high school which leads to a slightly lower magnitude and no loss in significance. The results in Model 1 of Table 4 appear to indicate that distance to schooling coefficients are not solely picking up the value for desirable land near schools, but are in fact returning an accurate value for distance to schooling.[18]

There may be a concern that distance to an assigned school is not important, but merely the distance to any nearby school. As a check, variables are added for distance to the nearest unassigned elementary, middle, and high school to our preferred specification, Model 3 in Table 2, which includes catchment area fixed effects. The results from this specification are displayed in Model 2 in Table 4. The coefficients on distance to nearest unassigned elementary and high school are insignificant. Also, the inclusion of distance to unassigned schools has little impact on the value for distance to the assigned elementary and high school. There is no loss of significance and very little change in magnitude as compared to the results from Model 3 in Table 2. This alleviates some concern for elementary and high school. Still, middle schools demonstrate a peculiar result which raises some general concern about our overall estimates. The coefficient on distance to nearest unassigned middle school is significant. Also, its inclusion in

[18] As an additional check, percent commercial land and protected open space with access within an eighth of a mile of elementary and middle schools was included in a regression. There was very little change in the magnitude of the coefficients and a minor loss of significance in the distance to middle school coefficient.

the regression has weakened the significance for the coefficient on distance to assigned middle school. While all of this taken together is a strange result, it fits well with the story that suggests elementary and high schools are important to home buyers, while the assigned middle school is of far less importance. If a home buyer selects a home based on the assigned elementary and high school, they value being closer to these schools and have no value for other nearby elementary and high schools. On the other hand, if a home buyer does not care about their assigned middle school, they will not value being close to that assigned school, and instead may value being closer to other unassigned options, holding constant the distance to their assigned school. Since the assigned school matters very little, the closeness of outside options may provide value to homeowners. While we do not have information on school choice for our sample, it may be the case that a large amount of school choice at the middle school level could explain our peculiar result.

6. CONCLUSION

This study uses hedonic analysis of home transactions in the Denver Public School District to estimate the effect of distance to schooling on home sale price. This study considers all three levels of public schooling: elementary, middle, and high school. While most studies on schooling and home prices investigate the change in home value based on quality of schooling, this paper attempts to control for school quality differences and focus on the value of distance. School catchment area fixed effects are used to control for differences in school quality and neighborhood characteristics tied to a residential location.

The results yield several important insights. First, as distance to schooling increases, home prices generally decrease, as expected. Results using a continuous distance measure indicate that for all three levels of schooling a 1,000-foot increase in distance to schooling leads to a drop in home prices between 0.2 and 0.7 percent. Interestingly, distance to middle school has the weakest effect. This result may be explained by the lower importance placed on middle school by households. Students spend the smallest amount of time in middle school (three years), compared to elementary school (six years) and high school (four years). In this vein, middle school is arguably the least important stop in a student's education. For these reasons, households may not be concerned with locating near a middle school and so this weak result is not surprising.

Second, the distance dummy results indicate that homes very close to schools, less than 500 feet, are valued less than homes 1,000 feet away. This result indicates a nuisance or congestion effect very close to schools. Distance dummy results also indicate that homeowners have similar values for being just outside this congestion zone as being a mile from a school. It is interesting to note, however, that homes just inside the cutoff distance for walking to elementary school (1,320 feet) are priced lower than homes just outside of this cutoff. And finally, when homes are more than two miles from schooling, distance increases have no impact on home price. Taken all together these results generally suggest parents value homes within walking distance of a school.

Finally, outside of schooling options, desirable lands near schools have an impact on the value of housing. When charter and private schools are included as controls, the results suggest more outside options decrease the value for public location based schooling areas and thus the distance to schooling. Also, shopping areas are quite prevalent near high schools, and our model indicates that homeowners value proximity to these commercial lands. Controlling for commercial land near high school lowers the value for distance to high school as expected, but the coefficient still retains significance, indicating it is not just proximity to shopping centers that is valued.

These results have some straightforward policy implications. Since homeowners value being closer to schooling, care should be taken in the placement of schools. Boundaries should be drawn to minimize the overall distance to homes within the school district. Also, the existence of a congestion effect at all three levels of schooling indicates that a small buffer between schools and residential neighborhoods may be optimal. This study also contributes to the literature on home prices reflecting school quality differences. Several recent studies use nearest neighbor matching techniques for homes across school boundaries to estimate the value for school quality. This study indicates that prices drop as distance to schooling increases, and thus matching estimators should account for distance to schooling that would likely be discontinuous across a school boundary. For example, consider a scenario in which two homes are located close to each other across school boundary lines; one home is 1,000 feet from its school while the other home is 7,000 feet from its school. In this case, the difference in home price across the boundary may not be only attributable to school quality differences but in part due to differences in distance to schooling.

REFERENCES

Abbott, Joshua K. and H. Allen Klaiber. (2011) "An Embarrassment of Riches: Confronting Omitted Variable Bias and Multi-Scale Capitalization in Hedonic Price Models," *Review of Economics and Statistics,* 93, 1331–1342.

Anderson, Soren T. and Sarah E. West. (2006) "Open Space, Residential Property Values, and Spatial Context," *Regional Science and Urban Economics,* 36, 773–789.

Anselin, Luc and Daniel Arribas-Bel. (2013) "Spatial Fixed Effects and Spatial Dependence in a Single Cross-Section," *Papers in Regional Science*, 92, 3-17.

Black, Sandra E. (1999) "Do Better Schools Matter? Parental Valuation of Elementary Education," *Quarterly Journal of Economics*, 114, 578–599.

Bogart, William T. and Brian A. Cromwell. (2000) "How Much is a Neighborhood School Worth?," *Journal of Urban Economics*, 47, 280–305.

Cheshire, Paul and Stephen Sheppard. (2004) "Capitalizing the Value of Free Schools: the Impact of Supply Characteristics and Uncertainty," *Economic Journal*, 114, 397–424.

Clapp, John M., Anupam Nanda, and Stephen L. Ross. (2008) "Which School Attributes Matter? The Influence of School District Performance and Demographic Composition on Property Values," *Journal of Urban Economics*, 63, 451–466.

Des Rosiers, Francois, Antonio Lagana, and Marius Theriault. (2001) "Size and Proximity Effects of Primary Schools on Surrounding House Values," *Journal of Property Research,* 18, 149–168.

Dhar, Paramita and Stephen L Ross. (2012) "School District Quality and Property Values: Examining Differences along School District Boundaries," *Journal of Urban Economics,* 71, 18–25.

Fack, Gabrielle and Julien Grenet. (2010) "Do Better Schools Raise Housing Prices? Evidence from Paris Public and Private Schools," *Journal of Public Economics*, 94, 55-77.

Epple, Dennis and Richard E. Romano. (2003) "Neighborhood Schools, Choice, and the Distribution of Education Benefits," in Caroline Hoxby (ed.), *The Economics of School Choice*. University of Chicago Press: Chicago, pp. 227–286.

Gibbons, Steve and Stephen Machin. (2006) "Paying for Primary Schools: Supply Constraints, School Popularity or Congestion," *Economic Journal*, 116, 77–92.

_____. (2008) "Valuing School Quality, Better Transport, and Lower Crime: Evidence from House Prices," *Oxford Review of Economic Policy*, 24, 99–119.

Gibbons, Stephen, Stephen Machin, and Olmo Silva. (2013) "Valuing School Quality using Boundary Discontinuities," *Journal of Urban Economics,* 75, 15–28.

Gibbons, Steve and Henry G. Overman. (2012) "Mostly Pointless Spatial Econometrics?," *Journal of Regional Science*, 52, 172-191.

Kane, Thomas J., Stephanie K. Riegg, and Douglas O. Staiger. (2006) "School Quality, Neighborhoods, and Housing Prices," *American Law and Economics Review,* 8, 183–212.

Kelejian, Harry H. and Ingmar R. Prucha. (2007) "HAC Estimation in a Spatial Framework," *Journal of Econometrics,* 140, 131–154.

Koschinsky, Julia, Nancy Lozano-Gracia, and Gianfranco Piras. (2012) "The Welfare Benefit of a Home's Location: an Empirical Comparison of Spatial and Non-Spatial Model Estimates," *Journal of Geographical Systems*, 14, 319–356.

Machin, Stephen. (2011) "Houses and Schools: Valuation of School Quality through the Housing Market," *Labour Economics*, 18, 723–729.

McConnell, Virginia and Margaret Walls. (2005) "The Value of Open Space: Evidence from Studies of Nonmarket Benefits," Resources for the Future: Washington, D.C., available online in October 2015 at http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-REPORT-Open%20Spaces.pdf.

Metz, Neil. (2010) "Untangling the Value of Open Space: Adjacent vs. Neighborhood Area," *University of Colorado Discussion Paper in Economics 10-08*: Boulder, CO, available online in October 2015 at http://www.colorado.edu/econ/papers/Wps-10/wp10-08/wp10-08.pdf.

Nguyen-Hoang, Phuong and John Yinger. (2011) "The Capitalization of School Quality into House Values: A Review," *Journal of Housing Economics,* 20, 30–48.

Owusu-Edusei, Kwame, Molly Espey, and Huiyan Lin. (2007) "Does Close Count? School Proximity, School Quality, and Residential Property Values," *Journal of Agricultural and Applied Economics,* 39, 211–221.

Rosen, Sherwin. (1974) "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy,* 82, 34–55.

Waltert, Fabian and Felix Schläpfer. (2010) "Landscape Amenities and Local Development: A Review of Migration, Regional Economic and Hedonic Pricing Studies," *Ecological Economics*, 70, 141–152.

APPENDIX
Estimation using a Spatial Error Model

	(1)
Ln of Lot Size	0.1044***
	(0.0109)
# of Baths	0.0009
	(0.0071)
Ln of Home Size	0.3688***
	(0.0111)
Age of House	0.0073***
	(0.0022)
Age of House Squared	-0.0007***
	(0.0001)
Fireplace	0.353***
	(0.0045)
Basement	0.137***
	(0.0065)
Median Income by Census Tract	-0.0150
	(0.0137)
Distance to CBD	0.0114**
	(0.0053)
Adjacent to Protected Open Space without Access	0.0967***
	(0.0204)
Adjacent to Unprotected Open Space without Access	0.0330***
	(0.0059)
Distance to Elementary School	-0.0063**
	(0.0029)
Distance to Middle School	0.0045
	(0.0042)
Distance to High School	-0.0112*
	(0.0061)
# of Charter Schools within a Mile of Home	0.0273**
	(0.0133)
# of Private Schools within a Mile of Home	0.2571**
	(0.1280)
Rho (error)	0.2235***
	(0.0777)
Observations	1,589

Notes: Results from estimating spatial error hedonic model with a continuous distance measure where the dependent variable is the natural log of home sale price in 2002 dollars. Model includes year and quarter of sale dummies. Robust standard errors displayed in brackets. *** indicates significance at the 1 percent level, ** indicates significance at the 5 percent level, * indicates significance at the 10 percent level.

Due to concerns about heteroscedasticity an SHAC estimator (Kelejian and Prucha, 2007) was used to estimate the results in the table above. Additionally, due to the nature of the sub-sample, three variables were not included as their values are the same for all homes. All homes have air conditioning and an attached garage, while no home is adjacent to open space.