Home Sale Price and Public School Quality in Mecklenburg County

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In this paper I attempted to determine what effect public school quality has on home sales price in Mecklenburg County, North Carolina.[1] *I used general urban economic theory to form my expectations regarding the nature of this relationship and then performed statistical analysis to test these hypotheses. My final model defined home price as a function of distance from the city center, public goods (including public education), home characteristics, and neighborhood characteristics. I concluded that there is a strong positive relationship between home price and school quality, particularly school reputation.*

1. Introduction

Economists have long attempted to quantify the value of publicly provided goods in order to estimate demand and supply functions for the good as well as to assess the efficiency and equality of the good's provision. In the case of public education, researchers often use home sale price as a measure of an individual's willingness to pay for a given quality of public education. By this reasoning, given two identical homes with the same neighborhood characteristics in two different school districts, the difference in sale price between the two homes will be a measure of the value of school quality to homebuyers. All else equal, the home in the higher quality school district will sell for a higher price than the home in the district with the lower quality school. My paper will model home sale price as a function of public elementary school quality and home and neighborhood characteristics.

Many economists have studied the relationship between school quality and home prices, and most have observed a significant positive relationship between the two.[2] While the basic principal underlying these studies is the same, economists have individualized their research by using different measures of school quality, studying school districts under multiple government jurisdictions (Bogart and Cromwell 1997), introducing other variables into the model (such as school integration or segregation), and controlling for different school and neighborhood characteristics.

Charlotte Mecklenburg Schools (CMS) provides an interesting basis for this study since for many years students were bussed to attend schools in different areas of the county in order to aid in school desegregation. Often, students did not attend the school closest to their home and students from the same neighborhood occasionally were assigned to different schools. To my knowledge, there has only been one other study measuring the relationship between school quality and home prices in Mecklenburg County. Jud and Watts (1981) tried to predict home sale transaction prices based on public school character, among other variables. While their analysis focuses primarily on school racial composition and has been criticized for its failure to control for enough neighborhood characteristics (Black 1998), Judd and Watts bring up an important caveat to consider when creating any similar model for Mecklenburg County. Since the school system was under court-ordered desegregation until the 2002-2003 school year and school boundaries were reviewed and redrawn approximately every three years, the impact of school quality on home prices may be more difficult to measure than in school systems with more stable attendance boundaries. This may pose an interesting measurement and model specification problem but should not be seen as prohibitive.

2. Literature Review

While the relationship between school quality and home value has been explored only relatively recently, the roots of the theory behind the relationship date back to the early 19th century. The basic principles behind my research question were first discussed at length by David Ricardo (1911). He theorized that in a perfectly competitive economy, land rents would equal the difference in productivity of a given plot of land and the least productive plot of land. In a world of perfect information, land price is equivalent to land value, and economists generally assume that the market system works so that consumers will bid up land prices until they are equivalent to land values. Extensions of this model include industrial, business, and residential economic sectors as well as the agricultural sector, and they predict the distribution of land values throughout a city as well as where different economic sectors will locate in relation to each other.[3]

In sharp contrast to the urban economists, Tiebout (1956) ignored commuting costs and city growth to focus on developing a framework for predicting the demand for public goods. He theorized that cities and communities are made up of consumer voters who have a set preference pattern for public goods and who are assumed to be fully mobile and fully informed. The basic principle underlying his work is that housing consumers pick their location based on the tradeoff between the provision of public goods and taxes.

Wallace Oates' 1969 paper empirically supported Tiebout's hypothesis by explaining neighborhood median home value as a function of tax rate, distance to city center, control variables, and public school expenditure per pupil, which he used as his measure of public goods. He found that the benefits provided by local governments (school expenditures) do indeed exert a positive influence on local property values. Although his model has been criticized for being overly simplified (Edel and Sclar 1974), its contribution to the economic literature is important for this paper in two ways. First, Oates' work confirms Tiebout's theory and provides justification for further exploring the relationship between public goods and consumer location choice. Second, although not the main intent of his paper, he established an empirical relationship between school quality and home values.

Rosen and Fullerton (1977) re-estimated Oates' model for the same communities but used student achievement scores rather than expenditure per student to measure the quality of local public benefits. They used test scores rather than expenditures because educational factor prices and production functions may differ across communities and because they were not concerned with whether or not test scores reflect actual school quality, but rather with whether or not test scores represent perceived quality of education better than expenditures. In other words, they did not try to find a true measure of quality but a measure with which homebuyers would be more familiar and on which they would be more likely to base their home location decision. Rosen and Fullerton experimented with several different measures of test scores and found that regardless of how the test scores entered the empirical model, they had positive coefficients that were significantly different from zero at the 95% confidence level. Similar to Oates, Rosen and Fullerton did not set out to specifically define the relationship between school quality and home value, but rather public goods quality and home value, using school quality as a proxy for public goods quality. Regardless, these two studies gave later researchers a starting point for exploring the specific relationship between school quality and home value.

The hedonic method is the most commonly used technique for evaluating the determinants of home value. In his survey of hedonic methods, Palmquist (1982) remarked that the basis for hedonic studies is the observation that some goods (in this case, homes) are heterogeneous and can thus possess numerous different characteristics. Hedonic estimation provides a way to analyze the effects of different characteristics on the price of the good. In order to obtain reliable estimates, economists must not only include all relevant characteristics, but must also specify the correct relationship between these characteristics and the price of the good. Palmquist continued on to explain that in the case of the hedonic model relating home price to home, neighborhood, school, and community characteristics, theory dictates the inclusion or exclusion of many characteristics. However, as Palmquist emphasized, theory unfortunately does not clearly identify a superior functional form for the hedonic equation. Thus, the work by economists focusing specifically on the relationship between home value and school quality differ not only in the measurement and definition of characteristics, but also in the way these characteristics relate to home value.

Studies of this type merge the fields of urban and education economics. Although student and school specific quality measures that incorporate changes over time are the preferred method of quantifying school quality (at least for education economists), urban economists often resort to general input and output characteristics as measures of quality. Although there are differences in variables and models, nearly every study examining the relationship between school quality and home prices reaches the same conclusion: school quality has a positive effect on home value.[4] While economists, researchers, and educators agree on the existence of a positive relationship, there is much variation in variable measurement, model specification, and variable inclusion. The task for researchers is not so much to prove the significance of the relationship but to seek the best method for doing so.

3. Testable Hypotheses

Theory predicts that the value of a home will be divided into four main categories: distance from the central city, public goods, home characteristics, and neighborhood characteristics. The problem I encountered is that theory often stops at these broad categories of characteristics rather than continuing to break them down. Since these are categories rather than specific variables, there are many different theoretically correct models that I could use to explain home sales price. This can be quite problematic, considering that there are nearly countless ways to quantify variables as ambiguous as school quality. Additionally, many of the different measurements within a given category may be related to other measurements, resulting in potential problems with multicollinearity.

Since there is no universal equation to model the relationship between school quality and home price, individual researchers are left to decide for themselves what specific variables they will include in their analysis. I based my decisions on the work of others and on the availability of data for Mecklenburg County.

The independent variables included in each regression can be separated into four groups of composite goods. The specific variables as well as their expected marginal influences on home price are as follows:

Distance:

- Distance in miles from the city center (the intersection of Trade and Tryon Streets).

I expect that distance will have a diminishing negative marginal influence on home price since it is more expensive (in terms of commuting time) for households to locate further from the city center. This increase in commuting costs must be offset by a decrease in home price, all else equal.

Public Goods:

- Tax rate associated with home's jurisdiction
- Dummy variable = 1 if school is a partial magnet school, = 0 if not
- Dummy variable = 1 if school began a theme program in the 2002-2003 school year, = 0 if not.
- Grade given to school by parents of students, included as a measure of school reputation

The property tax rate for each home is the percent of assessed property value that must be paid by homeowners.[5] As the quality and level of provision of public goods increases, home price should increase. Most of the economic literature related to my topic includes crime rates or public parks a measure of the level and quality of public goods, but I could not find data that truly defined these variables. Therefore, I chose to use the tax rate as my measure of public goods. As a public goods measure, I would expect that the tax rate should have a decreasing positive marginal influence on home price.

Since I am primarily concerned with the marginal influence of school quality on home price, most of my public goods variables measure school quality. My model includes quality measures that are unique to the Charlotte school system, and I expect that the two dummy variables will have a positive marginal influence on home price. The family grade variable comes from a survey performed by the school corporation in which the parents of students rated the quality of their children's school on a 4-point grading scale. From preliminary estimates, it appears that this grade is a function of test scores, special recognition earned by the school, and the socio-economic composition of the student body. I used this variable to represent the school's reputation and overall quality.[6] This should have a decreasing positive marginal influence on home price.

Home Characteristics:

- Age of home at time of sale
- Size of yard associated with home in square feet
- Size of home in square feet
- Number of bedrooms in home
- Dummy variable = 1 if home has fireplace, = 0 if not

- Dummy variable = 1 if home has air-conditioning, = 0 if not.

Researchers attempting to measure home quality encounter the same difficulties as those trying to measure school quality. Theory does not outline a specific set of home characteristics to include in my model, so I followed other researchers in my selection of variables. These variables should all have a diminishing positive marginal influences on home price, with the exception of age. The relationship between age and home price is most easily seen graphically in Figure 1. When a home is first built, it has a high price, all else equal. As the home ages, it becomes less valuable, until a certain point in time, after which its value begins to increase. I cannot sign the first derivative of home price with respect to age because its value depends on whether the age corresponds to the upward or downward sloping portion of the curve. The second derivative will be greater than zero, since the value of the slope of the curve increases as the home ages.

Neighborhood Characteristics:

- Median income of residents in the home's census tract
- Tax rate associated with home's jurisdiction.

As with school and home characteristics, theory does not specify how to measure neighborhood characteristics. It does, however, indicate that a home's price should increase as the neighborhood in which it is located becomes more desirable. The median income variable corresponds to the median income for the census tract containing the home. Unfortunately, the publicly available census data aggregates information up to the tract level, which can include several thousand people. Since there is no way to disaggregate the data, this measurement is not very specific to each individual house. Regardless, median income should have a decreasing positive marginal influence on home price.

The tax rate should generally exert a diminishing negative marginal effect on home price since homeowners would want to be compensated for high tax rates through lower home prices. However, I also included the tax rate as a measure of the provision level of public goods associated with each jurisdiction. Since the tax rate has both a positive and negative marginal impact on home price, the net effect is indeterminate.

Functional Form:

Not only must researchers individually determine which variables to include in their analysis, they must decide how they will model the relationship between the dependent and independent variables. Unfortunately, theory does not dictate the form of this relationship (Palmquist 1982). While many of the papers mentioned in my literature review used log-lin models, some used strictly linear models. I chose the log-lin form as the best model of the relationship between the dependent and independent variables (e.g. an absolute change in the tax rate results in a percentage change in price). With this functional form and the variables discussed above, I can construct the final model:

(1) $$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_{6'} X_6^2 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \mu$$

where

(2) $Y =$ Natural log of home sale price

(3) $X_1 =$ Distance in miles from the intersection of Trade and Tryon Streets

(4) $X_2 =$ Tax rate associated with home's jurisdiction

(5) $X_3 =$ Dummy variable = 1 if school is a partial magnet school for the 2002-2003 school year, = 0 if not

(6) $X_4 =$ Dummy variable = 1 if school began a theme program in the 2002-2003 school

year, = 0 if not

(7) X_5 = Grade given to school by parents of students, included as a measure of school reputation.

(8) X_6 = Age of home at time of sale

(9) X_7 = Area of land surrounding the home in square feet

(10) X_8 = Size of home in square feet

(11) X_9 = Number of bedrooms in home

(12) X_{10} = Dummy variable = 1 if home has fireplace, = 0 if not

(13) X_{11} = Dummy variable = 1 if home has air conditioning (AC), = 0 if not

(14) X_{12} = Median income of residents of the home's census tract

For the regression analysis associated with my variables and functional form, I expect that the intercept term (β_0) will be greater than zero. Obviously, this estimate is an extrapolation and logically, no one would pay anything for a house with zero square feet, but the price of a house also includes the price of the land, and a plot of land at the city center with no crime and no tax should have a non-zero price.

My variables fit into three categories based on their definition and the way they enter the equation. The following three sections mathematically discuss the relationships between the dependent variable and the independent variables in each category.

Quantitative Measurements

The variables in this category are reasonably continuous. X_1, X_2, X_5, X_7, X_8, X_9, and X_{12} all fall under this heading. For these variables, the marginal effect of the independent variable X_i on the dependent variable Y in the log-lin functional form is given below:

(15) $\partial Y/\partial X_i = \beta_i Y$

and

(16) $\partial^2 Y/\partial X_i^2 = \beta_i^2 Y$.

The value of Y will always be greater than zero, and I expect that β_i will always be nonzero. Therefore, the functional form dictates both that all marginal effects should be non-constant and that the marginal influence of X_i on Y will always be increasing since the second derivative of Y with respect to X_i will always be positive (Equation 16).

Based on the previous discussion, I expect that β_1 should be less than zero and that β_5, β_7, β_8, β_9, and β_{12} should be greater than zero. The value of β_2 depends on which aspect of the tax rate is dominant. Theory predicts that the variables associated with these coefficients should have diminishing marginal effects on Y, but the log-lin model forces the marginal effects to be increasing for variables with positive first derivatives. This discrepancy between theory and the model highlights the difficulty of finding an appropriate functional form to model the relationship between the variables.[7]

Quadratic Variables

While age is a continuous measure, the fact that it enters the equation quadratically changes the form of the first and second derivatives of Y with respect to age. The effect of a change in age on the change in Y is given by

(17) $\partial Y/\partial X_6 = (\beta_6 + 2\beta_{6'} X_6)Y$.

This value is at an extreme where

(18) $X_6 = -\beta_6/2\beta_{6'}$

so either β_6 or $\beta_{6'}$ must be less than zero since X_6 will always be positive. The second derivative of Y with respect to age is

(19) $\partial^2 Y/\partial X_6^2 = (\beta_6 + 2\beta_{6'} X_6)(dY/dX_6) + 2Y\beta_{6'}$.

(20) $= (\beta_6 + 2\beta_{6'}X_6)^2\, Y + 2Y\beta_{6'}$.

The first term in equation (20) will always be positive, so the second derivative will take a positive value if $\beta_{6'}$ is greater than zero. If $\beta_{6'}$ is less than zero, the second derivative can still be positive if $(\beta_6 + 2\beta_{6'}X_6)^2$ is greater than $2\beta_{6'}$.

Qualitative Variables

Some of the variables in my model are impossible to assign a meaningful numerical value to (X_3, X_4, X_{10}, X_{11}), so I use dummy variables in my model to represent the qualitative aspects of home price. In contrast to the coefficients associated with the quantitative variables, these coefficients do not directly give the percentage change in the dependent variable caused by a one unit change in the independent variable. As shown by Halvorsen and Palmquist (1980), the semielasticity of a dummy variable X_i is given by

(21) Semielasticity = $(e^{\beta i} - 1)*100$.

This conversion results in a semielasticity with the same sign as the coefficient. For these variables, I expect that β_3, β_4, β_{10}, and β_{11} will all be greater than zero.

4. Data and Statistical Assumptions[8]

Sample statistics for my 215 observations are given in Table 1. Examination of the medians and means reveals that many of my variables are skewed. Most of the home characteristic variables are skewed to the right (particularly yard size), indicating that there are a few observations with large values for these variables, resulting in a mean that is much higher than the median. These statistics also show that nearly all of the homes in the sample have air-conditioning and many have a fireplace. Most of my variables take a large range of values, which can help increase the explanatory power of my model.

Before I began any regression analysis, I examined the data to try to anticipate any problems that might arise during analysis. The only pair of variables that have a correlation coefficient greater than 0.7 are age and age squared, which is expected since age squared is an explicit function of age. Since theory dictates the inclusion of both variables, there is no justification for removing either one to correct for multicollinearity.[9]

I expect that I will have a problem with heteroscedasticity, and there are several target variables that could explain the variance in the error terms. For example, there could be differences among the schools in my sample that are not captured in the family grade. Principals often make unique contributions to schools that are not easily measurable. Thus, there is reason to suspect that a series of dummy variables representing each school could serve as target variables. Family income could also create nonconstant error term variances. As income increases, public school quality may become less important to a family since children can be sent to private schools. If median income does not effectively capture this difference between families with low and high incomes, the percent of children within a given census tract who attend private elementary school may serve as a better target variable.[10]

5. Empirical Model and Results

As a general test of whether or not heteroscedasticity existed in my model, I performed White's test on the data and rejected the null hypothesis at the 10% level, concluding that heteroscedasticity does exist. I then developed a list of different combinations of variables that could serve as target variables.[11] I tested the null hypothesis that the error term variance was constant versus the alternative that it was a function of the target variable(s). Since the weighted least squares model that included the predicted sales price and private school attendance percentage as the heteroscedasticity target variables had the lowest AIC, I chose to use this correction. I performed the Breusch-Pagan-Godfrey test on the new regression to test whether or not the weighted least squares correction actually corrected the heteroscedasticity. I accepted the null hypothesis that the corrected model contained no heteroscedasticity ($\chi^2_1 = .11 < 2.71 = \chi^2_{1, .10}$).

After correction for heteroscedasticity, my final model is:

(22) *ln* Sales Price = 11.60 – 0.05 Distance – 0.02 Tax – 0.16 New Magnet + 0.06 Theme + 1.13 Family Grade – 0.011 Age + 0.000083 Age^2 + 0.0000043 Yard Size + 0.00026 Size + 0.26 Bedrooms – 0.03 Fireplace – 0.014 AC + 0.0000079 Median Income + e.

For each of the following hypothesis tests, I tested the null hypothesis that the first derivative of the natural log of sales price with respect to each independent variable equals zero against the alternative outlined in the testable hypotheses section of this paper. Since the t-test does not apply to the age variable, I include the results of the associated F-tests in the discussion below. All tests are one tailed (except the test associated with tax rate) and use a 10% significance level. Table 2 outlines my hypothesis test conclusions before and after correction for heteroscedasticity.

For the intercept term, I rejected the null hypothesis in favor of the alternative. This is consistent with the theory outlined earlier in the paper. The value of the coefficient implies that the value of a new home site at the city center in a jurisdiction with no tax rate and a school with an excellent reputation without a new magnet or theme program would be roughly $109,100.

The conclusion of the test for the distance coefficient is consistent with theory, which predicts the presence of a negative relationship. This is not at all surprising since distance was one of the first variables that early economists included in their land rent models. I accepted the null hypothesis that the coefficient of tax rate equals zero. Since the coefficient does not take either a positive or a negative sign, it appears that the two opposing effects balance each other.

Two of the three school quality variables had coefficients with the right signs, and the coefficients for all three were significant. For the new magnet dummy variable, I accepted the null hypothesis, which is problematic not only because the derivative does not have the expected positive sign but also because it is significant and negative.[12] The positive coefficients for the theme dummy variable and the family grade variable confirmed the theory outlined earlier in the paper.

All of the tests for the quantitative home characteristics variables (yard size, size, and number of bedrooms) confirmed the positive relationship outlined earlier in the paper. The negative coefficients associated with the qualitative home characteristics variables (fireplace, air-conditioning) do not have the right sign. This is not expected because theory predicts that the price of a home will increase with increases in the quality of the home. However, the values of the coefficients are not significant, so the contradiction between my results and the theory is most likely due to my specific sample rather than faulty theory. It is interesting to note that the fireplace variable lost its significance after heteroscedasticity correction, which is most likely due to the fact that the presence of heteroscedasticity wrongly attributed extra explanatory power to that variable.

By Equation (17), the marginal effect of age on home price will be zero if $\beta_6 + 2\beta_{6'}X_6$ is equal to zero. I performed an F-test and concluded that this term is statistically different from zero at the 10% significance level. The second derivative of sales price with respect to age will be zero if $\beta_6 + 2\beta_{6'}X_6$ and $\beta_{6'}$ jointly equal zero. Again, I performed the appropriate F-test and concluded that they are together statistically different from zero at the 10% significance level.

Thus, changes in age have a significant effect on the value of a home. Both before and after heteroscedasticity correction the coefficient for β_6 is less than zero and the coefficient of $\beta_{6'}$ is greater than zero. Therefore the second derivative is greater than zero, which is consistent with theory. According to Equation (18) and the sample values in Equation (22), a home begins to become more valuable as it ages when it is approximately 66 years old. For the variables defining neighborhood characteristics, the income variable performed as expected and the tax variable yielded inconclusive results, as discussed above.

6. Summary and Conclusions

Since my data came from reliable and unbiased resources and I performed the tests correctly, my results should be valid. Although I had potential problem multicollinearity, I still rejected the null hypotheses associated with the school quality variables. The only data issue that may have affected the results is that my observations were not distributed completely evenly among the nine schools. For example, Westerly Hills Elementary, which is near Uptown Charlotte, did not have many associated home sales during my observation period. If I could have expanded my data set over time, perhaps there would be changes in some of my home quality variable coefficients. However, I believe that my conclusions are valid overall.

I was surprised that the fireplace variable was not significant in the corrected model. I incorporated it as a measure of general home quality, but it does not appear that it has a significant effect on the value of a home. My complete dataset included other quality measures such as the exterior surface of the house and whether or not the house has a basement, so it would be interesting to see if substituting those variables for the fireplace dummy would yield the same results. The tax rate variable was neither strongly positive nor negative, which indicates that neither the neighborhood nor public good effect outweighed the other.

One of the results that was unexpected but perhaps should not have been was the negative sign of the magnet school coefficient. If my reasoning outlined in Footnote 12 holds then the coefficient for the theme variable should be negative as well. When I was dividing the schools into three quality groups during the data collection process, I noticed that many of the schools that I defined as “low quality” were scheduled to begin theme programs in the 2002-2003 academic year. It would be interesting to perform this same study in five years to determine what effect the magnet and theme programs have on home price and to track the changes in this effect over time.

For the most part, my expectations about the relationships between the variables were met. My model fit the data relatively well, and I found that school quality, particularly school reputation, plays a large part in determining the price of a home. To summarize, a one unit increase in the family grade (an improvement in reputation) results in a 112.6% increase in home price. Additionally, if a home is assigned to a school that becomes a magnet school, the home price decreases by 14.8% and if the school begins a theme program, the home price increases by 6.2%. These changes all assume that all else is held constant. The change in home price caused by a unit change in the family grade may seem unrealistically large, but such a change in the family grade is quite substantial since the family grade takes a very narrow range of values. Over the entire sample, the family grade had a range of only .83, so it is reasonable to assume that this measurement would never change by as much as a full point over a short period of time. Figure 2, which shows this relationship graphically, makes it clear that small changes in school reputation result in large changes in home price.

School reputation is apparently an important determinant of home price, and the next step in this analysis could be to examine the factors that make up school reputation. I ran some preliminary regressions to try to predict the family grade, and my models declined in their goodness of fit as the number of schools in the sample increased. However, the most successful models included the percentage of black students, the student teacher ratio, the percentage of parents who volunteer in the school, and the percentage of gifted students as independent variables.

While, to my knowledge, there are no other studies that incorporate school reputation as a determinant of home price, my general results coincide with the results of other economists. Since my variables are specific to the Charlotte school system, my analysis makes a unique contribution to the existing economic literature. Providing that school systems that do not currently measure reputation could create a reputation measure, this analysis could apply to school systems other than Charlotte Mecklenburg Schools.

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[11] This paper is adapted from my honors thesis proposal and my final paper for my Econometrics class. Both were due in December 2002.

[2] See Jud and Watts 1981, Hayes and Taylor 1996, Black 1997, Bogart and Cromwell 1997, Brasington 2000, Clark and Herrin 2000, and Weimer and Wolkoff 2001.

[3] Anas, Arnott and Small (1998) give a good summary of the evolution of these models of urban form from the development of the monocentric city to work continuing into the 21st century.

[4] For examples of different variable inclusion and model specification see Hanushek 1986, Hanushek and Taylor 1990, Summers and Wolfe 1997, Hayes and Taylor 1996, Oates 1969, Rosen and Fullerton 1977, Weimer and Wolkoff 2001, Brasington 2000, and Figlio and Lucas 2000. For support of the positive relationship between school

quality and home price see Jud and Watts 1981, Bogart and Cromwell 1997, Black 1998, Brasington 1999, Hoxby 1999, Clark and Herrin 2000.

[5] While there is a set county rate, there are differences between Charlotte and other jurisdictions, such as Davidson and Pineville.

[6] Following Rosen and Fullerton (1977), I am not concerned so much with an accurate measure of actual quality as with a measure of the public's perception of quality.

[7] It is important to also consider how changes in one variable will change the effect that a second variable has on home price. The log-lin form indicates that there will be non-constant cross derivatives, whose signs will be determined by the signs of β_i and β_j since $\partial^2 Y/\partial X_i \partial X_j = \beta_i \beta_j Y$.

[8] Details regarding data collection and sources are available upon request.

[9] I continued the multicollinearity analysis after I created my final model and found that age and age squared also have relatively high variance inflation factors, 12.2 and 8.3 respectively. As one last measure of multicollinearity, I looked at the condition indices for the fourteen eigenvalues. Six of the fourteen are between ten and thirty, indicating moderate multicollinearity, and two are greater than 30, indicating severe multicollinearity. The associated collinearity diagnostics confirm the collinear relationship between age and age squared.

[10] I did not expect that autocorrelation would be a problem. Later tests confirmed this.

[11] Details available upon request.

[12] I do not know enough about the location decisions made within the magnet programs to definitively solve this discrepancy, but I can hypothesize as to its cause. If research shows that turning a school into a partial magnet school improves overall school quality, then planners would have reason to locate new magnet programs in poorly performing schools. Therefore, the negative relationship between magnet status and home price may be due to the school's prior performance rather than any homeowner expectations about the quality of magnet programs.

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Table 1

Sample Statistics

Variable	Median	Mean	Skewness	Standard Deviation	Minimum	Maximum
Sales Price	$130,000	$176,821	1.631	$107,405	$50,000	$600,600
Distance	7.852	8.357	1.133	4.175	2.375	19.407
Tax Rate	1.307	1.234	-1.305	0.122	0.985	1.307
New Magnet	0	0.214	1.405	0.411	0	1
Theme	0	0.158	1.887	0.366	0	1
Family Grade	3.13	3.256	0.418	0.227	0.33	1.16
Age	13	19.5	1.340	20.1	0.25	101
Yard Size	10988	15577	7.417	20361	2177	211229
Size	1624	1860	1.321	763	867	5161
Bedrooms	3	3.195	0.383	0.554	1	5
Fireplace	1	0.833	-1.794	0.374	0	1
AC	1	0.949	-4.103	0.221	0	1
Median Income	$55,947	$57,132	0.358	$16,916	$27,868	$91,529
Private School Percentage	10.5%	15.7%	0.897	11.3%	1.8%	44.6%

Table 2

Regression Summary

		Before Het. Correction		After Het. Correction	
Variable	Expected Sign	Right Sign?	Significant?	Right Sign?	Significant?
Intercept	> 0	Y	Y	Y	Y
Distance	< 0	Y	Y	Y	Y
Tax	?	Sign < 0	Y	Sign < 0	N
New Magnet	> 0	N	Y	N	Y
Theme	> 0	Y	N	Y	Y
Family Grade	> 0	Y	Y	Y	Y
Yard Size	> 0	Y	Y	Y	Y
Size	> 0	Y	Y	Y	Y
Bedrooms	> 0	Y	Y	Y	Y
Fireplace	> 0	Y	Y	N	N
AC	> 0	Y	N	N	N
Median Income	> 0	Y	Y	Y	Y

Figure 1

Home Price and Home Age

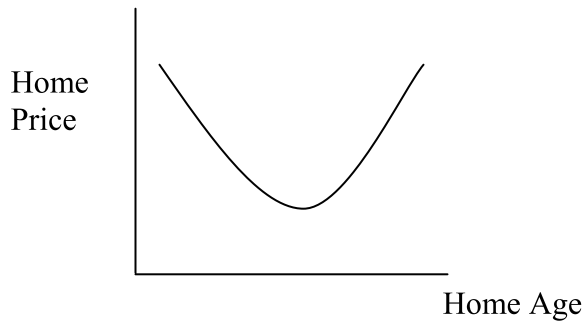

Figure 2

Family Grade and Home Price