**Capitalization of School Quality in Housing Prices: Evidence from Boundary Changes in Shelby County, TN**

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**Abstract (100 / 100 words)**
In 2013 Memphis City Schools and Shelby County Schools consolidated into a unified system, creating one of the largest districts in the nation. Six Memphis suburbs subsequently voted to create separate municipal districts. A large number of school zoning changes resulted from the merger and subsequent splintering of districts, providing a rare opportunity to separately identify the value of both school and district quality as they are capitalized in housing prices. Utilizing repeat sales data we find that a one standard deviation increase in test scores increases home prices by 2-4% while district administration accounts for 5-7% of home values.

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## 1. Introduction

In 2013 Memphis City Schools and neighboring Shelby County Schools consolidated into a unified system, ending decades of a dual city/county system and creating one of the largest districts in the nation. The merger combined two districts that were markedly different along dimensions of race, income, and school achievement. Schools previously in the city district enroll high numbers of minority and low-income students and produce significantly lower standardized exam scores and graduation rates, relative to schools originally served by the county district. Subsequently, and after much legal controversy, six Memphis suburbs voted to create separate municipal districts for their residents, which would be run independently from the new unified Shelby County Schools system. A large number of zoning changes occurred at both the school and district levels as a result of the merger and subsequent creation of the municipal districts, providing a rare opportunity to separately identify the capitalization of both school and district quality in housing prices.

Although there exists a large literature on the capitalization of school quality in the housing market, most previous studies estimate differences in housing prices across existing school boundaries (for review see Nguyen-Hoang and Yinger, 2011). In order for these "boundary fixed effects" estimates to yield an unbiased valuation of school quality, preference for school quality must be independent from preferences over other neighborhood amenities. Since this assumption is unlikely to be met, buyers' sorting behavior due to unobserved preferences for neighborhood attributes will result in a biased estimate of the value of school quality. A notable exception, Ries and Somerville (2010), use changes in school boundaries in Vancouver to identify the value of school quality independent from other neighborhood characteristics in a repeat sales specification. Since this specification housing prices in areas that were not rezoned as a counterfactual for areas that were rezoned, it requires the *trend* in housing prices to be uncorrelated with whether or not the neighborhood was rezoned. A robustness check indicates that this was not the case for the Vancouver boundary changes, and the majority of the initial findings could be explained by pre-existing differences in home price trends between the areas that were rezoned and those that were not. We suspect that any zoning changes motivated by changes in neighborhood school demographics to be subject to a similar endogeneity issues. In this paper, we employ a similar methodology to Ries and Somerville (2010) to estimate the effects of both of school and district-level attributes on housing prices using unique changes in school boundaries and district administration generated from the recent

school district merger in Memphis, TN— the largest of its kind in United States history. We believe that the complex political circumstances motivating these zoning changes provide a natural experiment, which enables us to estimate the capitalization of school quality in the housing market.

Geocoded parcel-level data from the Shelby County Assessor of Property, yields data on 66,897 arm's-length residential sales that occurred in a sixteen-year window surrounding the merger. These data are combined with school zone boundary and test score data from the 128 elementary, 53 middle, and 38 high schools within the county. Including school output measures in a simple hedonic regression of housing prices, which controls for an array of house-specific characteristics, explains nearly 90% of variation in housing prices in the sample. Estimates from this naïve specification indicate that a one standard deviation increase in the percent of high school students scoring proficient or advanced test scores results in a 10% increase in home prices. Using zoning changes in addition to the district merger and subsequent succession of the new suburban districts, we are able to identify the effect of both school and district-level attributes, including test scores, dropout rates, and district administration. As predicted, the difference-in-difference specifications including origin high school fixed effects and parcel fixed effects, yield significantly smaller estimates of 3.2% and 4.3%, respectively, controlling for changes in district administration. The same specifications estimate that district administration explains 5.8% and 7.8% of the variation in home prices.

In sum, this paper makes several key contributions to the existing literature on school quality capitalization. First, this is the first study in the United States to use changes in geographic boundaries to estimate the impact of school quality on housing prices. Second, the nature of the school boundary changes that occurred in Shelby County, TN are arguably more exogenous than changes in school boundaries that are motivated by changes in demographic characteristics of neighborhoods or schools. Third, to date little is known about the contribution of school districts to student achievement and school quality. Due to the unique nature of the district level changes in our dataset we are able to examine the effect of district management on housing prices, separate from school quality. This latter estimate may reflect both changes in school financing as well as whether households consider broad administrative characteristics of a school system, on top of performance measures at a particular school.

## 2. Background on the Shelby County Schools Merger

Until 2013, the students of Shelby County were served by two parallel public school systems. Memphis City Schools (MCS) provided education for students within the city limits, and all other students in the county attended schools in the Shelby County Schools (SCS) system. There had been tension between the two districts for decades. Action towards the creation of a one-district county began in earnest by the city in December 2010 when the MCS school board voted to surrender its charter, forcing SCS to absorb Memphis' students.[1] (See Appendix 1 for a detailed timeline of the merger.) On March 8, 2011, Memphis city residents approved a referendum that would dissolve the MCS charter and transfer control of the system to SCS, effective beginning in the 2013-2014 school year.[2]

At the same time city officials and MCS school board members were planning to disband the city school system, county representatives who opposed a single district were considering their response to the proposed merger. A popular strategy involved the creation of separate municipal school districts by each of Memphis' six incorporated suburbs: Arlington, Bartlett, Collierville, Germantown, Lakeland, and Millington.[3] However, a state law banning the creation of new municipal districts had existed in Tennessee since 1998[4], creating a considerable legal barrier for the county. The state legislature reconsidered the law in April 2012 and passed a bill removing the municipal district ban in specific circumstances relevant to Memphis' situation.[5] They passed a related law allowing municipalities to hold referenda on the creation of new school districts,[6] and in August, each of the suburbs held elections and voted in support of their own independently-run districts.[7]

Months later, however, a federal judge overturned the municipal elections and declared one of the newly passed laws unconstitutional, on the basis that it affected only Shelby

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[1] Jody Callahan and Jane Roberts, "Board axes charter—After lengthy debate, city school board puts issue in voters' hands," *The Commercial Appeal*, December 21, 2010.
[2] Zack McMillin and Jane Roberts, "Now what? Memphis voters give landslide endorsement to surrender of MCS charter," *The Commercial Appeal*, March 9, 2011.
[3] Clay Bailey and Lela Garlington, "Suburbs seek advice for new districts—Pending merger with Memphis City Schools stirs quest for breakaway options," *The Commercial Appeal*, August 31, 2011.
[4] "An Act to amend Tennessee Code Annotated, Title 4; Title 5; Title 6; Title 7; Title 13; Title 49; Title 67 and Title 68, relative to growth," State of Tennessee, Public Acts 1998, Chapter 1101, Section 13(b).
[5] Richard Locker, "Bill raises spectre of segregation," *The Commercial Appeal*, April 27, 2012.
[6] Richard Locker, "Schools bill earns House approval—Proposal allowing referendums this year on its way to Haslam," *The Commercial Appeal*, April 28, 2012.
[7] Clay Bailey, Sara Patterson, and Cindy Wolff, "Elections 2012/Suburban schools: Yes—Municipalities unanimously endorse separate districts, gird for legal hurdle," *The Commercial Appeal*, August 3, 2012.

County.[8] In response, lawmakers from the county returned to the state legislature in 2013—this time with a bill that would remove the municipal school district ban statewide, without consideration of a county's population. This revised version of the bill was signed into law in April of 2013,[9] and in July, each of the suburbs again voted in favor of their own independent districts, effective at the start of the 2014-2015 school year. The measures were approved overwhelmingly in all six suburbs, with pass rates ranging from 74% to 94%.[10]

For one school year, 2013-2014, the county operated as a single school district under the SCS title, given the surrender of the MCS charter. The following July, the six municipalities all withdrew from the county system and established their own districts. The final zoning outcomes of the merger, demerger, and municipal district creation differed for homes in three distinct areas of Memphis. First, homes within the city of Memphis, which were originally served by MCS, all switched to the SCS district following the MCS charter surrender. In terms of zoning, this was a nominal change; there were no significant school zone changes within the city of Memphis itself. Second, homes located within one of the six suburban municipalities switched to their respective municipal districts, each of which was now operated independently from the county, representing a significant shift in organizational structure and administrative control. In addition to this district change, some—but not all—of those homes also switched school zones. Finally, homes in suburban Memphis that were not located within one of the new municipal districts were merged into the new SCS system, which now included all of the city schools. Some of these homes also switched school zones as a result of the merger.

[Insert Figure 1]

Figure 1 is a map of Shelby County summarizing the district and school changes at the high school level. Table 1 presents the associated number of parcels and sales for these change areas. Within suburban Memphis, we observe two types of areas: homes that are absorbed back into SCS (20,718 parcels) and homes that are redistricted to an independent municipal district (56,190 parcels). Within each of these groups, we observe homes that are rezoned to

[8] Zack McMillin, "Ruling rejects suburbs' schools—Boards, referendums fail legal test," *The Commercial Appeal*, November 28, 2012.
[9] Richard Locker, "State OKs municipal school bill," *The Commercial Appeal*, April 16, 2013.
[10] Lela Garlington, "Suburbs say 'Yes'," *The Commercial Appeal*, July 17, 2013.

different schools of varying quality and homes that remain in the same school zone after the districting changes.

[Insert Table 1]

## 3. Data

Three data sources were necessary for this analysis. First, a detailed dataset on all properties in Shelby County was obtained from the Shelby County Assessor's office. Second, school zone boundaries were obtained from each of the seven school districts within the county. Finally, various measures of school quality were provided by the Tennessee Department of Education. Merging these three sets of data allows us to identify both original and new school zones for each residential parcel within Shelby County, to ascertain the relevant school quality measures for each parcel before and after the zoning changes, and to observe the parcels' sale prices at various points in time.

### 3.1 Shelby County Property Data

Data from the Shelby County Assessor of Property contains a snapshot of all property parcels within the county as of January 1, 2016. The dataset includes detailed housing characteristics (e.g., square footage, lot size, year built, number of bedrooms, number of bathrooms, physical condition, and heating systems) as well as information about all previous sales (e.g., sale date, price, and sales type) for each parcel. We utilize 16 full years of property sales data from 2000-2015.[11]

All sale types are registered and recorded with the property assessor, so the dataset includes commercial sales, timber and mineral rights sales, right-of-way sales, and estate sales, in addition to sales between related parties and other non-arms-length transaction sales. We exclude all of these sales types and restrict our analysis to only qualified residential sales[12]

[11] In addition, we also include data from the first three months of 2016. Although the dataset is meant to be a snapshot as of January 1, it is not released publically until April, resulting in several more months of data in the public file.

[12] The Shelby County Assessor of Property defines qualified sales as "sales transactions between two unrelated parties acting knowledgably, each seeking to maximize their position in an arms-length transaction." In addition, the Assessor notes that "[f]oreclosures and sales between family members are not

with transaction prices above $10,000, yielding a dataset of 116,855 individual parcels and 158,970 total sales across the time period. There are 47,306 unique parcels and 66,897 total sales in the rezoned areas, where we will focus our analysis. The median house price in the rezoned areas is $235,000.[13]

## 3.2 School Boundaries

We collect geocoded school boundary data for Shelby County Schools, Memphis City Schools, and each of the municipal districts for the 2013 school year[14] through the 2015 school year.[15] During the 2013 school year, SCS and MCS operated separately. The two systems merged in July of 2013, and for the 2014 year only, the entire county operated under one system, the unified Shelby County School system. During this year, planning for the six municipal school districts was finalized. The municipal systems were officially established in July of 2014 for the 2015 school year. Starting this year, the county houses seven separate systems: the six municipal districts, as well as SCS, which serves all students in Shelby County who do not reside within the boundaries of a municipal district. Due to the nature of the county's charter, the resulting school district is discontiguous. The SCS boundaries dataset covers all systems in the county through 2014. Supplementing this data with boundary maps for each of the municipal districts in 2015 allows us to assign each property parcel to its respective district and school before and after the change. Boundaries are available for elementary, middle, and high school zones for all systems in the county.[16]

Only district changes occurred between 2013 and 2014; no genuine school zone changes were enacted until 2015. The district changes in Shelby County generated school zone changes for seven high schools, 14 middle schools, and 27 elementary schools in suburban Memphis. Because these zoning changes were initiated by complex changes in district administration rather than the changing demographics of individual schools, they provide a natural experiment from which we can identify the school quality effect.

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considered qualified sales." (Assessor of Property, Shelby County, Tennessee, "Glossary of Terms," accessed 3 March 2016, https://www.assessor.shelby.tn.us/Content.aspx?key=Glossary.)

[13] Price in 2015 dollars

[14] School years are tagged by their spring semesters; the "2013 school year" is the 2012-2013 school year.

[15] School zone shapefiles are available upon request from the Office of Planning and Accountability at Shelby County Schools.

[16] There are a few schools within Shelby County that serve as combined elementary and middle schools, but the majority of elementary, middle, and high schools serve grades K-5, 6-8, and 9-12, respectively.

Six of the seven high school catchment areas split into multiple new high schools, so that students attending the same original school were rezoned among up to four new high schools. (The seventh high school's catchment area expanded, but all of the original students remained zoned to the school after the change.) Eleven of the 14 middle schools zones split into new schools, and 16 of the 27 elementary school zones split.

### 4.3 School Characteristics

We use several different measures of school quality, all publically available from the Tennessee Department of Education.[17] Our main quality variable is based on school-level math and reading scores from the Tennessee Comprehensive Assessment Program (TCAP), the statewide standardized test. For each school, school quality is defined as the percent of students scoring "proficient" or "advanced" on the TCAP exam. The measure is averaged across the math and reading exams and across grades within the school. Because one-year student test scores are likely to be noisy measurements of school quality, given the large amount of variation across time (Kane and Staige, 2002), our measure is based on a three-year average.[18] We calculate this variable for schools at all levels—high schools, middle schools, and elementary schools.

We also include two supplemental measures of school quality for high schools: graduation rates and school-level ACT averages.[19] In Tennessee, the ACT is administered annually in April to high school juniors. Although the test is not tied to schools' accountability incentives and is not considered "high-stakes" from the perspective of the schools, almost all students take the exam, whether or not they are planning to attend college. There should be minimal concerns related to only college-bound students selecting into taking the exam, and the variable should be a valid measure of school quality. The average ACT score across schools is 16.7, and the average graduation rate is 72 percent.

## 4. Methodology

[17] Tennessee Department of Education, "Data Available for Download," accessed 3 March 2016, https://www.tn.gov/education/topic/data-downloads.

[18] We average the "percent proficient or advanced" measures across the 2011, 2012, and 2013 school years to obtain the three-year average variable.

[19] We obtain this data from three separate files from the TN Department of Education. TCAP scores are available in the Aggregate Accountability File, ACT scores are available in the Achievement Files, and graduation rates are available in the Attendance and Graduation Files.

A basic hedonic model of school quality is given by the following equation:

$$\ln(price_{ij}) = \gamma SQ_j + X_{ij}\beta + \varepsilon_{ij}, \quad (1)$$

where $price_{ij}$ represents the real price of house *i* in school zone *j*, $SQ_j$ measures school quality at school *j*, and $X_{ij}$ is a vector of house-specific characteristics, such as number of bedrooms and bathrooms, square footage, and lot size. If households sort into particular neighborhoods so that unobserved house or neighborhood characteristics are correlated with school quality, then $\gamma$ will be a biased estimate of the school quality effect. In particular, if households that prefer high-quality schools also prefer homes and neighborhoods with more amenities or lower crime rates, for example, then the school quality estimate will be biased upward.

Many papers within the literature attempt to address this issue by using "boundary fixed effects," or by examining home sales within small geographic areas on either side of an existing school boundary. The main problem with this strategy is the necessary assumption that homes on both sides of the boundary are similar along unobservable characteristics. This assumption will fail if buyers choose their particular homes *because* of the school assigned by the existing boundary and if preferences over schools are correlated with preferences for other neighborhood amenities.

The school zone and district modifications in Shelby County provide a unique opportunity to exploit boundary *changes*, rather than existing boundaries, to estimate the school quality effect. As a result of the municipal district formation, many original school catchment areas split, and homes that were originally all zoned to the same school were rezoned into as many as four new schools. We use the original catchment areas to add school fixed effects to equation (1). Specifically, we include fixed effects for each parcel's "origin" school, or the school to which the parcel was zoned in the 2013-2014 school year, as shown the in the following equation:

$$\ln(price_{ijk}) = \gamma_1 SQ_j + \gamma_2 SQ_j * post_{ijk} + X_{ijk}\beta + \alpha_k + \varepsilon_{ijk}, \quad (2)$$

where $price_{ijk}$ represents the real price of house *i*, which is located in new school zone *j* and origin school zone *k*. Including for origin school fixed effects, which are captured by the term $\alpha_k$, the model described by equation (2) estimates the school quality effect of the new school *j.*

The variable $post_{ijk}$ is equal to one if house *i* sold in the period after the school zone changes were announced, and zero otherwise. The parameter of interest is now $\gamma_2$ , which measures the effect of the new school's quality on price, after the announcement of the boundary switch.

Given the origin high school fixed effects, we are exploiting variation in new school quality *within* the origin high school. Intuitively, we are comparing two homes which were both zoned to the same origin high school. After the districting changes occurred, the two homes were rezoned to two new high schools of varying quality. The coefficient on the school quality interaction term shows how the quality of the new school affected housing prices for homes in the rezoned area.

One common problem in the school quality and housing literature is the concern that houses zoned to different schools (or, in our case, houses rezoned to different schools within the same original school catchment area) are systematically different in terms of unobserved characteristics that may be correlated with housing prices. Although we are examining houses within a small geographic area and controlling for many key observable characteristics, it is possible that other unobserved factors may bias the school quality estimate.

To address this concern, we exploit the fact that our dataset includes many repeat sales of the same home. Using repeat sales allows us to employ parcel fixed effect, so that we are comparing the price of the same house in two different school zones. We use the following model:

$$\ln(price_{ijk}) = \gamma SQ_j + X_{ijk}\beta + \delta_i + \varepsilon_{ijk}, \quad (3)$$

where $\delta_i$ represents the parcel fixed effects. Note that all parcel-specific, time-invariant characteristics drop out of this model, so $X_{ijk}$ includes only those house characteristics that vary across time, such as age of the home.

## 5. Results

### 5.1 Hedonic Sales Regressions

The results from a basic hedonic housing price model are presented in Table 2. School quality is measured by test score at the high school, middle school, and elementary school levels. All specifications in table 1 include controls for number of bedrooms, age and an age quadratic, home condition, number of bathrooms, square footage, and lot size. These naïve

estimates indicate that there is a positive, statistically significant relationship between high quality schools and housing prices. When evaluated in terms of standard deviations, they suggest that a one standard deviation increase in school quality increases predicted prices by about 10 percent at the high school level, 7 percent at the middle school level, and 8 percent at the elementary school level.[20] When all three measures of school quality are included in the same regression, only the high school measure is significant at the 5 percent level; however, this is not surprising, given that the three measures are highly correlated.

These school quality measurements are fairly large in magnitude, but they are unlikely to represent an unbiased estimate of capitalization of school quality. If buyers' school preferences are positively correlated with preferences for other unobserved home or neighborhood attributes, then the school quality coefficient will be biased upward. To address this concern, we estimate the model using high school fixed effects for a parcel's origin high school.

### 5.2 High School Fixed Effects

We exploit the school zone changes generated by the district changes in Shelby County to identify the school quality effect. The municipal district formation created zoning changes for seven high schools, 11 middle schools, and 27 elementary schools. Six of the seven high schools' original attendance zones split, so that some houses within the original high school catchment area were rezoned to new schools. In addition, there is variation in the districts of the new high school zones: some homes were redistricted to the Shelby County School System, and others were redistricted to a new municipal school system.

Table 3 presents the results from the origin high school fixed effects model. We examine three measures of high school quality: test score (percent of students scoring "proficient" or "advanced"), graduation rate, and ACT score. As expected, the magnitude of the school quality effect is substantially smaller than in the naïve hedonic regressions, but statistically significant for each measure of school quality. The specifications in columns (2), (4), and (6) include dummy variables for homes that were redistricted to a municipal school system interacted with the post-February 2013 dummy. The coefficient on the interaction term captures the true redistricting effect. We find that homes that were moved to the municipal school system sold

[20] The standard deviations of the school quality measures are 17.0 (high school), 20.3 (middle school), and 19.6 (elementary school).

for prices between 5.6 and 8.3 percent higher than similar homes that were absorbed back into the Shelby County system.

Not surprisingly, including the redistricting effect decreases the magnitude of the school quality coefficients. The results indicate that, after controlling for redistricting, a 1 standard deviation increase in school quality as measured by high school test score increases housing prices by about 3 percent. The analogous estimates for school quality measured by graduation rate and ACT scores are 0.7 percent and 1.3 percent, respectively, although the graduation rate measure is not statistically different from zero.

### 5.3 Repeat Sales

In addition to using origin high school fixed effects, we also exploit the repeat sales that are available in our dataset. Between 2000 and 2016, we observe 5,471 parcels in the rezoned areas of suburban Memphis that are sold at least once before February 2013 and at least once after that date. While our other models control for a variety of house-specific characteristics (e.g., number of bedrooms and bathrooms, square footage, and lot size), there still exists the possibility that unobserved house characteristics may be correlated with school quality and may bias the school quality estimates upward. Using repeat sales allows us to employ parcel fixed effects, so that we can compare the price of the same house before and after the zone changes.

The repeat sales results are presented in of Table 4. Because we use parcel fixed effects, all house-specific, time-invariant characteristics are eliminated; however, we still include the age terms. In addition, we cannot include high school quality alone as a covariate, because it does not vary within a parcel. The fact that the coefficient on the school quality interaction term changed very little with the inclusion of school quality itself in the high school fixed effects models alleviates concerns related to the inclusion of both terms.

The repeat sales results confirm the conclusions from the fixed effects models. School quality is positive and significant across specifications. The magnitudes of the estimates are qualitatively similar, although slightly higher, in the repeat sales regressions: the effect on housing prices of a one standard deviation increase in school quality ranges between 2.7 and 4.3 percent. The coefficients on the district rezoning variables indicate that homes redistricted to a municipal school system increased in price by between 7.8 and 11.1 percent, on average.

## 5.4 Robustness Check

It is important to note that, given our identification strategy, our results will be biased if housing prices in the areas rezoned to higher quality schools were trending differently than areas rezoned to lower quality schools or areas that were not rezoned. In particular, if areas that switched to better schools were already increasing in price before the zoning changes, we would expect our school quality estimates in Tables 2 and 3 to be positive, even if rezoning didn't actually *cause* prices to increase. Because we recognize that the areas within the original catchment area may vary systematically by the new school zone, we present a robustness check in Table 5, in which we include destination school quality in addition to the interaction term in columns (2), (4), and (6). If the interaction term is insignificant in the presence of the school quality variable, this would indicate there is no school quality related housing price increased generated by the change. Previous research (Ries and Somerville, 2010) fails this robustness check, indicating a violation in the parallel trends assumption for their data.

Our results for this specification confirm the relationship between increased school quality and higher prices. The coefficient on school quality itself (not the interaction term) is actually negative but significant only at the 10 percent level. This indicates that, within an origin high school zone, areas rezoned to higher quality schools were *not* already experiencing increases in price, relative to areas rezoned to lower quality schools. The interaction term, which captures the actual school quality effect created by the zone changes, is positive and significant, suggesting that higher school quality significantly increases housing prices. This result is robust to the measure of school quality, although graduation rate is only marginally significant. The effects of a one standard deviation increase in school quality range between 1.4 and 3.2 percent, while controlling for district. The municipal district effects in this specification are similar to previous estimates and range from 5.5 to 8.3 percent.

Because our repeat sales specifications estimate school quality using parcel fixed effects, we cannot run a similar robustness check for those results. However, the fact that the results changed very little with this robustness check for the origin high school fixed effects model provides confirmation that our identification strategy is sound.

## 5.5 Middle and Elementary Schools

We repeat our analysis, using both school fixed effects and repeat sales, for middle and elementary schools, in addition to high schools. The results are presented in table 3. The

measure of school quality in all specifications is TCAP score. The middle and elementary school results are similar to the high school results. Positive and significant in all specifications, the school quality coefficients show that a one standard deviation in school quality increases prices by 3.1 percent for middle schools and 2.3 percent for elementary schools. When three measures of school quality are included in the same specification, only the high school measure is significant.

Analysis using repeat sales reveals a similar pattern. Higher levels of school quality for all three school types predict significantly higher housing prices. House price effects for a one standard deviation increase range from 4.2 percent (elementary school) to 5.1 percent (middle school), but only the high school measure is significant in column (8) when all three school types are included.

## 6. Conclusions

This paper analyzes the effect of school quality as it is capitalized in housing prices using unique school zoning and district changes that have recently occurred as a result of the Memphis City Schools/Shelby County Schools merger and municipal district creation. Specifications exploiting cross-sectional variation in housing prices using a basic hedonic sales model reveal a large and significant school quality effect, consistent with the literature. Our preferred specifications utilizing fixed effects yield estimates that are smaller in magnitude but still statistically significant. We find that a one standard deviation increase in school quality increases predicted housing prices by between 2% and 4%. These results persist across several robustness checks, including a repeat sales method. We find similar results using variation in elementary, middle, and high school quality, although, when all measures of school quality are included, the results seem to be driven by high school quality. In addition, we examine district effects and find that homes rezoned to a municipal district experienced a 5-7% increase in price, holding school quality constant.

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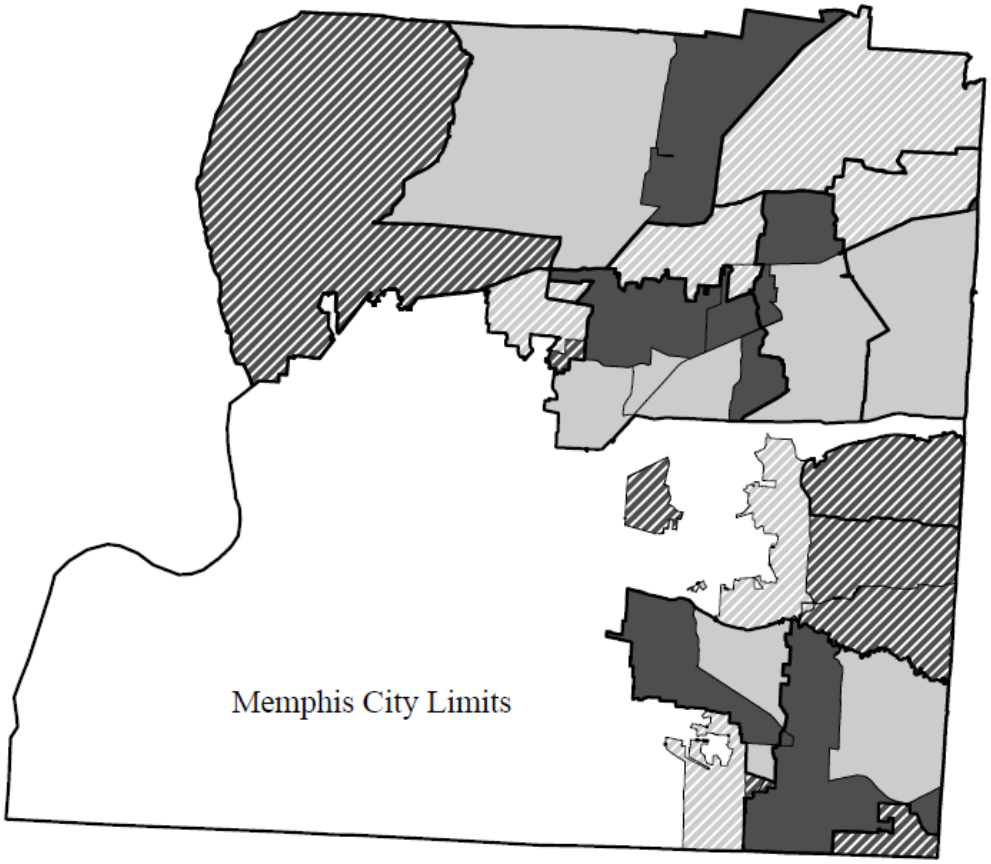
Figure 1




*Note:* This map of Shelby County summarizes changes in school and district boundaries. Dark grey denotes areas outside of the Memphis city limits that were rezoned to a new high school; whereas, the light gray areas remained in the same high school. The white area denotes the city of Memphis. Striped areas are part of the new unified Shelby County Schools, and solid areas were rezoned to one of six new municipal school districts.

Table 1: List of High School Changes Generated by Merger and Municipal District Creation

| new district: Shelby County Schools | score difference | number of parcels | number of sales |
|---|---|---|---|
| no school change | | | |
| Bolton-Bolton | ---- | 2783 | 1579 |
| Germantown-Germantown | ---- | 6570 | 6789 |
| | | | |
| school change | | | |
| Arlington-Bolton | -15.3 | 1952 | 1935 |
| Bartlett-Bolton | -0.5 | 1262 | 971 |
| Bartlett-Cordova | -10 | 3686 | 4192 |
| Houston-Germantown | -14.2 | 1387 | 1408 |
| Millington-Woodstock | -21.7 | 3078 | 1198 |
| | | | |
| total (new district: SCS) | | 20,718 | 18,072 |
| new district: municipal districts | | | |
| no school change | | | |
| Arlington-Arlington | ---- | 7320 | 8201 |
| Bartlett-Bartlett | ---- | 9855 | 6353 |
| Collierville-Collierville | ---- | 9434 | 8884 |
| Houston-Houston | ---- | 5446 | 4924 |
| Millington-Millington | ---- | 3211 | 1729 |
| | | | |
| school change | | | |
| Arlington-Bartlett | -14.8 | 984 | 529 |
| Bolton-Arlington | 15.3 | 148 | 90 |
| Bolton-Bartlett | 0.5 | 7097 | 6652 |
| Bolton-Milington | -0.8 | 346 | 126 |
| Germantown-Houston | 14.2 | 7610 | 5778 |
| Houston-Collierville | 0.7 | 4739 | 5559 |
| | | | |
| total (new district: municipal districts) | | 56,190 | 48,825 |
| total (SCS and municipal districts) | | 76,908 | 66,897 |

Note: Score difference is the difference in the percent of students scoring at the advanced or proficient level on the TCAP between the destination and origin schools. Number of parcels represents the number of unique parcels located within a certain region. Number of sales represents the number of individual sales recorded between 2000 and 2016.

Table 2: Hedonic Sales Regressions

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| high school quality | 0.00612*** | | | 0.00310*** |
| | (0.00147) | | | (0.00109) |
| middle school quality | | 0.00360*** | | 0.00142 |
| | | (0.000859) | | (0.000924) |
| elementary school quality | | | 0.00409*** | 0.00244* |
| | | | (0.00114) | (0.00131) |
| observations | 66,070 | 66,026 | 65,938 | 65,869 |
| R-squared | 0.895 | 0.895 | 0.896 | 0.898 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is ln(real house price). All specifications include year dummies, month dummies, and tax district dummies. Housing characteristic controls include number of bedrooms, age and an age quadratic, home condition, number of bathrooms, square footage, and lot size. School quality is measured using percent of students scoring proficient or advanced (three-year average) on the TCAP. Standard errors clustered at the elementary school level (using both origin and destination schools). Sample includes all suburban parcels sold in the 2000-2016 period.

Table 3: Effect of High School Quality on Housing Prices

| | test score | | graduation rate | | ACT score | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| high school quality *post | 0.00270*** | 0.00176*** | 0.00115*** | 0.000567 | 0.00785*** | 0.00427*** |
| | (0.000394) | (0.000426) | (0.000341) | (0.000352) | (0.00159) | (0.00154) |
| rezone MSD*post | | 0.0575*** | | 0.0838*** | | 0.0723*** |
| | | (0.0182) | | (0.0193) | | (0.0191) |
| observations | 66,070 | 66,070 | 64,892 | 64,892 | 64,892 | 64,892 |
| R-squared | 0.900 | 0.900 | 0.899 | 0.900 | 0.899 | 0.900 |

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is ln(real house price). Test score, graduation rate, and ACT score are all measures of school quality. All specifications include origin school fixed effects, year dummies, month dummies, and tax district dummies. Housing characteristic controls include number of bedrooms, age and an age quadratic, home condition, number of bathrooms, square footage, and lot size. Standard errors clustered at the elementary school level (using both origin and destination schools). Sample includes all suburban parcels sold in the 2000-2016 period.

Table 4: Repeat Sales

| | test score | | graduation rate | | ACT score | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| high school quality *post | 0.00398*** | 0.00251*** | 0.00350*** | 0.00259*** | 0.0151*** | 0.00889*** |
| | (0.000514) | (0.000518) | (0.00101) | (0.000733) | (0.00287) | (0.00248) |
| rezone MSD*post | | 0.0779*** | | 0.111*** | | 0.0940*** |
| | | (0.0110) | | (0.0103) | | (0.0118) |
| observations | 13,165 | 13,165 | 13,063 | 13,063 | 13,063 | 13,063 |
| R-squared | 0.734 | 0.745 | 0.712 | 0.742 | 0.725 | 0.743 |
| number of parcels | 5,471 | 5,471 | 5,426 | 5,426 | 5,426 | 5,426 |

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is ln(real house price). Test score, graduation rate, and ACT score are all measures of school quality. All specifications include parcel fixed effects, year dummies, month dummies, controls for age, and an age quadratic term. Standard errors clustered at the elementary school level (using both origin and destination schools). Sample includes all suburban parcels sold in the 2000-2016 period.

Table 5: Effect of High School Quality on Housing Prices (Robustness Check)

| | test score | | graduation rate | | ACT score | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| high school quality | | -0.00508* | | -0.00976* | | -0.0331* |
| | | (0.00258) | | (0.00497) | | (0.0167) |
| high school quality *post | 0.00176*** | 0.00186*** | 0.000567 | 0.000610* | 0.00427*** | 0.00450*** |
| | (0.000426) | (0.000424) | (0.000352) | (0.000353) | (0.00154) | (0.00154) |
| rezone MSD | | 0.116* | | 0.00881 | | 0.0371* |
| | | (0.0617) | | (0.0237) | | (0.0189) |
| rezone MSD*post | 0.0575*** | 0.0547*** | 0.0838*** | 0.0831*** | 0.0723*** | 0.0710*** |
| | (0.0182) | (0.0180) | (0.0193) | (0.0195) | (0.0191) | (0.0192) |
| observations | 66,070 | 66,070 | 64,892 | 64,892 | 64,892 | 64,892 |
| R-squared | 0.900 | 0.901 | 0.900 | 0.900 | 0.900 | 0.900 |

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is ln(real house price). Test score, graduation rate, and ACT score are all measures of school quality. All specifications include origin school fixed effects, year dummies, month dummies, and tax district dummies. Housing characteristic controls include number of bedrooms, age and an age quadratic, home condition, number of bathrooms, square footage, and lot size. Standard errors clustered at the elementary school level (using both origin and destination schools). Sample includes all suburban parcels sold in the 2000-2016 period.

Table 6: Effect of School Quality on Housing Prices, by School Type

| | Origin School Fixed Effects | | | | Repeat Sales | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| high school quality | -0.00508* | | | -0.00650** | | | | |
| | (0.00258) | | | (0.00254) | | | | |
| high school quality*post | 0.00186*** | | | 0.00193** | 0.00251*** | | | 0.00161** |
| | (0.000424) | | | (0.000738) | (0.000518) | | | (0.000778) |
| middle school quality | | 0.00141 | | 0.000924 | | | | |
| | | (0.00139) | | (0.00131) | | | | |
| middle school quality*post | | 0.00154*** | | -9.88e-05 | | 0.00250*** | | 0.000391 |
| | | (0.000570) | | (0.00105) | | (0.000739) | | (0.000980) |
| elem school quality | | | 0.00144** | 0.00108** | | | | |
| | | | (0.000672) | (0.000500) | | | | |
| elem school quality*post | | | 0.00118** | -5.77e-05 | | | 0.00215*** | 0.000978 |
| | | | (0.000480) | (0.000852) | | | (0.000542) | (0.000850) |
| rezone MSD | 0.116* | 0.00456 | 0.0381 | 0.0992* | | | | |
| | (0.0617) | (0.0591) | (0.0606) | (0.0591) | | | | |
| rezone MSD*post | 0.0547*** | 0.0558** | 0.0685*** | 0.0567*** | 0.0779*** | 0.0713*** | 0.0842*** | 0.0679*** |
| | (0.0180) | (0.0221) | (0.0207) | (0.0197) | (0.0110) | (0.0191) | (0.0148) | (0.0161) |
| observations | 66,070 | 65,765 | 66,070 | 65,765 | 13,165 | 13,150 | 13,165 | 13,150 |
| R-squared | 0.901 | 0.900 | 0.901 | 0.901 | 0.745 | 0.743 | 0.743 | 0.748 |
| number of parcels | | | | | 5,471 | 5,464 | 5,471 | 5,464 |

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Specifications (1)-(6) include origin school fixed effects, year dummies, month dummies, and tax district dummies. Housing characteristic controls include number of bedrooms, age and an age quadratic, home condition, number of bathrooms, square footage, and lot size. Specifications (7)-(9) include parcel fixed effects, year dummies, month dummies, controls for age, and an age quadratic term. Standard errors clustered at the elementary school level (using both origin and destination schools). Sample includes all suburban parcels sold in the 2000-2016 period.

## Appendix 1

Memphis City Schools/Shelby County Schools Consolidation Timeline

| | |
|---|---|
| December 20, 2010: | The MCS School Board, in a 5-4 vote, decides to begin the process of surrendering its charter, subject to a voter referendum. |
| February 2011: | Memphis City Council votes to surrender the MCS charter. |
| February 2011: | Lawsuit from SCS School Board, alleging that MCS "improperly surrendered" its charter. |
| March 8, 2011: | Memphis city residents approve a referendum dissolving MCS charter and transferring control of MCS to SCS, effective at the start of the 2013-2014 school year. |
| August 2011: | A federal judge orders that the MCS charter was properly surrendered and that the current SCS board is unconstitutional because it includes no Memphis residents. |
| April 2012: | State legislature passes law removing statewide ban on new municipal school districts for counties involving a "transfer of the administration of the schools in a special school district to the county board of education" (effectively only for Shelby County). A separate law provided for the creation of municipal school districts through local referenda. |
| June 2012: | Transition Planning Commission (TPC) submits its recommendation plan for consolidation to the unified school board. |
| August 2012: | Six Shelby County municipalities (Arlington, Bartlett, Collierville, Germantown, Lakeland, and Millington) approve referendum, voting to create municipal school districts. |
| November 27, 2012: | Federal judge declares the April 2012 law unconstitutional and overturns municipal referenda. |
| April 2013: | State legislature passes law removing statewide ban on new municipal school districts for all counties. |
| July 2013: | As of 1 July, all Shelby County residents, including Memphis residents, are served by SCS. |
| July 16, 2013: | Six incorporated areas vote again to withdraw from SCS and form separate municipal districts. |
| July 2014: | The six municipal districts begin, effective July 1, 2014. |