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EDUCATION ECONOMICS

Capitalization of School Quality in Housing Prices: Evidence from Boundary Changes in Shelby County, Tennessee†

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In 2013 Memphis City Schools and nearby 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. Subsequently, and after much legal controversy, six Memphis suburbs voted to create separate municipal districts, run independently from the new unified Shelby County Schools system. Many zoning changes occurred at both the school and district levels as a result of the merger and municipal district creation, 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 a review see Nguyen-Hoang and Yinger 2011). For these "boundary fixed effects" estimates to yield an unbiased valuation of school quality, school preferences must be independent from preferences for neighborhood amenities. Since this assumption is unlikely to hold, buyers' sorting behavior will cause estimates of school quality to be biased upward.

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. This specification requires the *trend* in housing prices to be uncorrelated with rezoning. A robustness check indicates this does not hold for the Vancouver boundary changes, and the majority of their initial findings could be explained by pre-existing differences in home price trends between rezoned and non-rezoned areas. We suspect zoning changes motivated by neighborhood or school demographic changes will be subject to similar endogeneity issues.

In this study, we employ a methodology similar to Ries and Somerville (2010) to estimate the effects of school and district attributes on housing prices using unique changes in school boundaries and district administration generated from the school district merger in Memphis—the largest of its kind in US history. The complex political circumstances motivating the rezoning, which were not related to demographic changes, provide a natural experiment, reducing concerns about endogeneity.

I. Background

Until 2013, the students of Shelby County, Tennessee were served by two parallel public school systems. Memphis City Schools (MCS) provided education for students within the Memphis city limits, and all other students in the county attended Shelby County Schools (SCS). Action toward the creation of a one-district county began in 2010 when the MCS school board voted to surrender its charter, forcing SCS to absorb students from the city of Memphis.

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The charter surrender was approved by Memphis city residents the following year.

County representatives opposing a single district proposed the creation of separate districts for each of Memphis' six incorporated suburbs. However, a state law banning the creation of new municipal districts had existed since 1998, creating a considerable legal barrier for the county. After more than two years of legislative and judicial wrangling, the Tennessee General Assembly passed a law removing the ban, and the six municipalities voted in favor of forming their own independently-run districts, starting in the 2014–2015 school year.

The final zoning outcomes of the merger and municipal district creation differed for homes in three distinct areas of Shelby County, summarized in the map in Figure 1. First, homes within the city of Memphis, which were originally served by MCS, all switched to the SCS district following the charter surrender. In terms of zoning, there were no significant school boundary changes within the city of Memphis itself. Two areas, both located outside the Memphis city limits, experienced genuine school and district changes. Homes located within the six suburban municipalities (56,190 parcels) switched to municipal districts, each of which is now operated independently from the county. The formation of these districts represents a shift to more localized administrative control. Second, homes outside the Memphis city limits that were not located in one of the new municipal districts (20,718 parcels) were merged into the unified SCS system. Within each of the two suburban groups, we observe homes that are rezoned to different schools of varying quality and homes that remain in the same school zone after the districting changes.

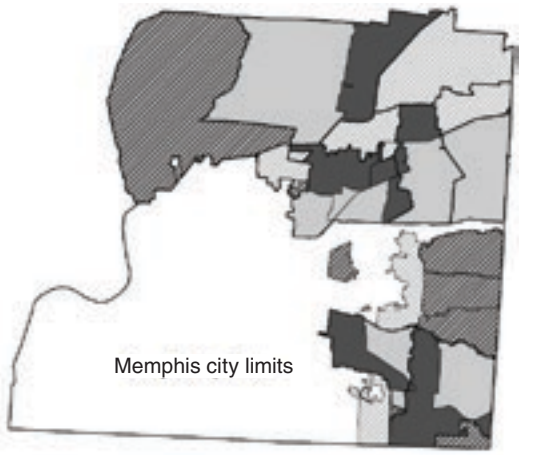

FIGURE 1. SHELBY COUNTY SCHOOLS BOUNDARY CHANGES

Notes: This map of Shelby County summarizes changes in school and district boundaries. Dark gray 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.

II. Data

We use three data sources for our analysis: residential sales data from Shelby County, school zone boundaries from each district, and school quality data. Data from the Shelby County Assessor of Property contains a snapshot of all residential property parcels within the county as of January 1, 2016. The dataset includes detailed home characteristics (e.g., square footage, lot size, number of bedrooms and bathrooms) as well as information about all previous sales (e.g., sale date, price, and sales type) for each parcel. We use 16 years of sales data from 2000–2015, restricting our analysis to arms-length residential sales above $10,000.

We collect geocoded school boundary data for SCS, MCS, and each of the municipal districts for the 2013 through 2015 school years.[1] Starting in 2015, the county housed seven separate systems: the six municipal districts and SCS, which serves all students outside a municipal district. Due to the nature of the county's charter, the resulting school district is discontiguous. We collect boundaries for elementary, middle, and high school zones.[2]

Our key measure of school quality is based on the percent of students at a school scoring proficient or advanced on the Tennessee Comprehensive Assessment Program (TCAP) prior to the boundary changes.[3] Because test

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

[2] We use high school boundaries for our primary analysis, but our results are robust to the use of middle and elementary zones.

[3] We also collect data on graduation rates and ACT scores. Our results are robust to these alternative school quality measures.

scores are likely to be noisy measurements of school quality, this measure is averaged across reading and math assessments and across all grades over a three-year period.[4]

III. Methodology

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

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

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 features, such as number of bedrooms. If unobserved neighborhood or home characteristics are correlated with school quality, then γ is biased upward.

Previous studies attempt to address this issue by using "boundary fixed effects," examining home sales within small geographic areas on either side of an existing school boundary. The problem with this approach is the necessary assumption that homes on both sides of the boundary are similar along unobservable characteristics.

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). As shown in the following equation, we include fixed effects for each parcel's "origin" school based on boundaries for the 2013–2014 school year:

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

where $price_{ijk}$ represents the real price of house i, which is located in new school zone j and origin school zone k. Including origin school fixed effects, which are captured by the term α_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 (February 2013), and zero otherwise. The parameter of interest is now γ_2, which measures the effect of the new school's quality on price, after the announcement of the boundary switch. The fixed effects model exploits variation in new school quality *within* the origin high school, comparing homes zoned to the same origin high school but rezoned to two new high schools of varying quality.

The fixed effects model yields biased estimates if houses rezoned to different schools within the same original school catchment area are systematically different. Although we examine houses within a small geographic area and control for many key observables, it is possible that unobserved factors may bias these estimates. To address this concern, we exploit the fact that our dataset includes multiple sales of the same home. The repeat sales model includes parcel fixed effects in a specification similar to equation (1). Note that all parcel-specific, time-invariant features drop out of this model, so X_{ijk} includes only house features that vary across time, such as age.

IV. Results

A. *Hedonic Sales Regressions*

The estimate from a basic hedonic model appears in column 1 of Table 1. The model includes controls for number of bedrooms, age and an age quadratic, home condition, number of bathrooms, square footage, and lot size. This estimate suggests that a one standard deviation increase in school quality, increases home prices by about 10 percent; however this is 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 coefficient will be biased upward. To address this concern, we estimate the model using origin high school fixed effects.

B. *High School Fixed Effects*

We exploit school zone changes generated by the county's redistricting to identify the school

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

Table 1—School Quality and District Administration

	Hedonic (1)	HS fixed effects (2)	HS fixed effects (3)	HS fixed effects (4)	Repeat sales (5)	Repeat sales (6)
Test scores	0.0061			−0.0051		
	(0.0015)			(0.0026)		
Test scores × post		0.0270	0.0018	0.0019	0.0040	0.0025
		(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0005)
Rezone MSD				0.116		
				(0.0617)		
Rezone MSD × post			0.0575	0.0547		0.0779
			(0.0182)	(0.0180)		(0.0110)
Observations	66,070	66,070	66,070	66,070	13,165	13,165
R^2	0.895	0.900	0.900	0.901	0.734	0.745
Parcels					5,471	5,471

Notes: Dependent variable is the log of real house price. All specifications include year dummies, month dummies, age, and an age quadratic. Additional housing characteristic controls in columns 1–4 include tax district dummies, number of bedrooms, 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 before zoning changes occur. 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.

quality effect using origin high school fixed effects, presented in column 2. As expected, the magnitude of the school quality effect is smaller than in the naïve hedonic regressions, but remains statistically significant. Column 3 includes a dummy variable for homes that were redistricted to a municipal school system interacted with the post-February 2013 dummy. We find that homes that were moved to the municipal school system sold for prices 5.6 percent higher than similar homes that were absorbed back into the SCS system. Including the district effect decreases the magnitude of the school quality coefficient, although it is still significant and positive. After controlling for redistricting, a 1 standard deviation increase in school quality increases housing prices by about 3 percent.

It is important to note that, given our identification strategy, our results will be biased if housing prices in areas rezoned to high quality schools were trending differently than areas rezoned to low 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 school quality estimates to be positive, even if rezoning didn't actually *cause* prices to increase. Because neighborhoods within the original catchment areas may vary systematically by the new school quality, column 4 presents a robustness check which includes destination school quality in addition to the interaction term. If the interaction term is insignificant in the presence of the school quality variable, this indicates that the estimates from column 3 are due entirely to pre-existing differences in the trend in home prices. Previous research (Ries and Somerville 2010) fails this robustness check, indicating a violation in the parallel trends assumption.

Results in column 4 confirm the validity of the parallel trends assumption. The coefficient on school quality is negative and significant only at the 10 percent level. This indicates that, within an origin 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 school quality effect identified by zoning changes, remains positive and significant, suggesting that higher school quality significantly increases housing prices. The effect of a one standard deviation increase in school quality, as measured by test scores, is 3.2 percent, controlling for district. The municipal district effect in this specification is 5.5 percent.

C. *Repeat Sales*

In addition to using origin high school fixed effects, we exploit the repeat sales available in our dataset. Between 2000 and 2016, 5,471 parcels in the suburban rezoned areas were sold at least once before and once after February 2013. While we control for a variety of parcel-specific characteristics, estimates from the high school fixed effects model may still be biased if homes have unobserved characteristics which are correlated with school quality. Using parcel fixed effects allows us to compare the price of the same house before and after the zoning changes.

The repeat sales estimates are shown in columns 5 and 6. Because we use parcel fixed effects, house-specific, time-invariant features are eliminated. In addition, we cannot include origin school quality alone as a covariate, because it does not vary within a parcel. However, the results of this robustness check in the high school fixed effects models offers evidence that the identifying assumption holds in our dataset.

The magnitudes of the estimates from the repeat sales specifications are qualitatively similar, although slightly higher than the high school fixed effects estimates. The effect on housing prices of a one standard deviation increase in school quality is 4.3 percent, after controlling for redistricting. The coefficient on the district rezoning variable indicates that homes redistricted to a municipal school system increased in price by 7.8 percent.

V. 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. A basic hedonic sales model reveals 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 about 3 percent. These results persist across several robustness checks, including a repeat sales method. In addition, we examine district effects and find that homes rezoned to a municipal district experienced a 5–7 percent increase in price, holding school quality constant.

REFERENCES

Nguyen-Hoang, Phuong, and John Yinger. 2011. "The Capitalization of School Quality into House Values: A Review." *Journal of Housing Economics* 20 (1): 30–48.

Ries, John, and Tsur Somerville. 2010. "School Quality and Residential Property Values: Evidence from Vancouver Rezoning." *Review of Economics and Statistics* 92 (4): 928–44.