Too Late to Buy a Home? School Redistricting and the Timing and Extent of Capitalization[*]

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Abstract

In the past fifty years, a voluminous literature estimating the value of schools through capitalization in home prices has emerged. Prior research has identified capitalization using a variety of approaches including discontinuities caused by boundaries. Here, we use changes in school boundaries and the opening of a new school in Fayette County (Lexington), Kentucky to identify this capitalization. Critical to properly estimating the effect of redistricting is to account for when information on redistricting is available. We treat the information about the effects of zoning as occurring in three stages: announcement of the intent to open the new high school and redistricting, approval of the specific redistricting plan (map), and implementation (opening of the new high school and actual changes in boundaries). We find significant changes in values for homes redistricted from lower-performing schools and we find that this capitalization occurs well before implementation of the redistricting. As we show, failure to account for capitalization occurring before implementation will attenuate and even change the sign of capitalization.

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1 Introduction

There were 99,728 public elementary and secondary schools operating in the United States during the 2020-2021 school year. Among them, 1,027 schools changed agency or boundaries and 258 were expected to open in the near future.[1] Reflecting changes in schools and school quality, home values in the school district (zone for individual schools) are affected as households purchase (or sell) a home to gain access to better schools for their children. A survey of recent home buyers found that fifty-three percent of households with children under the age of eighteen said that the quality of the school district was important in their housing decisions and fifty percent cited convenience to schools as important.[2] According to a local news report, redistricting in Henrico County, Virginia in 2017 drew criticism from some elementary school parents in the county, "[s]ome parents explained that they moved into a house thinking their kid would go to a certain middle school",[3] underscoring the importance in understanding how people make housing choices and how they value a change in attendance boundaries.

Equally important is how these changes in attendance boundaries, as well as other changes in educational policies, affect property values, that is, the extent to which these changes are capitalized into property values, the focus of numerous studies. However, changes in attendance boundaries or other educational policy changes are not instantaneous – there are often lengthy periods between the announcement, approval, and implementation of new policies. What has not been considered in previous literature is when any capitalization into property values associated with these policy changes might occur. Is it at announcement, approval, or implementation? The focus of this paper is to examine when capitalization occurs in the context of high school boundary changes in Fayette County (Lexington), Kentucky.

Beginning with the seminal papers of Oates (1969) and Kain and Quigley (1970) a voluminous literature has examined the relationship between measures of school quality and property values. The traditional approach of identifying the impacts of schools and school quality on property values is through cross-sectional variation in quality among schools. More recently, quasi-experimental approaches have emerged – through boundary-fixed effects (Black, 1999) or changes in school boundaries (Bogart and Cromwell, 2000; Ries and Somerville, 2010; Collins and Kaplan, 2022). We follow the latter approach, taking advantage of recent high school redistricting or, as we shall refer to it, "rezoning" [4] in Fayette County, Kentucky to employ a difference-in-differences

[1] U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD), "Public Elementary/ Secondary School Universe Survey."

[2] National Association of Realtors, "2018 Profile of Home Buyers and Sellers."

[3] http://wtvr.com/2017/06/22/henrico-school-board-votes-for-option-e-middle-school-redistricting-plan/

[4] While changes in school attendance boundaries are often referred to as "redistricting," we shall refer to these changes in school boundaries as the "rezoning" of high school boundaries within a school district to avoid confusion with changes in school district boundaries which did not occur in Fayette County.

approach to measure how housing prices change when a neighborhood is rezoned to a different high school and how adding a new school to the system changes housing prices. Many studies have examined the relationship between property value and specific measures of educational quality or services, including student test scores (Black, 1999), school report cards (Figlio and Lucas, 2004), or educational expenditures (Bayer, Blair, and Whaley, 2020). In contrast, our approach compares the differences between schools in the value of their "bundles" of educational services with the treatment being the change in school rather than a single attribute of the school. Schools can be considered a composite good, composed of a "bundle" of attributes (similar to a house or car): test scores and student achievement, peer effects, teacher quality, class size, and the physical plant itself. In addition, as discussed in Section 2, using the difference-in-differences approach along with consideration of "new," rather than pre-existing boundaries provides a distinctive identification advantage of comparing the same properties with different schools as the boundaries change. Concerns with static boundary comparisons have included differences in access to other public goods (parks, transportation) as well as differences in neighborhood effects. Further, as we have comprehensive data on (mean) ACT scores for the public high schools in Fayette County, we also contribute to the large literature on the capitalization of school quality measures.

In contrast to existing studies focusing on elementary school quality, we examine the impact of high school rezoning for several reasons. First, while the rezoning affected all three levels of schooling, Fayette County high school zones were the most affected.[5] Second, by far most of the focus in the local media and public forums was on the opening of the new high school and the associated rezoning. Finally, while our focus is on high school rezoning, we control for changes in rezoning at all levels of schooling throughout our analysis.

Numerous studies have used exogenous changes in educational policy including changes in educational funding (Jackson, Johnson, and Persico, 2016; Bayer, Blair, and Whaley, 2020) and changes in school boundaries (Bogart and Cromwell, 2000; Ries and Somerville, 2010; Collins and Kaplan, 2022). While these policy changes may be implemented at a specific date, there is always a time between the announcement and implementation of the policy. As mentioned, our paper differs from these studies of educational policy as we are not only capturing the actual impact of school quality change associated with such rezoning on house values but also the impact of the expected change in quality. While little attention has been paid to when the capitalization of educational quality might occur, studies of other policy changes have considered "anticipation" effects. Examples include Malani and Reif (2015) that considers anticipated physician labor supply effects from tort reform and Blundell, Francesconi, and van der Klaauw (2011) that considers the

[5]Out of 22,526 sales after 2015, 26% were in rezoned high school areas, 23% were in rezoned elementary school areas, and only 12% were in rezoned middle school areas. Among all sales, only 8% were subject to both elementary and high school rezoning and only 3% were subject to all rezoning of all three levels of schools.

effects of welfare reform in the UK on female labor supply during both an anticipatory period and following implementation. In the literature on hedonics and environmental quality, the timing of capitalization has been addressed as a "learning" phenomenon in, for example, Kiel and McClain (1995), Case et al. (2006), and Somerville and Wetzel (2022). For policies in which the period between the announcement (or anticipation) of the policy change and its implementation is relatively short, consideration of these anticipatory effects prior to implementation may not be a concern. However, these studies, like ours, suggest that when the period between the announcement or anticipation of a proposed change and its actual implementation is longer, ignoring anticipation or learning can lead to significant biases in the estimated impacts of the policy being evaluated.

In our case, as with most cases of school boundary changes or the opening of new schools, the process of approval and implementation of the boundary and new high school (Frederick Douglass) in Fayette County took several years. The site for the new high school was announced in late 2013 and the rezoning process began in 2014. The proposed rezoning was presented by the Lexington-Fayette Board of Education in April 2015 and approved by the board on June 3, 2015, for revisions of the five existing high school catchment areas or, as the Board refers to them and the term that we shall use, school "zones" and the boundaries for the new high school, Frederick Douglass.[6]

Our results suggest that the timing of capitalization matters and, as we show, failure to account for capitalization prior to educational reform may bias estimates of the effect of the reform on property values. That the process of boundary revisions took several years with the revised boundaries being known over two years before the new school became operational raises an important question: when did capitalization of these changes occur? If it did occur, was it after the announcement of potential unspecified changes (April 2014), after the approval of a specific rezoning plan (June 2015), or not until the approved plan became effective (August 2017)? We address this question using multi-period difference-in-differences and show, in fact, that the most significant capitalization occurred prior to the implementation of the new boundaries and opening of Frederick Douglass. In our case, failure to consider these anticipatory effects and, instead, focus only on the opening of the school or implementation of the new boundaries as the "treatment," will significantly attenuate the estimates of capitalization. Implementing the difference-in-difference approach using boundary changes for several high schools in Fayette County allows us to investigate the impacts of boundary changes on property values in different zones – essentially allowing for a less parameterized estimate.

While our results show that the rezoning proposed in 2015 had, on average, no significant effect

[6]The five operating high schools in Fayette County prior to August 2017 are Bryan Station, Paul Dunbar, Henry Clay, Lafayette, and Tates Creek as can be seen in Appendix Figure A1. As also seen in Figure A1 the zone for Frederick Douglass is between those of the Bryan Station High School and Henry Clay High School.

on housing values in Fayette County, this result is not surprising – some houses were rezoned from higher-performing high schools to lower-performing ones as measured by numerous metrics while the reverse is true for other houses. However, houses that are rezoned from low-performing to high-performing high schools, as measured by mean ACT scores, had statistically-significant increases in property value with this appreciation occurring prior to the implementation of the rezoning. Further reexamining changes in property values by pairs of schools, we find that houses rezoned from the lowest-performing school as measured by mean ACT score (Bryan Station) to other existing schools significantly increased in value. Houses rezoned from a higher performing school (Henry Clay) to the proposed school (Frederick Douglass) had statistically significant decreases in value after the implementation of the rezoning. Moreover, for most of the current higher-performing schools, the values of rezoned houses decreased though the timing of this impact was not uniform among the schools.

As done in many other studies, we also consider how a possible measure of school quality, in our case, the mean ACT score in the high school affects property values. However, as with our analysis focusing on the change in school zones, we also focus on whether the "return" on school ACT score is affected by timing. We find that test scores contribute to changes in home values only when we use expected (future) school test scores rather than current school scores during the approval stage.

In Section 2 we provide a brief review of the literature on the relationship between primary and secondary education and property values. Background on the process for and, importantly, the timing of when school boundaries were determined is provided in Section 3. Section 4 discusses the data used in empirical analysis and Section 5 provides the basic methodology. Section 6 presents the results of our estimation and addresses the possibility of learning in the model. Section 7 concludes.

2 Literature Review

2.1 Education and Property Values

Economists have long been interested in estimating the relationship between housing prices and school quality. Early work done by Oates (1969) and Kain and Quigley (1970) inspired a burgeoning literature examining the impact of school quality on property values. However, a critical problem associated with evaluating the causal link between housing prices and school quality is controlling for neighborhood characteristics. As "good" schools are often correlated with other neighborhood amenities, it is difficult to isolate the effect of school quality from the effects of these amenities through ordinary least squares regressions. If increased housing prices increase property tax revenues, a greater willingness to pay for school quality in a district will lead to increased school spending – making school quality endogenous to the district (Epple and Romano, 2003; Nechyba, 2003).

Numerous studies have attempted to identify the relationship between school quality and property values. Bogart and Cromwell (1997) use an Oaxaca decomposition to examine houses across school districts where jurisdiction districts are overlapped and isolate the common public service effect from observable components and unobservable components. Weimer and Wolkoff (2001) also follow the same spirit finding a significant impact of test scores on housing values. Downes and Zabel (2002) adopt a standard log-linear regression, a first-difference model, and a value-added model to examine the impact of school characteristics on housing prices. They find that individuals are willing to pay more for a house close to a school with higher standardized test scores. Clapp, Nanda, and Ross (2008) use a panel of school districts in Connecticut to examine the effect of school district test scores and demographic composition on housing prices after controlling for the influence of unobserved neighborhood attributes with fixed effects. They find a one standard deviation increase in test scores leads to a 1.3 percent increase in property values. They also find that a 10-percentage point increase in the percent of African-Americans and Hispanic leads to a 3.5 percent and 3 percent decline in property values, respectively, in contrast to earlier work where they do not find demographic changes affect differences in housing prices (Clapp and Ross, 2004). While these studies offer valuable insights into the relationship between property value and educational quality, a concern that arises is that residential sorting based on education quality may bias their results.

2.2 Quasi-Experimental Approaches and the Valuation of School Quality

Boundary Fixed Effects and Regression Discontinuities One approach to avoid some of the issues plaguing the traditional panel approaches to estimating the effects of educational quality on property values is to identify differences in property values along school boundaries, the "boundary fixed effect" model pioneered by Black (1999). She uses elementary school data in Massachusetts and compares houses within similar neighborhoods but across school attendance boundaries, finding a 2.5 percent increase in house prices for a five percent increase in test scores. An alternative boundary is related to voting on education spending. Cellini, Ferreira, and Rothstein (2010) utilize discontinuities in voting on education spending to see the impact of school facility investment on housing markets and find a \$1 increase in spending increases housing prices by \$1.50 though the effect of spending on test scores is small.

Bayer, Ferreira, and McMillan (2007) expand on the boundary fixed effect approach of Black (1999) by controlling for differences in demographics (parents' college education, percentage black, income) along school catchment boundaries that might arise from sorting. Employing boundary fixed effects and neighborhood demographic controls with San Francisco MSA property value data, they find that the impact of school quality on property values is reduced by almost fifty percent relative to estimates with the boundary fixed effects alone. Kane, Riegg, and Staiger (2006) use boundary fixed effect and regression discontinuity methods with data from Mecklenburg County, North Carolina between 1994 and 2001 to study the impact of various school characteristics on housing prices. They test whether observed housing and neighborhood characteristics shift discontinuously at the school boundaries and find a pronounced correlation between differences in school test scores and differences in housing and neighborhood characteristics, which shows the importance to control for these differences. An alternative approach to addressing these concerns with boundary fixed effects is to control for demographic differences that may arise from sorting and employ panel data (repeated cross-sections) along boundaries (Dhar and Ross, 2012; Dachis, Duranton, and Turner, 2012).

Educational Reforms, Difference-in-Differences, and Property Values In contrast to studies that employ boundary fixed effects or regression discontinuities, which might be thought of as comparing equilibrium property values across school zones, are studies that employ exogenous changes in educational quality to identify differences in property values between those areas subject to the reforms (treated) and those areas that are not (comparison).

For example, Bogart and Cromwell (2000) use a difference-in-differences framework to examine the impact of redistricting schools on house values in Shaker Heights, Ohio where school closings resulted in dramatic shifts in boundaries. They find the impact of losing a neighborhood school on home values reduces house values by 9.9 percent ($5,738 at the mean house value). However, as all schools in Shaker Heights are considered high quality, they cannot exploit variations in the quality of schools. Ries and Somerville (2010) use repeated sales in Vancouver and exploit a redistricting process that redraws catchment areas to study the impact of school quality on housing values. They find the only significant effects of this redistricting occur for the top-quartile of residences. Machin and Salvanes (2016) use Norwegian data to examine whether access to school choice affects housing prices by exploiting a policy eliminating catchment areas. They find housing valuation sensitivity is reduced, suggesting that parents value better-performing schools. Bonilla-Mejía, Lopez, and McMillen (2020) take the reform of the school lottery in Chicago to study the capitalization effect and find a significant impact of higher admission probability associated with close proximity on housing prices. Collins and Kaplan (2022) utilize exogenous boundary changes in Shelby County, Tennessee to estimate the effects of school quality and district attributes on housing prices. They use repeated sales data and control for original school district fixed effects in a difference-in-differences framework. Their result shows that within the original school zone, areas zoned to higher-quality schools experience a 2-3% increase in housing prices through a one standard deviation increase in test scores.

2.3 Timing and Hedonic Estimation

While the issue of whether educational policies are capitalized into property values prior to their implementation has not been addressed in this literature, whether environmental policies are anticipated in property values has been studied. Kiel and McClain (1995) looked at a rumored but later constructed incinerator facility and its impact on house prices; Case et al. (2006) examined the effect of contamination on property values where the location of contamination was affected by urban growth; and a recent paper, Somerville and Wetzel (2022), also investigates information shocks based on proximity to negative externalities from facilities.

2.4 Distinctions between Our Study and the Existing Literature

Our approach most closely follows that of Bogart and Cromwell (2000), Ries and Somerville (2010) and Collins and Kaplan (2022) by taking advantage of a natural experiment – changes in school boundaries – with difference-in-differences estimation.[7] Importantly, a key distinction between approaches of our study and these studies is how the period between the announcement and implementation of changes in school boundaries is considered. In the case of Bogart and Cromwell (2000), the period following the announcement of a proposed redistricting plan is the start of the treatment period; for Ries and Somerville (2010) the treatment period begins with the approval of the redistricting plan; and in Collins and Kaplan (2022) the treatment period begins with the implementation of redistricting.[8] Thus, each of these three studies applies different definitions of when the treatment, redistricting, begins. In Bogart and Cromwell (2000) and Ries and Somerville (2010), the period between the announcement and implementation of the redistricting was relatively short; in contrast, because redistricting in Fayette County also involved

[7] While, as discussed in the literature cited above, there are obvious econometric advantages to using quasi-experimental approaches, including difference-in-differences, there are challenges to interpreting the findings from these approaches as welfare measures (Klaiber and Smith, 2013; Kuminoff and Pope, 2014; Banzhaf, 2021). In another paper, we provide a fuller treatment of these issues and how they might be addressed (Ding et al., 2023).

[8] In the case of Shaker Heights, OH redistricting, evaluated in Bogart and Cromwell (2000), the redistricting was made public in January 1987, approved in March 1987, and implemented in September 1987. All sales in 1987 were considered to be in the treatment period. In Vancouver, BC redistricting, studied in Ries and Somerville (2010), the initial proposal was public in September 2000, approved with minor changes in January 2001, and effective in September 2001. All sales in 2001 were considered to be in the treatment period. The Memphis/Shelby County redistricting studied in Collins and Kaplan (2022) is more complicated as it involved state involvement and the creation of six new school districts. However, their treatment period is consistent with our implementation period.

the construction of a high school, the period between the announcement and implementation of redistricting was almost four years in our study. Then with this length of time, unlike these other studies, we not only capture the actual impact of school quality change associated with such redistricting on house values but also the impact of the anticipated quality change. To do this, we split the entire redistricting process into multiple periods to see how people update their beliefs about where the redistricting will take place and its impact on house prices, thereby also contributing to a related literature on information and learning in hedonic evaluations (Cheshire and Sheppard, 2004; Ma, 2019). As we show with school boundary changes in Fayette County, the extent of capitalization critically depends on what is considered the treatment – announcement, approval, or implementation of a policy. And, as we show, the choice of which of these is identified as the treatment will affect the estimate of capitalization.

3 Rezoning in Fayette County

In the Fayette County public high schools, there has been an average increase in enrollment of 600 to 750 students a year before the redistricting. Figure 1 shows the upward trend of increasing enrollment in most of the public high schools prior to 2016. To accommodate this growth, a rezoning process began in late 2013 in anticipation of a new high school opening in 2017. The year-long work of drawing new school boundaries began in the spring of 2014 with a committee of parents, teachers, Fayette County Public Schools administrators, two school board members, a district Equity Council representative, a city planning official, a home builder, and other community stakeholders. The committee met three times to review some initial demographic information and community growth trends. On April 14, 2015, the committee presented a plan to the Fayette County Board of Education with a summary of its draft proposals. The school board then met with the redistricting committee on April 21st for a joint work session. At their June 3, 2015 meeting, the Fayette County Board of Education approved the rezoning plan. Table 1 summarizes the timeline of the rezoning process.

Figure 2 shows the map of the original school catchment areas or, henceforth, the school "zones" and the proposed zones with the school boundaries change. The dashed line represents the old school district boundaries and the red solid line represents changes in school district boundaries from the rezoning. Based on these changes, we are able to determine the school catchment area for each house sold before and after the rezoning process.[9] Under the new plan, Bryan Station still covers a large proportion of Fayette County, but its southeast share was rezoned

[9] Appendix Figure A1 presents separate maps for the original and the proposed school zones with high school locations labeled on the map.

to the proposed school, Frederick Douglass.[10] There are not large geographical changes in the other four high-school zones.[11] To better understand the magnitude of the rezoning, we calculate the percentage of housing stock in each original school zone in 2013 that was rezoned, which is presented in Appendix Table B1. Consistent with the visualized map, almost 40 percent of the homes in Bryan Station before 2017 were rezoned to a different or the new school while the Henry Clay, Lafayette, and Paul Dunbar high schools had approximately 20 percent of their homes rezoned. In contrast, Tates Creek only had 2.31 percent of its homes rezoned.

Housing sales data from Fayette County Property Valuation Office (PVA) come with an address for each sale record. We use ArcGIS to match each sale with a high school zone. Our data from 2010 to August 2017 are prior to the implementation of the new school district plan with data from August 2017 to August 2020 following implementation. We identify three "treatments": 1) the Fayette County School Board vote to undertake rezoning and build a new high school on Winchester Road (April 29, 2014) with no mention of any specific changes in school zones or what the catchment area for the new school would be; 2) the passage of the proposal (June 3, 2015) that mapped the approved school zones; and 3) the implementation of the approved school zones and opening of the new high school (Frederick Douglass) (August 16, 2017). Then, as the rezoning proceeded, information about the new zones increased and, presumably uncertainty decreased. The information regarding each of these "treatments" was well-reported in local media, including the Lexington daily newspaper, the *Lexington Herald Leader (LHL)*.[12] Though the construction of the new high school was made public in December 2013, no specific information about catchment area (re)assignment was available until April 29, 2014, a committee was formed and began their work in redrawing school attendance boundaries. If anything, our estimates of the post-announcement effect based on April 29, 2014, underestimates the true effect. Given the extensive press coverage in Lexington, we expect that those in the market for housing would have been aware of the upcoming changes in school districts prior to this date. As will be seen, our

[10]The name of the proposed high school was not announced until November 10, 2016, and was approved by the Fayette County School Board on November 21, 2016, over a year after the approval and districting for the proposed high school (see Spears, Valarie Honeycutt (November 10, 2016) "Frederick Douglass recommended as name for new Lexington high school," *The Lexington Herald Leader, https://www.kentucky.com/news/local/education/article114008613.html*).

[11]Critical to there being a relationship between property values in a school zone and the quality of education in that school zone is that a significant share of the students attending the school reside in that district (for example Zheng (2022)). Fayette County has no open enrollment program nor any charter schools. It does, however, have magnet programs that allow a limited number of students to attend schools other than the school to which they are zoned.

[12]As mentioned, the relevant articles are all from the *Lexington Herald Leader (LHL)*. All were written by Valarie Honeycutt Spears. The first article on rezoning we found in the *LHL* was "New $76 million Lexington high school proposed for Winchester Road, outside New Circle," (December 14, 2013) followed by "Fayette County Public Schools redistricting committee releases tentative rezoning maps" (January 29, 2015), "Public gets a look at final Fayette school attendance zone recommendations" (April 14, 2015), and "Fayette County school district issues final versions of new school attendance zones (get maps)" (June 17, 2015).

empirical results support this conjecture.

Sales for the pre-treatment and the three treatment periods need to be matched with a high school zone. Sales prior to April 29, 2014, are matched to the "old" zone, the zone in operation, and are in the pre-treatment period. Sales after April 29, 2014, are matched to the "new" zones, that is, the zones that will be effective after August 2017. Of course, sales after August 2017 are in the new zones, which at that time are operational. Appendix Table B2 shows sales transactions categorized into before the announcement, after the announcement and before the approval, after the approval and before the opening, and after the opening for both the properties' old and new school zones. Of the 10,610 houses sold in the old Bryan Station area during the years of study, 9,021 sales are within both the old and new Bryan Station zone while 841 sales occurred in the area to be redistricted to the Paul Dunbar High School and 6,870 sales were in the area to be in the proposed school (Frederick Douglass) zone. The second largest change was in the Henry Clay High School zone where 5,189 of the 8,788 sales were located in the Henry Clay area, 730 of the sales were in the Tates Creek zone and 1,516 transactions were in the zone of the proposed high school. Lafayette High School zone was subject to redistricting to both the Henry Clay and proposed high school zones, but with only a few sales in the latter (19, 52, and 89 sales after announcement, approval, and implementation). Similarly, only 11, 23, and 28 sales were in the area that was rezoned from Tates Creek to Henry Clay in these three stages. Therefore, we exclude Lafayette to the proposed high school (Frederick Douglass) and Tates Creek to Henry Clay for school-pair analyses.

4 The Data

4.1 Housing Data

Our housing price data comes from the Fayette County Property Valuation Administrator (PVA). These data include the general characteristics of all parcels matched to a sales data set. The sales data set records all transactions from January 2010 to August 2020. For each dwelling, we have its physical characteristics including the number of bathrooms, square footage, and exterior finish along with its transaction history (e.g., sale date, price, and sale type). We restrict our sample to the arm's length transactions of single-family residential houses. Columns (1) - (5) of Table 2 show the summary statistics of all houses in each school zone that were sold before the announcement of the redistricting. The Henry Clay and Paul Dunbar zones have the most expensive houses, but these houses also tend to be larger, have more bathrooms, and are more likely to have brick finishes. In contrast, Bryan Station has the least expensive and smallest houses. It is also worth noting that houses sold in Bryan Station on average are 3.6 miles from the high school, almost double the distance for houses in the Paul Dunbar and Tates Creek zones. In Figure 3, we plot the median price of sales for each school zone between 2010 and 2020. The ordering of median house prices across the high school areas is generally unchanged and the inflation-adjusted housing prices are relatively constant with the exception being in the Henry Clay zone where there have been significant price increases since 2011.

In columns (6) and (7) of Table 2, we divide sales into rezoned and non-rezoned groups. The t-statistics for the differences between the two groups are reported in column (8). While there are several statistically-significant differences in the housing characteristics in the two groups, only the differences in dwelling age (Age) and the distance to school are large in magnitude.

Columns (6) and (7) of Table 2 show the differences in housing characteristics across all boundary changes. However, these are not the appropriate comparisons to be made as in our empirical strategy we investigate each of the boundary changes separately. This being the case, in Table 3 we estimate the difference in housing attributes controlling for the original school fixed effect similar in spirit to the approach used in Billings, Brunner, and Ross (2018). As can be seen in the table, when controlling for the school, not surprisingly, the only statistically-significant difference between the two groups is the distance to the school.

4.2 Test Score Data

While our empirical strategy does not rely on school test scores or other measures of school quality to quantify school quality premiums, we follow much of the literature and obtain data on the mean ACT test score for each of the high schools between 2010 and 2019.[13] Following Dills (2004), we use mean ACT scores as a measure of school quality and examine its effect on property values. In Figure 4, we present the annual average ACT composite scores for each school by year. Bryan Station has significantly lower scores than the other high schools in all tested subjects. The other four schools have relatively similar scores except for a recent (post-2015) decrease in the scores of Tates Creek. We only have two years, 2018 and 2019, of ACT scores for Frederick Douglass and its scores are slightly above those of Bryan Station. Similar to the consistent differences in housing prices across high school zones in Figure 3, Figure 4 displays a similar pattern in ACT scores across high schools.

A possible concern with using ACT scores to measure school quality is the possibility of selection bias – the students taking the exam might not be a representative sample of all students in the school. As of the 2007-2008 school year all Kentucky juniors are required to take the ACT, dramatically reducing concerns about selection bias. Based on the school report cards we obtained, the percentage of students tested does not vary significantly across schools or years, with more

[13] ACT test scores are available from https://education.ky.gov/AA/Acct/Pages/Proficiency.aspx.

than ninety-eight percent of high school students in Fayette County taking the ACT during our sample period.

5 Empirical Strategy

5.1 A Multi-Period Difference-in-Differences Approach

We exploit a natural experiment arising from school boundary changes to examine the capitalization of school quality.[14] A "naive" approach would be using a difference-in-differences (DID) model to estimate the impact of changing school zone boundaries on housing prices. Letting $\ln P_{ijt}$ denote the log of sale price of house i in census tract j at time t, we estimate

$$\begin{aligned}\ln P_{ijt} =& \mathbf{X}_{it}\beta + \mathbf{Z}_{it}\delta + \phi Rezoned_i + \tau Post_{it} + \theta Rezoned_i \times Post_{it} \\ &+ \text{Elementary}_{it} + \text{Middle}_{it} + \zeta_j + \zeta_t + u_{ijt}.\end{aligned} \tag{1}$$

where $\mathbf{X}_{it}$ is a vector of housing attributes and $\mathbf{Z}_{it}$ represents locational amenities such as distance to parks, schools, and distance to urban service boundary. $Rezoned_i$ is a dummy variable indicating the treatment status of house i in census tract j that equals one if a house will be in a new school zone after redistricting is implemented – these are the "switchers." In Appendix Table B2, the comparison group is the diagonal representing house sales in areas that were not rezoned, the "non-switchers". The binary variable $Post_{it}$ that equals one if a house i sold in time t was after the implementation of the redistricting plan and equals zero if sold before. The term θ represents the effect of switching zones on housing prices and should be interpreted as the effect of all aspects of how schools affecting property values. Specifically, we have not included any separate measures of educational quality in (1). In Section 6.2 we consider how the redistricting affects the impact of current test scores on housing prices. To eliminate confounding factors, we include time-varying elementary and middle school fixed effects that reflect the current school assignment in each year. To absorb any aggregate shocks at the neighborhood level, we use census tract fixed effects ζ_j. The term ζ_t accounts for year and quarter fixed effects which capture the aggregate shocks and seasonal factors in the housing market.

The key identifying assumption of a difference-in-differences model is common trends. It implies that in the absence of rezoning, the potential log prices of houses in the treated group would have followed the same trend as log prices in the control group. Under this assumption θ will identify the average treatment effect on the treated. However, Figure 5 shows that properties sold in treatment areas started trending differently before the implementation of rezoning in 2017,

[14] Black and Machin (2011) and Machin (2011) provide a summary of major empirical approaches that deal with those issues, including regression discontinuity, instrumental variables, and difference-in-differences methods.

which is also supported by an inspection of an event-study graph in Appendix Figure A2 where we compare the difference in log sales between rezoned and non-rezoned homes relative to 2013. Regarding *DID* estimates, there might be concerns that some people have anticipated rezoning prior to its implementation (August 2017) and passage (June 2015) as the Fayette County Public Schools (FCPS) announced its intention to redraw school boundaries on April 29, 2014. If the boundary changes were anticipated, the coefficient on $Rezoned \times Post$, our measure of the impact of rezoning on housing prices, could be biased.

To address this concern, we use a multi-period difference-in-differences model adding two periods before the implementation of the plan.[15] The first is the post-announcement period containing sales between the day FCPS announced the rezoning process (April 29, 2014) and the day the plan was officially approved (June 3, 2015). The second is the post-approval period including sales between the day FCPS approved the plan and the day the new plan was implemented. Specifically, we define a new set of binary variables $Post_k$ indicating the period of a house sold at time k with $k = \{1, 2, 3\}$. $Post_1$ is equal to one if a house was sold after the announcement but before the approval; $Post_2$ is equal to one if a house was sold after the approval but before the plan was in effect; and $Post_3$ is equal to one if a house was sold after August 2017.

$$\begin{aligned} \ln P_{ijt} =& \mathbf{X}_{it}\beta + \mathbf{Z}_{it}\delta + \phi Rezoned_i + \sum_{k=1}^{3} \tau_k Post_{ik} + \sum_{k=1}^{3} \theta_k Rezoned_i \times Post_{ik} \\ &+ \text{Elementary}_{it} + \text{Middle}_{it} + \zeta_j + \zeta_t + u_{ijt} \end{aligned} \tag{2}$$

where θ_1 captures the premium of information received by home buyers between the day when FCPS announced that rezoning was to be considered and the approval date of the plan. The term θ_2 captures the "net" impact of approval of the rezoning plan. The term θ_3 captures the "net" impact of the plan after implementation. In the absence of an information effect, that is no anticipation of rezoning changes, we expect θ_1 to equal zero.[16]

In essence, we are looking at the same house before and after each time information of rezoning is updated including the announcement of the intent to rezone, the approval of rezoning, and the implementation of the approved plan though we are not using repeated sales as in Ries and Somerville (2010) but pooled cross-sections. Our identification comes from variations in both anticipated and realized school quality. As the quality of the existing high schools, at least as measured by ACT scores and funding, has not significantly changed during the time of our study,

[15] A more detailed examination of heterogeneous treatment effects in a multiple-period setting can be found in Callaway and Sant'Anna (2021). In our case, all the treated houses received treatment at the same time. For this reason, we believe our approach is not subject to their criticism.

[16] Even though we control for both year and quarter fixed effects in our specification, *Post* dummies will not be dropped because all three treatments happened in mid-year. The interpretation of *Post* however will be less intuitive since it captures within year time effect.

we are able to capture how rezoning affects housing prices through expectations of future school quality through approved, but not yet implemented, boundary changes. With the help of sales data post-implementation, we are also able to examine how people value school quality based on actual school quality. Our ability to estimate the impact of expected school quality cannot be addressed in studies focused on using contemporaneous test scores (or moving averages) to determine the extent that school quality is capitalized into housing prices.

Equation (2) implicitly assumes that rezoning has the same effect on housing prices regardless of the high school zone of a house before rezoning and its zone following rezoning. We address the possibility that the effect of rezoning depends on the change in high schools in two ways. First, we estimate a model that distinguishes between houses that are rezoning from lower-performing high schools to higher-performing ones, as measured by mean ACT, and those for which the reverse is true – a triple difference-in-difference. Second, we perform pair-wise comparisons of houses that were rezoned to a specific high school to those that were in the same pre-2017 high school zone and were not rezoned (for example: sales of houses that remain in Bryan Station vs. houses rezoned from Bryan Station to Frederick Douglass).

Finally, we relate sale prices to one measure of school quality or performance, mean school ACT score, following an extensive literature on the boundary fixed effect model. However, to highlight the possible effects of rezoned and its timing, we examine the relationship between property values and test scores along the school boundaries both prior to and following rezoning.

5.2 Identification and Interpretation

With our methodology and data, two important threats to the identification of causal results merit attention: 1) divergent pre-treatment trends for our treated and comparison groups (parallel trends) in difference-in-difference estimation; and 2) concerns about the exogeneity of school district boundaries.

Concerns about pre-treatment trends were discussed earlier. In our analysis, whether and when the parallel trends assumption applies is essentially a question of when the treatment(s), the effects of rezoning, occurs. As was seen in Figure 5, parallel trends are not maintained at the time when the rezoning plan is implemented (August 2017) but if treatment begins with the announcement of the rezoning plan, it does not indicate any significant divergence in trends in sales prices prior to the announcement (April 2014).[17]

Difficulties with boundary estimation, either following the boundary-fixed effect approach

[17] To further alleviate the concerns of differential trends prior to rezoning, we also test the difference in terms of the sales price gap between rezoned and non-rezoned areas in 2010 and 2013. The result in Appendix Table B3 shows there is no statistically-significant difference among the houses in the rezoned and non-rezoned areas in 2010 and 2013.

(Black, 1999) or regression discontinuity can arise for several reasons: 1) sorting along the border; 2) changes in other policies; and 3) boundaries not being drawn randomly.

As discussed in Section 2, Kane, Staiger, and Samms (2003) and Bayer, Ferreira, and McMillan (2007) provide nice demonstrations of significant demographic differences at school boundaries arising from sorting. These demographic differences may, in themselves, affect school quality and performance measures, in our case school mean ACT scores. As seen in Table 4 Panel A, the differences in the percentage of white along school boundaries have also been reduced along for all but two boundaries. Importantly, the difference in median income and percentage of white along the Bryan Station-Frederick Douglass border is statistically insignificant ($1,882 and 13.9%) and along the Henry Clay-Frederick Douglass border the differences are $7,780 and 11.6%. To give more perspective to the differences along the Henry Clay-Frederick Douglass border, the differences along the old Henry Clay-Bryan Station border were $9,804 and 11.7%. In addition, since our data are repeated cross-sections, we can account for time-invariant factors employing neighborhood (census tract) fixed effects, as in Dhar and Ross (2012) and Dachis, Duranton, and Turner (2012), for example. The school-level statistics also show that there is no evidence that the composition of students changed abruptly after the rezoning.[18]

As stated on the Fayette County School District website, the School Zoning committee "...involves parents, teachers, FCPS administrators, two school board members, a district Equity Council representative, a city planning official, a home builder, and other community stakeholders. The committee's meetings are open to the public, and community input is welcome throughout the process."[19] As this suggests, the assignment of school boundaries is not random for this and other reasons including balancing student populations across the schools. However, we note that while the high school boundaries are not "straight lines" as in Turner, Haughwout, and van der Klaauw (2014) with few exceptions they follow major corridors in the city rather than streets that are primarily residential.

Even though the parallel trend provides suggestive evidence that housing prices in rezoned areas and non-rezoned areas trended similarly prior to the announcement of the redistricting, it is still possible that the policy was targeting other dimensions in rezoned areas. To test the randomness of the new boundaries, we provide an exogeneity test of whether rezoned and non-rezoned areas differ significantly along the new boundaries in the period prior to 2014. Table 5 presents the results. Specifically, we compare housing prices, percent of white, percent of bachelor degree holders, and median household income on the two sides of new boundaries. All regressions control for boundary, school, and year fixed effects. Within a quarter mile from the new boundaries,

[18]Figure A3 presents the trend of the percentage of free and reduced lunch in each school and the percentage of nonwhite students.

[19]See https://www.fcps.net/zones.

prices of houses in rezoned areas are 6.9 percent higher than ones on the other side, but this difference is not statistically different. Rezoned areas have 4.7 percentage points fewer white households, 5.5 percentage points more bachelor's degree holders, and a negligible 74.9 dollar difference in household income. As we expand our sample to include further locations from the new boundaries, sale price differences become smaller but remain statistically insignificant. A similar pattern is also found for the percentage of white. The composition of education levels is relatively stable and the difference in median household income is reduced as distance to the boundary decreases.

6 Results

Our focus, again, is on the extent to which capitalization of these boundary changes may occur prior to their actual implementation, that is, how much of the capitalization occurs in anticipation of boundary changes and how much follows implementation. We begin with a discussion of the results from estimating Equation (2) with the entire sample to determine the average effect of being rezoned. We then discuss the results when Equation (2) is modified to distinguish between houses rezoned to higher-performing schools and those rezoned to lower-performing schools. Next, we examine how the impact of the rezoning may differ for different school pairs. We highlight what we find in all these cases – that timing matters but varies among the boundary changes.

The results of this *DID* estimation highlight the importance of the timing of rezoning on when capitalization occurs. To better understand how timing affects residents' valuation of school boundary changes, we extend the approach of Black (1999) that employs common school boundaries to eliminate unobserved neighborhood effects. We find that the approval of rezoning disrupts the relationship between current school quality, as measured by current ACT scores, and housing prices. Our results indicate ACT scores had a significant effect on housing prices prior to the announcement of rezoning and continued through the post-approval period. However, expected school quality, that is, the test scores for the area school effective in August 2017, affects property values for the period following the approval of rezoning and before its actual implementation.

6.1 The Effects of Rezoning on Property Values

6.1.1 Aggregate Rezoning Effects

Table 6 reports the results of the difference-in-differences estimation of the effect of rezoning across all boundary changes including the boundaries of existing schools and the opening of Frederick Douglass. As seen in Equation (2) we have rezoning separated into three distinct treatments corresponding to the announcement of the intent to redraw new boundaries *(PostAnnounce)*, the approval of the boundaries *(PostApprove)*, and the implementation of the boundaries and opening of Frederick Douglass *(PostOpen)*. Sales in the areas that experience changes in high school zones after the announcement of new boundaries are designated as treated. All specifications include controls for house characteristics, distances to parks, schools, and urban service boundaries, as well as elementary and middle school effects.

Column (1) of Table 6 includes all three treatment periods and aggregates all rezoned houses into a single treated group. The coefficient on *Rezoned* is not significantly different from zero in all specifications implying that, on average, houses in rezoned areas are not systematically higher in value than houses that are not rezoned. As houses could be rezoned to either a better-performing school or a lower-performing school, it is difficult to predict either the sign or magnitude of the coefficients of the interactions between $Rezoned$ and the three treatment periods ($Post_{-}$), average treatment effects across all rezoned houses. Thus, that these three coefficients are small and insignificant is not surprising.

The effect of rezoning on property values is likely to critically depend on the perceived quality of the high school to which a house is rezoned. Then to better understand how rezoning affects property values, we create a binary variable $BetterRezoned$ that equals one if a home was rezoned to a higher-ranking school based on the average ACT composite scores between 2010-2013. We interact this variable with each $Post_{-}$ variable to examine the effects of rezoning based on the direction of rezoning (to a higher-performing school or to a lower-performing one).

The results are shown in Column (2). We do not find significant appreciation for homes that are rezoned to a better-performing school relative to a house rezoned to a lower-performing school following the announcement of a potential rezoning as the estimate of $BetterRezoned \times PostAnnounce$ is not statistically different from zero. In contrast, during the approval period, houses rezoned to a better school will experience a 3.1 percent appreciation relative to houses that were rezoned to a lower-performing school and 3 percent relative to houses that were not rezoned.[20] This impact is large and significant compared to the announcement stage and the effect found in column (1). The interaction between $BetterRezoned$ and $PostOpen$ is still large and similar to the approval period, though with more noise.

In columns (3) - (5) we test to see if omitting or grouping different periods alters our estimate with the three distinct periods reported in column (2). Column (3) excludes the treatment of announcement, including the sales during this period into the pre-treatment. Column (4) further excludes the treatment of approval so that only sales following the rezoning are in the treatment period ($PostOpen$). Column (5) aggregates sales during the post-approval and post-opening as a

[20]The t statistic of $Rezoned \times PostApprove + BetterRezoned \times PostApprove$ is 2.05, indicating the better rezoning effect is salient.

single treatment period (*PostApproveOpen*).

Our results suggest that failure to account for different stages in the rezoning process will bias the results. The coefficient on $BetterRezoned \times PostApprove$ in column (3), where we included the announcement stage with pre-treatment, is 2.8 percent, almost 10% less than what we have in the full model. As seen in column (4), when the treated group includes only sales after implementation and sales during the announcement and approval periods are included in the pre-treatment period, the treatment estimate becomes even more attenuated, reducing it to 2.3 percent and making it insignificant. Interestingly, grouping post-approval and post-opening treatments yields no statistical difference between the two specifications in columns (2) and (5), justifying the approach in Ries and Somerville (2010) where they use approval as the treatment and when the gap between announcement and approval was relatively short.[21]

6.1.2 Disaggregating Rezoning

That we found weak evidence of any capitalization from rezoning when we aggregated sales across rezoning in all the high school zones is not surprising – while we estimated an average treatment effect from rezoning there is no reason to believe it is a uniform effect. The rezoning proposal involved every high school in Fayette County with some houses being rezoned from what are considered higher-performing schools to lower-performing schools while other properties were rezoned from lower-performing schools to higher-performing schools. As discussed later, there is a strong relationship between the mean high school ACT score and property value in that zone. While some of the rezoning involved rezoning to high schools with higher mean ACT scores such as part of the Bryan Station zone to Paul Dunbar (2010-2013 mean composite score of 18 for Bryan Station and 22 for Paul Dunbar) other rezoning resulted in houses rezoned to schools with lower mean ACT scores Henry Clay (mean score of 22) to Tates Creek (mean score of 20). To address the likelihood of heterogenous impacts of these boundary changes, we disaggregate them into rezoning pairs and run a separate difference-in-differences estimation for each pair of boundary changes. We also put corresponding changes in terms of rankings of schools based on ACT scores under each case for easier tractability for readers.

The results of these estimations are found in Table 7. Each column is a regression following Equation (2) using all sales from a single school (pre-2017) zone. Our focus is on the three interaction terms, the difference-in-differences estimate of housing price changes for houses in rezoned areas post-announcement, approval, and new school opening. Inspection of the coefficients across the columns does indeed indicate heterogeneous impacts of rezoning with the

[21] While we do not find a statistically-significant effect on average housing price, we do find that housing sales in rezoned areas increased relative to non-rezoned areas and these increases occurred prior to and following implementation of the boundary changes. The results are in Appendix Table B4.

most pronounced effects being appreciation for houses rezoned to the proposed school (Frederick Douglass). Columns (1) and (3), respectively, show the effect of being rezoned to the proposed school for houses previously in the zones for Bryan Station and Henry Clay. Following announcement there was no statistically-significant change in housing prices in either zone reassigned to Frederick Douglass. Following approval, properties rezoned from Bryan Station to Frederick Douglass increased by a statistically-insignificant 2.2 percent while those rezoned from Henry Clay depreciated by 0.8 percent, which was also statistically-insignificant. The most significant impact for the proposed school happened in the $PostOpen$ stage where homes rezoned from Bryan Station zone to Frederick Douglass had a 4.8 percent increase in prices while, in contrast, homes rezoned from Henry Clay saw a dramatic 6.6 percent decrease in prices. Given that the proposed school had limited information available to home buyers, it is not surprising to see insignificant effects prior to the opening. Once it was opened with more information on school quality, diverging effects emerged for the two original school zones.

Confirming our expectations about school quality of the respective high schools, being rezoned from Bryan Station to Paul Dunbar results in a 1.6, 2.8, and 11.4 percent increase in housing price relative to non-switchers in Bryan Station in the three periods. Moving from Lafayette to Henry Clay leads to a 7.7, 5.0, and 3.1 percent increase as well. Only rezoning from Henry Clay to Tates Creek and from Paul Dunbar to Lafayette show a negative net impact in the post-approval period, consistent with the differences in test scores between these schools.

In addition to the magnitude of capitalization from this rezoning, the timing of the capitalization merits discussion as well. From Table 7 we see that significant capitalization occurs early – following the announcement of rezoning there was statistically-significant capitalization in three of the six rezoned boundaries. It seems puzzling that people in Lafayette and Paul Dunbar reacted to an uncertain boundary change so early as no information about the rezoning was available at this time. However, further analysis shows it is quite possible people had prior information on rezoning. Figure 6 presents a magnified map focusing on Lafayette to Henry Clay rezoning. The old school zones were covered by light and dark blue colors, and the boundaries after rezoning were drawn by solid black lines. It is apparent that the southeast corner of Lafayette was the only part on the shared boundary that is cut into the new Henry Clay zone. No sales were possible in the area above this corner as it is a university campus. In addition, the old boundary was overlapped with Tates Creek Road and the new boundary overlapped with Nicholasville Road, another major road in Lexington. To understand the odd estimate for Paul Dunbar, as shown in Appendix Table B5, we control for the fact that much of the rezoned area is within 0.35 miles from the Lafayette-Dunbar border. By doing so, we find that this result disappears – there is no significant appreciation in the rezoned areas during the announcement period.

6.1.3 Discussion: Expectation versus Implementation

The importance of how policy expectations, rather than simply implementation, affect housing prices can be seen by comparing the estimation results in Table 7 to the results found in Table 8, Panel A, a set of "naive" regressions in which the only treatment is the implementation of the rezoning (*PostOpen).* If we compare the coefficients on $Rezoned \times PostOpen$ for the respective samples in Table 7 to those found in Table 8 we see a pattern of attenuation – smaller coefficients (in absolute value) and fewer significant results. This result is not surprising as sales in the rezoned (treated) areas following the announcement of the rezoning proposal and prior to its implementation are now part of the comparison group rather than another treatment – for the entire sample, sales during this period comprised 38 percent of the comparison sample. Then, as seen in Table 7, these sales had appreciation (or depreciation) of equal or greater magnitudes to that found after opening any comparison that includes these sales tends to bias the coefficient on $Rezoned \times PostOpen$ towards zero in Table 8. As can be seen in Table 8, Panel B, this attenuation is exacerbated when there is a higher percentage of sales incorrectly placed in the pre-treatment phase that should be considered in the post-approval treatment.

These results are also consistent with Cheshire and Sheppard (2004), where it is argued that uncertainty plays an important role in determining expected school quality and hence expected housing value. Because both the quality of a school could change and boundaries could be redefined, home buyers face uncertainty. Cheshire and Sheppard (2004) estimates show that for houses located in periphery areas with new construction the value of educational quality is discounted by more than forty percent relative to houses in other parts of the city. That the houses previously in the Bryan Station and Henry Clay school zones rezoned to the proposed saw little changes in sales prices during the approval period contrasts with the significant changes in sales prices found during the approval period for houses rezoned between existing schools. This finding is consistent with the possibility of more uncertainty about the quality of education in the proposed school. After the new school, Frederick Douglass, opened and there was more information about it, there is significant capitalization.

6.2 Test Scores, Capitalization, and The Timing of Rezoning

One explanation for the effect of rezoning on property values reported in Table 7 is the change in expected school quality for those houses scheduled to be rezoned. As discussed in Section 2, a frequently used measure of school quality in the literature is school test scores. In the case of Kentucky high schools the test used is the ACT, required for all students after 2007. The relationship between housing prices and ACT scores is summarized in Figure 7. The scatter plot of the annual median sale price and average ACT score shows a clear, if noisy, positive correlation between the two. To better understand the impacts of rezoning on property values, we next estimate the relationship between test scores (ACT) and property values. Our particular interest is on how the impact of test scores on property values may differ throughout the rezoning process.

We follow Black (1999), among others and use a boundary fixed effect approach to isolate the effects of school quality on property values from other shared amenities along school boundaries. There are seven shared boundaries between high schools in Fayette County. These bordered pairs capture those unobserved characteristics within a neighborhood. As we have a repeated cross-section following Dhar and Ross (2012) and Dachis, Duranton, and Turner (2012), we include fixed effects for each school/border to control for sorting and resulting demographic differences along school boundaries (Bayer, Ferreira, and McMillan, 2007). As discussed in Section 5.2 concerns about sorting and unobserved differences in populations along the school boundaries are reduced both because we have a repeated cross-section and the fact that the borders we use were announced only in 2015 and implemented in 2017.

We estimate separate repeated cross-sectional regressions using observations within 0.35 miles from the common boundary for sales for three separate periods: 1) before the approval of rezoning; 2) between the approval and implementation of rezoning; and 3) after the implementation. For the periods prior to the approval of the rezoning plan and following its implementation we use the ACT score for the high school to which the property is zoned. However, for the period between approval of the plan and its implementation (June 2015 - August 2017) the appropriate measure of ACT is not obvious for those properties to be rezoned in 2017 – should it be their current high school or their high school effective in 2017? For this reason, we estimate two regressions for this period with one using the current ACT and one using the expected ACT, that is, the ACT score of the 2017 high school. We express our estimating equation as a simple cross-sectional hedonic in which, as mentioned, the sample is restricted to sales within 0.35 miles of the seven boundaries and run separately for sales prior to and after the June 2015 approval of rezoning.

In Column (1) of Table 9 we report coefficient estimates when we include all sales within Fayette County and do not control for demographic variables while in column (2) we include percent Black, percent Hispanic, and median household income to account for residential sorting. In general, we find that before the rezoning proposal, increases in ACT composite test scores increase housing prices. In contrast to Bayer, Ferreira, and McMillan (2007) among others, the coefficient we estimate on test scores controlling for boundary fixed effects is not statistically different from when we control for demographics.

Panel B shows the estimates where we use sales after approval but before implementation of the rezoning plan with current school ACT scores. The valuation of school quality appears unchanged as a one-point increase in ACT scores continues to lift housing prices by 2.5 percent.

However, the results found in Panel C,[22] where the current high school ACT score is replaced with the ACT score for the 2017 high school for rezoned properties, serve as a striking contrast to the results in Panel B. Coefficients on the ACT scores in Panel C are all significant and of magnitudes almost doubled as those found in Panel A and B. That current high school ACT score during the approval period had little impact on housing prices (Panel B) but the scores of the future high school had a large and significant impact (Panel C) strongly suggesting that home purchasers knew of rezoning plans and considered them and their implications on future school quality when purchasing for housing. Finally, we conduct similar analyses but with the new boundaries in panels D through F. We do not find significant impacts of test scores on hypothetical boundaries for sales before the approval. Using current school test scores along the new boundaries attenuates the impact by about 30% though not statistically significant. Nonetheless, it is still an economically large impact as we replace the current school with the expected school test scores and the effect of ACT on house values increases to 1.9 percent, almost a 50% increase compared to 1.3 percent in Panel D.

Relevant to correctly interpreting the results of how people value the quality of existing schools and future schools, given that school demographics did not change abruptly and sales prices reflect the valuation of the properties by new buyers outside the current zones, changes in the quality of future students are likely to be minor and have limited influence on current ACT scores. We also conducted a robustness check controlling for school demographics of the percentage of free and reduced lunch and the percentage of nonwhite students, the results are quantitatively similar to Table 9.

7 Conclusion

Using the process of school rezoning in Fayette County, Kentucky, we are able to identify the changes in housing values from switching from one school zone to another. In our study, our estimates suggest that the prices of homes rezoned increased by one percent on average after the approval of the rezoning plan, but the extent of appreciation differs across rezoning pairs. Houses in the lowest-performing school (as measured by ACT scores) that are rezoned to the new school appreciate by 4.8 percent relative to houses there that are not being rezoned, equivalent to a price increase of $8,048 using the mean price of the original zone. As well, following Black (1999) we estimate a boundary fixed effect model to examine the impact of test scores on house prices and find that changes in boundaries disrupt existing valuation of school quality near the boundaries after the approval of rezoning.

[22] Sales in old Bryan Station but in new Frederick Douglass are not included because no test scores data are available.

In contrast to existing studies examining the effect of educational reform on housing prices, we consider the possibility that the timing of these effects differs among stages in the policy process – the announcement of a policy reform, its approval, and, finally, its implementation. We find that residents update their beliefs and anticipate the policy in their housing decisions – changes in housing prices occur before the policy reform is implemented. Evidence of this can be seen by differences in the impact of school quality on property values for houses to be rezoned when we use the test scores for their current schools and their future schools during the approval period.

While we are examining a specific type of policy reform in education, high school rezoning, in a single school district (Fayette County, KY), that we find the effects of this reform on housing prices occurs before the policy is implemented is consistent with studies examining anticipatory behavior in environmental policy (Kiel and McClain, 1995; Somerville and Wetzel, 2022), labor policy (Malani and Reif, 2015), and welfare policy (Blundell, Francesconi, and van der Klaauw, 2011). We find, like these other studies, that failure to consider the possibility of anticipatory behavior can bias estimates of the treatment effects. Future studies examining the effects of educational and other policies on housing markets might be well advised to address the possibility of these anticipatory effects in their experimental framework.

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8 Figures

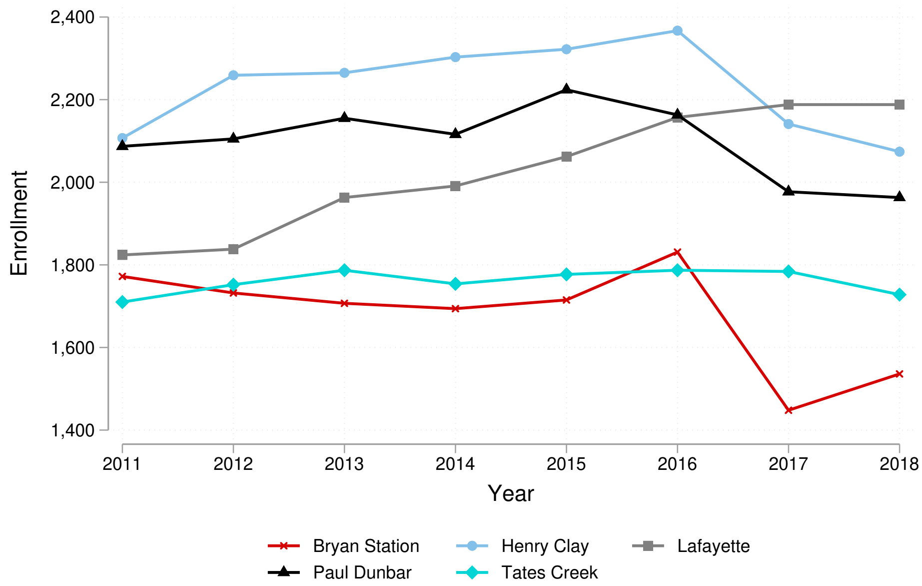


Figure 1: Annual Enrollment in Fayette County High Schools

Notes: This figure plots the annual enrollment for the five public high schools in Fayette County, KY. Data is downloaded from the School Report Card from Kentucky Department of Education.

Figure 2: Change in High School Catchment Area Boundaries

Notes: This figure shows the map for Fayette County public high schools attendance boundaries. We overlap the old boundaries and the new boundaries under the redistricting plan. The shape file is obtained from Lexington-Fayette Urban County Government (LFUCG) Lexington's Data Hub.

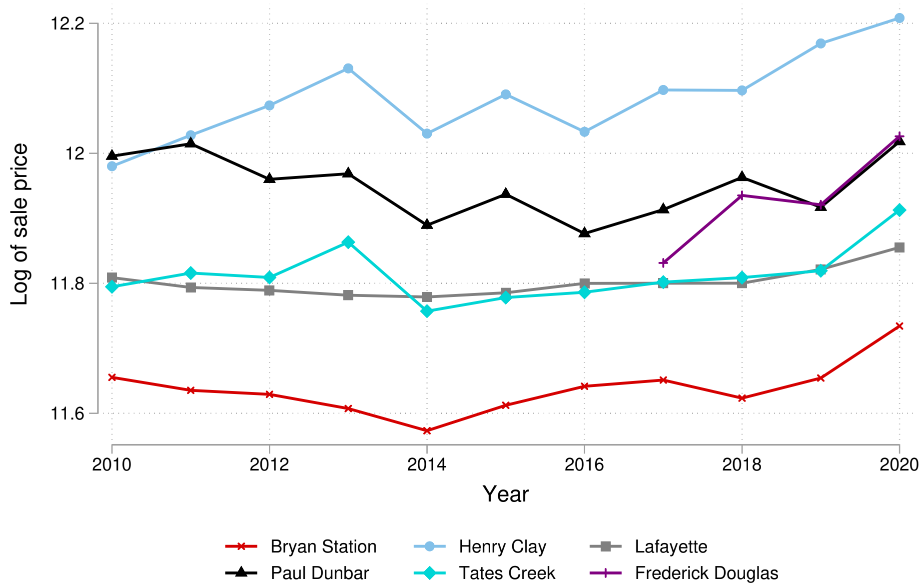


Figure 3: Median House Prices by High School Catchment Area and Year

Notes: This figure plots the median house prices for each public high school between 2010 and 2020. Price data are adjusted by the US Urban Housing CPI.

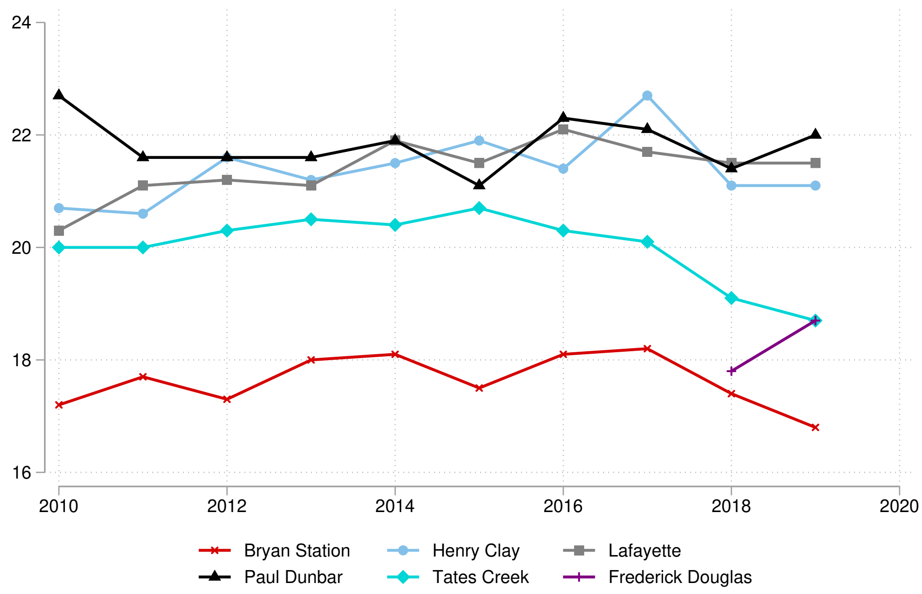


Figure 4: ACT Composite Scores by High School Catchment Area and Year

Notes: This figure plots the ACT composite scores for each public high school between 2010 and 2019. ACT scores are from the Kentucky Department of Education School Report Card.

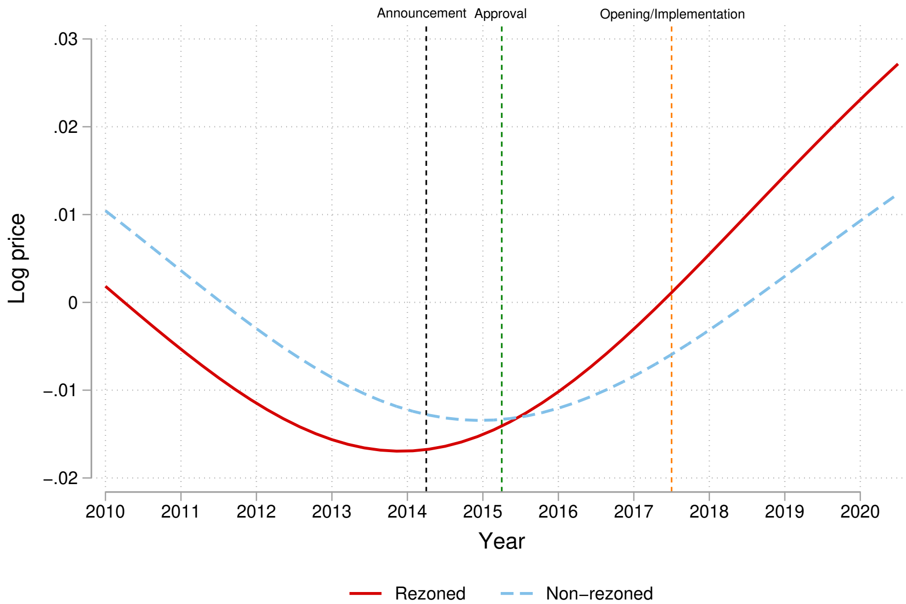


Figure 5: Sales Price Trends for Rezoned and Non-rezoned Groups

Notes: This figure compares the trend of log sales prices in rezoned areas and non-rezoned areas. Houses sold in areas that are subject to rezoning are in rezoned group and houses that are not subject to rezoning in included in the non-rezoned group. We regress log sales prices on house attributes first and then obtain the residuals. We next use local polynomial regressions to smooth the quarterly residuals.

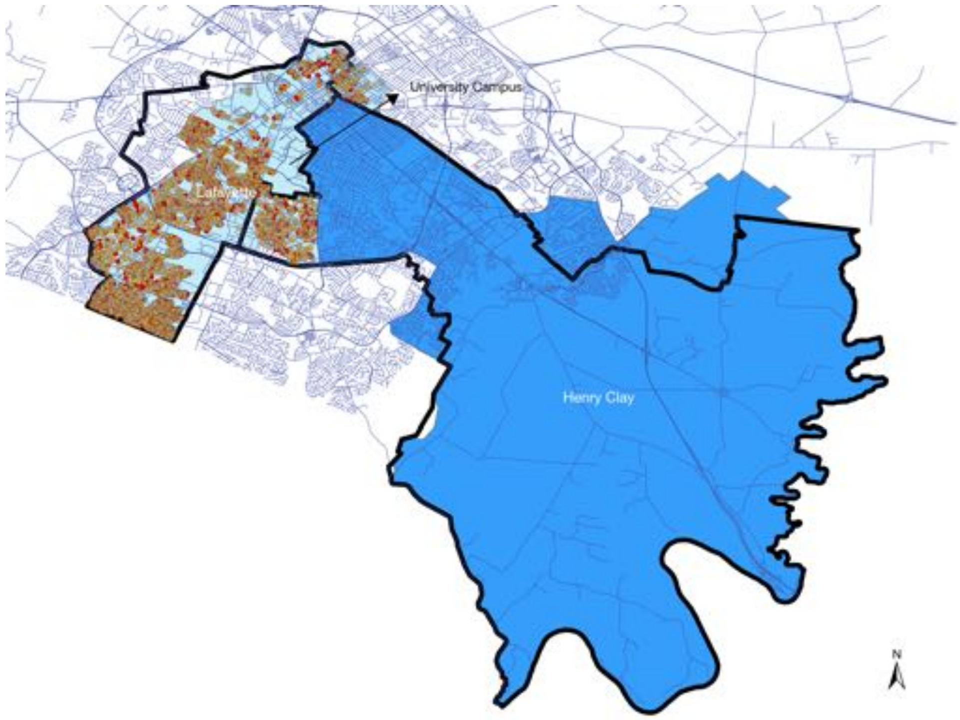


Figure 6: Lafayette to Henry Clay Redistricting

Notes: This map shows the rezoning of Lafayette to Henry Clay. We also overlap the school zones with major roads and sales points in Lafayette. Colored regions represent pre-rezoning school zones where solid black lines draw the post-rezoning school boundaries. Red, orange, and grey dots represent sales that happened in the post-announcement, post-approval, and post-opening stages in the old Lafayette zone. Data are from the Kentucky Department of Education School Report Card.

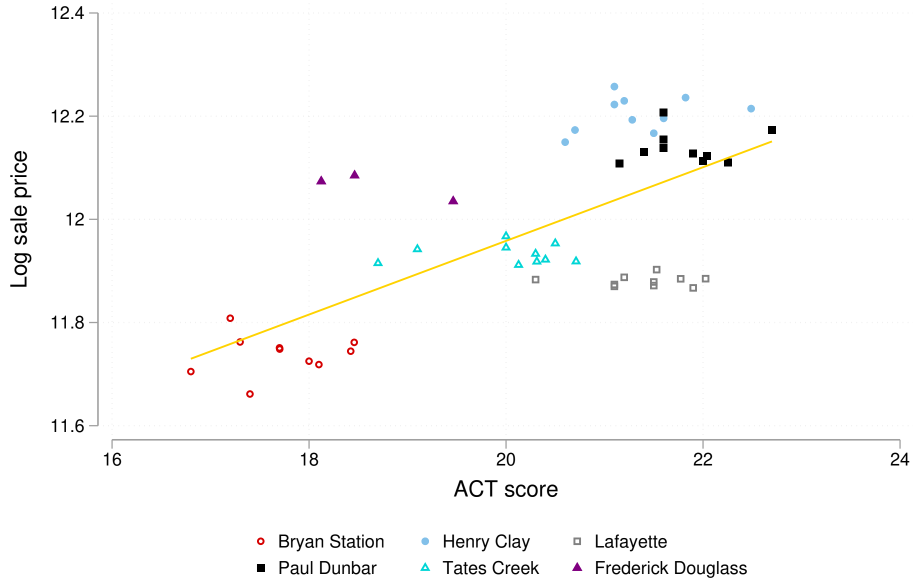


Figure 7: Scatter Plot of Mean Price and Composite ACT Score by High School and Year

Notes: This figure shows the scatter plot of the mean house price and composite ACT score. Each data point represents a school-year observation.

9 Tables

Table 1: Timeline for Planning and Implementation of Rezoning

(1) Date	(2) Event	(3) Treatment
April 29, 2014	Announce Plan to Redistrict/Add School	
April 14, 2015	Present Plan to Board/Public	Announcement
April 21, 2015	Board Meets to Get feedback	
June 3, 2015	Approve Plan	Approval
August 16, 2017	Open Fredrick Douglass and Implement New Zones	Opening

Notes: This tables shows the timeline of the rezoning process. The data is obtained from Fayette County Public Schools.

Table 2: Summary Statistics, Pre-Treatments (2010 - April 2014)

	(1) Bryan Station	(2) Henry Clay	(3) Lafayette	(4) Paul Dunbar	(5) Tates Creek	(6) Rezoned	(7) non-rezoned	(8) *t*-statistic	(9) All Sales
Sale price	127688.4	197033.7	143501.7	191757.6	154319.2	156511.2	159853.1	1.79	159016.0
	(58925.7)	(105125.6)	(54947.1)	(104262.3)	(70270.7)	(81005.6)	(84573.8)		(83703.0)
Log sale price	11.68	12.06	11.81	12.03	11.86	11.86	11.87	1.15	11.87
	(0.373)	(0.525)	(0.352)	(0.519)	(0.410)	(0.436)	(0.463)		(0.457)
Square footage	1653.8	1959.5	1664.8	2017.4	1838.1	1784.0	1808.6	1.67	1802.4
	(528.8)	(730.0)	(523.8)	(790.2)	(675.8)	(623.5)	(667.6)		(656.9)
Log square footage	7.365	7.510	7.373	7.535	7.450	7.431	7.437	0.70	7.435
	(0.295)	(0.379)	(0.296)	(0.386)	(0.365)	(0.327)	(0.353)		(0.347)
Age	0.191	0.359	0.401	0.299	0.244	0.243	0.312	12.92	0.294
	(0.197)	(0.282)	(0.269)	(0.181)	(0.134)	(0.209)	(0.244)		(0.238)
Stories	1.397	1.473	1.342	1.431	1.443	1.400	1.419	1.85	1.414
	(0.451)	(0.446)	(0.428)	(0.463)	(0.471)	(0.451)	(0.454)		(0.453)
No. full bath	1.923	1.979	1.743	2.089	1.978	1.994	1.908	-5.91	1.929
	(0.520)	(0.727)	(0.582)	(0.853)	(0.607)	(0.640)	(0.660)		(0.656)
All brick	0.181	0.458	0.433	0.536	0.346	0.343	0.379	3.26	0.370
	(0.385)	(0.498)	(0.496)	(0.499)	(0.476)	(0.475)	(0.485)		(0.483)
Urban	0.985	0.992	1	0.984	1	0.992	0.992	0.24	0.992
	(0.122)	(0.0869)		(0.127)		(0.0904)	(0.0878)		(0.0885)
Distance to school	3.574	2.258	2.141	1.711	1.700	3.267	2.129	-36.19	2.414
	(1.722)	(1.238)	(1.243)	(1.045)	(0.721)	(1.304)	(1.439)		(1.490)
Distance to park	0.372	0.363	0.333	0.334	0.282	0.360	0.335	-3.95	0.341
	(0.341)	(0.253)	(0.197)	(0.390)	(0.177)	(0.282)	(0.283)		(0.283)
Distance to USB	0.827	1.645	1.664	0.666	0.997	1.237	1.163	-3.38	1.182
	(0.662)	(1.236)	(1.037)	(0.590)	(0.612)	(0.850)	(1.010)		(0.973)
Observations	2,856	2,233	2,239	1,467	1,856	2,668	7,983		10,651

Notes: This table shows summary statistics of major variables for houses sold before the approval of the rezoning. Standard deviations are in parentheses. Sale prices are adjusted by U.S. urban housing inflation deflator. House age is measured in a hundred years. Stories refer to the number of stories a house has. No. full bath refers to the number of full bathrooms. All brick is a dummy representing whether a house is an all-brick house. Urban is a dummy indicating whether a house is located inside the urban service boundary. Distance to school measures the minimum distance to the actual catchment area school. Distance to park and USB are referring to the minimum distance to the nearest park and urban service boundary.

Table 3: Differences in House Attributes, 2010 - April 2014

	(1) Log price	(2) Log square footage	(3) Age	(4) Stories	(5) No. full bath	(6) All brick	(7) Urban	(8) Dist to school	(9) Dist to park	(10) Dist to USB
Rezoned	0.049	0.017	-0.038	-0.022	0.095	0.043	0.005	0.613*	-0.002	0.206
	(0.129)	(0.072)	(0.091)	(0.086)	(0.179)	(0.100)	(0.003)	(0.280)	(0.059)	(0.496)
Observations	10,651	10,651	10,651	10,651	10,651	10,651	10,651	10,651	10,651	10,651
R^2	0.104	0.041	0.123	0.011	0.032	0.070	0.007	0.269	0.013	0.187

Notes: This table shows differences in major house attributes for sales prior to 2014. Robust standard errors are clustered at the school level. Dist to school measures the minimum distance to the actual catchment area school. Dist to park and USB are referring to the minimum distance to the nearest park and urban service boundary. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Demographics along New and Old School Boundaries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. 2010-2015 (Pre-Approval)	Bryan Station Henry Clay	Bryan Station Lafayette	Lafayette Tates Creek	Henry Clay Lafayette	Henry Clay Tates Creek	Lafayette Paul Dunbar	Bryan Station Paul Dunbar	
White	0.117***	-0.207***	0.029*	-0.168***	-0.085***	-0.049***	-0.085***	
	(0.007)	(0.022)	(0.015)	(0.022)	(0.007)	(0.008)	(0.019)	
Median household income	9,804.464***	-4,712.725***	-25,573.239***	9,959.761***	-1,793.431	6,689.403***	-31,702.515***	
	(1,461.960)	(682.589)	(1,354.408)	(2,209.923)	(1,659.993)	(1,663.063)	(1,148.657)	
B. 2016 (Post-Approval)	Bryan Station Frederick Douglass	Bryan Station Lafayette	Lafayette Frederick Douglass	Henry Clay Lafayette	Henry Clay Tates Creek	Lafayette Paul Dunbar	Bryan Station Paul Dunbar	Henry Clay Frederick Douglass
White	-0.139***	-0.003	-0.315***	0.062***	-0.079***	-0.079***	-0.131***	-0.116***
	(0.047)	(0.096)	(0.025)	(0.009)	(0.007)	(0.020)	(0.017)	(0.015)
Median household income	1,882.091	-2,725.750***	3,504.167***	8,474.734*	-1,713.645	12,543.243***	-13,287.817***	-7,780.134**
	(3,347.690)	(854.059)	(314.930)	(4,426.606)	(1,384.580)	(3,825.862)	(1,745.883)	(3,675.002)

Notes: This table reports the mean differences in the percent of white and median household income of census tracts on the two sides of school-paired borders using ACS 5-year data. The sample consists of houses located within 0.25 miles from the boundary. Panel A reports the differences along the old boundaries and Panel B reports the differences in 2016 along the new boundaries. The difference is using the latter school subtracting the former. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Exogeneity Test: Differences of Sale Price and Demographics along New School Boundaries

	(1) Log price	(2) White	(3) Bachelor	(4) Median income
A. 0.25 mile				
Rezoned	0.069	-0.047	0.055	74.921
	(0.104)	(0.024)	(0.043)	(8,504.608)
Observations	1,898	1,898	1,898	1,898
R^2	0.247	0.553	0.529	0.409
B. 0.5 mile				
Rezoned	0.056	-0.030	0.066	-3,171.243
	(0.123)	(0.024)	(0.046)	(10,272.591)
Observations	4,178	4,178	4,178	4,178
R^2	0.206	0.497	0.474	0.303
C. 0.75 mile				
Rezoned	0.005	-0.015	0.060	-3,615.671
	(0.154)	(0.028)	(0.048)	(11,019.697)
Observations	6,094	6,094	6,094	6,094
R^2	0.209	0.463	0.428	0.273

Notes: This table reports the results of our exogeneity test of random boundaries. Each column shows the mean difference for houses in rezoned areas compared to houses that stay in the original school zones in terms of sale prices, census tract level percent of white, percent of bachelor's degree holders, and median household income. The sample consists of houses located within 0.25, 0.5, and 0.75 miles from the boundary. Robust standard errors are clustered at the old school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Rezoning Effects for All Sales

	(1)	(2)	(3)	(4)	(5)
	All treatments	All treatments	Approval & opening	Only opening	Approval & opening grouped
Rezoned	0.074	0.085	0.083	0.080	0.083
	(0.059)	(0.060)	(0.061)	(0.061)	(0.060)
PostAnnounce	0.007	0.008			
	(0.006)	(0.006)			
PostApprove	0.022**	0.021**	0.014**		
	(0.010)	(0.010)	(0.007)		
PostOpen	0.012	0.012	0.004	-0.012*	
	(0.011)	(0.012)	(0.010)	(0.007)	
PostApproveOpen					0.014**
					(0.007)
Rezoned × *PostAnnouce*	-0.003	-0.010			
	(0.010)	(0.010)			
Rezoned × *PostApprove*	0.009	-0.010	-0.007		
	(0.009)	(0.012)	(0.011)		
Rezoned × *PostOpen*	0.015	-0.008	-0.006	-0.003	
	(0.019)	(0.023)	(0.024)	(0.024)	
Rezoned × *PostApproveOpen*					-0.007
					(0.013)
BetterRezoned × *PostAnnouce*		0.011			
		(0.016)			
BetterRezoned × *PostApprove*		0.031**	0.028**		
		(0.014)	(0.012)		
BetterRezoned × *PostOpen*		0.038	0.035	0.023	
		(0.025)	(0.025)	(0.025)	
BetterRezoned × *PostApproveOpen*					0.031**
					(0.015)
Observations	35,773	35,773	35,773	35,773	35,773
R^2	0.861	0.861	0.861	0.861	0.861

Notes: This table shows the results using different specifications of treatment and timing of shocks. Column (1) uses all three treatments. Column (2) shows the results of where we interact difference-in-differences estimators with a dummy *BetterRezoned* indicating that the rezoned future school is better than the old school. Columns (3) through (5) follow the specification in column (2) with different treatments. Column (3) does not account for announcement shock. Column (4) only uses opening shock. Column (5) groups approval and opening together. All regressions control for log square footage, building age and age square, number of stories, number of full baths, all-brick dummy, urban dummy, distance to school, distance to park, distance to urban service boundary, and elementary and middle school time varying effects. Census tract, year, and seasonal fixed effects are also included. Robust standard errors are clustered at the census tract level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Rezoning Effects by School-Pair

	(1) Bryan Station to Frederick Douglass (6)⟶(5)	(2) Bryan Station to Paul Dunbar (6)⟶(1)	(3) Henry Clay to Frederick Douglass (2)⟶(5)	(4) Henry Clay to Tates Creek (2)⟶(4)	(5) Lafayette to Henry Clay (3)⟶(2)	(6) Paul Dunbar to Lafayette (1)⟶(3)
$Rezoned \times PostAnnouce$	0.008	0.016	0.001	-0.019*	0.077***	-0.050***
	(0.013)	(0.010)	(0.014)	(0.011)	(0.013)	(0.012)
$Rezoned \times PostApprove$	0.022	0.028**	-0.008	-0.050***	0.050***	-0.008
	(0.014)	(0.013)	(0.014)	(0.013)	(0.009)	(0.013)
$Rezoned \times PostOpen$	0.048*	0.114***	-0.066***	-0.058	0.031**	-0.007
	(0.026)	(0.023)	(0.016)	(0.058)	(0.014)	(0.026)
Observations	9,767	6,442	6,705	5,919	6,595	4,621
R^2	0.854	0.815	0.873	0.881	0.733	0.906
Non-rezoned	5,601	5,601	5,189	5,189	5,830	3,680
Rezoned	4,166	841	1,516	730	765	941

Notes: This table reports estimates based on Equation (2). High school rankings by average ACT score are listed in parentheses. Each column shows a separate regression using sales only from one old school catchment area. Independent variables and fixed effects follow Table 6. Robust standard errors are clustered at the census tract level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Rezoning Effects by School-Pair with Opening Treatment

	(1) Bryan Station to Frederick Douglass (6)⟶(5)	(2) Bryan Station to Paul Dunbar (6)⟶(1)	(3) Henry Clay to Frederick Douglass (2)⟶(5)	(4) Henry Clay to Tates Creek (2)⟶(4)	(5) Lafayette to Henry Clay (3)⟶(2)	(6) Paul Dunbar to Lafayette (1)⟶(3)
Panel A: 2010-2020						
$Rezoned \times PostOpen$	0.034	0.099***	-0.061***	-0.027	0.001	0.005
	(0.027)	(0.019)	(0.015)	(0.056)	(0.014)	(0.031)
Observations	9,767	6,442	6,705	5,919	6,595	4,621
R^2	0.853	0.815	0.873	0.880	0.732	0.906
Panel B: 2013-2020						
$Rezoned \times PostOpen$	0.025	0.083***	-0.062***	-0.003	-0.015	0.017
	(0.027)	(0.021)	(0.017)	(0.055)	(0.013)	(0.033)
Observations	8,107	5,392	5,426	4,810	5,218	3,666
R^2	0.857	0.819	0.875	0.882	0.732	0.905

Notes: This table shows the results using only post-opening treatment as compared to Table 7. All specifications follow Table 7. Robust standard errors are clustered at the census tract level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

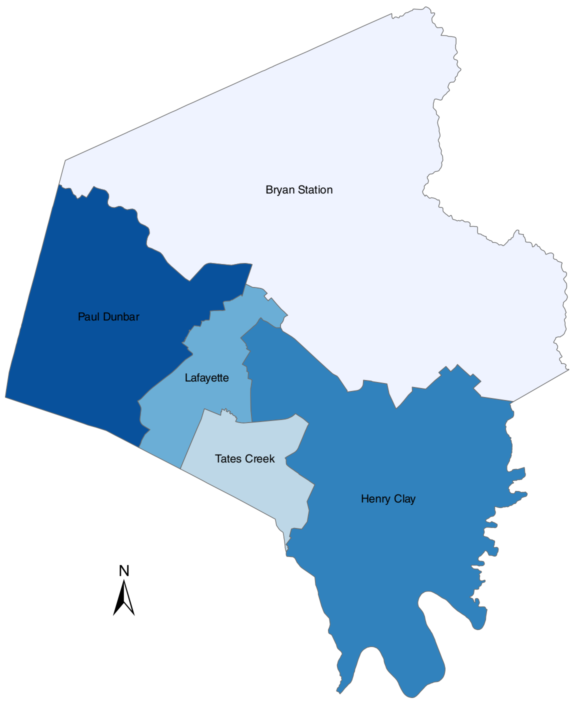
Table 9: ACT Scores and Housing Prices, Boundary Fixed-Effect Estimates

	(1) Excluding demographics	(2) Including demographics
Old Boundary		
A. Before approval		
ACT	0.024*	0.023**
	(0.013)	(0.011)
Observations	4,314	4,314
B. After approval & before opening (current school ACT score)		
ACT	0.025**	0.025**
	(0.010)	(0.012)
Observations	2,790	2,790
C. After approval & before opening (expected school ACT score)		
ACT	0.041***	0.045***
	(0.009)	(0.010)
Observations	2,169	2,169
New Boundary		
D. Before approval		
ACT	0.011	0.013*
	(0.008)	(0.007)
Observations	4,234	4,234
E. After approval & before opening (current school ACT score)		
ACT	0.009	0.009
	(0.012)	(0.011)
Observations	2,758	2,758
F. After approval & before opening (expected school ACT score)		
ACT	0.016	0.019
	(0.014)	(0.015)
Observations	2,293	2,293

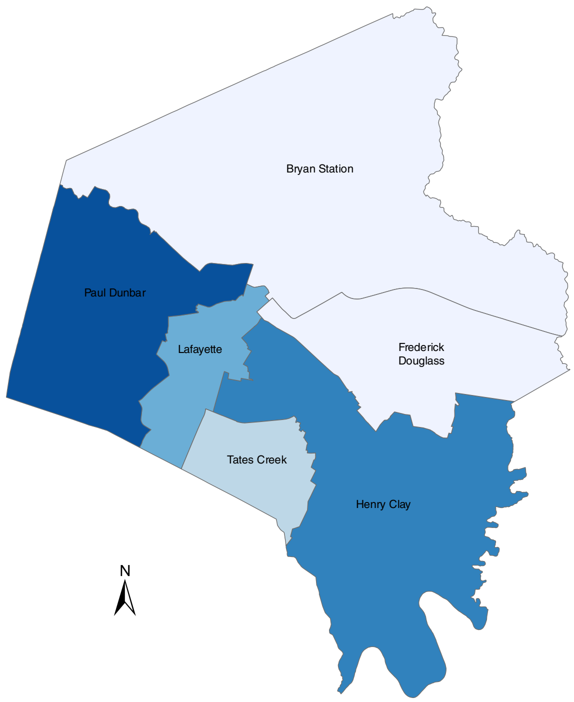
Notes: This table shows test score effects within 0.35 miles of school boundaries. The first three panels define boundaries based on old boundaries. The last three panels define boundaries based on new boundaries. Panel A and D use sales prior to the approval of redistricting plan. Panel B and E use sales between the approval day and the implementation day of the rezoning plan. For these panels, the scores we use are current school ACT scores. Panel C and F use the same sample following B and E but with expected future school ACT scores after approval. The dependent variable is log sale price. We include high school boundary fixed effects, elementary and middle school time varying effects, and year and seasonal fixed effects. Robust standard errors are clustered at the census tract level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendices

A Additional Figures



(a) Old School Attendance Zones



(b) New School Attendance Zones

Figure A1: Pre-Approval (Old) and Post-Approval (New) Fayette County High School Catchment Areas

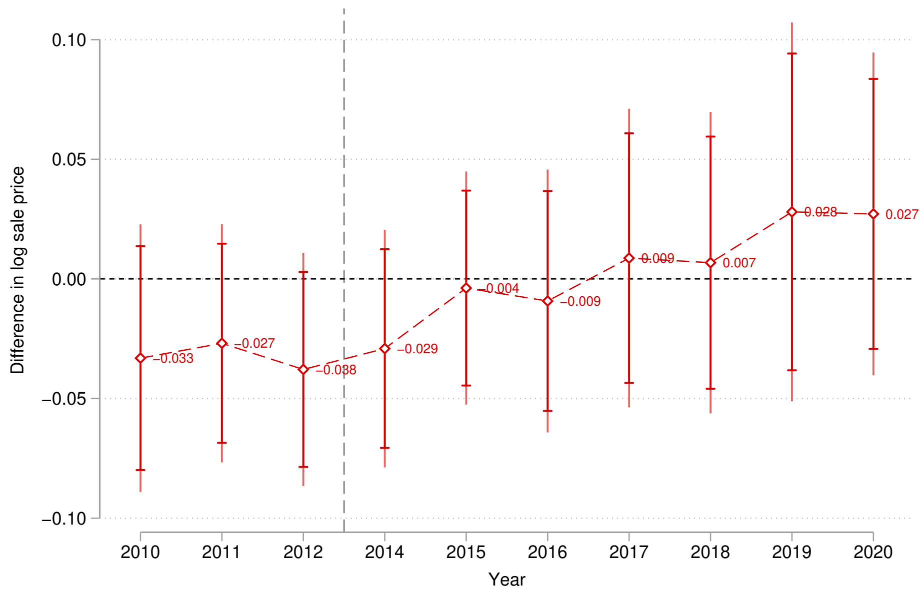


Figure A2: Parallel Trend Test

Notes: This figure plots the event-study style parallel trend test of the difference in log sale price between rezoned and non-rezoned homes relative to 2013.

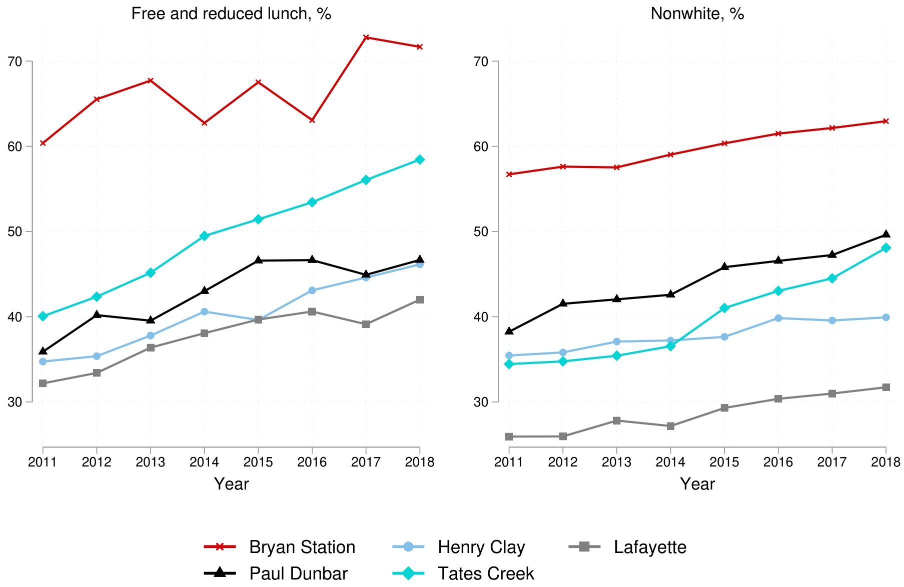


Figure A3: School Characteristics

Notes: This figure plots the percentage of students that are taking free and reduced lunch (left panel) and the percentage of students that are nonwhite (right panel) in each high school.

B Additional Tables

Table B1: Percent of Rezoned Homes by High School

	(1) Percent of rezoned homes
Bryan Station	39.87%
Henry Clay	22.77%
Lafayette	18.38%
Paul Dunbar	19.39%
Tates Creek	2.31%

Notes: This table shows the percentage of rezoned homes in each original school zone prior to rezoning.

Table B2: Number of Sales Based on the Rezoned High School Zones, 2010-2020

	Rezoned School Zones						
	(1) Bryan Station	(2) Henry Clay	(3) Lafayette	(4) Paul Dunbar	(5) Tates Creek	(6) Frederick Douglass	(7) Total
A. Before announcement							
Bryan Station	1,442	0	0	227	0	1,187	2,856
Henry Clay	0	1,564	0	0	190	479	2,233
Lafayette	0	248	1,949	0	0	42	2,239
Paul Dunbar	0	0	278	1,189	0	0	1,467
Tates Creek	0	17	0	0	1,839	0	1,856
Total	1,442	1,829	2,227	1,416	2,029	1,708	10,651
B. After announcement & before approval							
Bryan Station	588	0	0	82	0	473	1,143
Henry Clay	0	626	0	0	84	180	890
Lafayette	0	87	667	0	0	19	773
Paul Dunbar	0	0	120	438	0	0	558
Tates Creek	0	11	0	0	664	0	675
Total	588	724	787	520	748	672	4,039
C. After approval & before opening							
Bryan Station	1,596	0	0	247	0	1,142	2,985
Henry Clay	0	1,409	0	0	216	386	2,011
Lafayette	0	198	1,561	0	0	52	1,811
Paul Dunbar	0	0	268	942	0	0	1,210
Tates Creek	0	23	0	0	1,668	0	1,691
Total	1,596	1,630	1,829	1,189	1,884	1,580	9,708
D. After opening							
Bryan Station	1,976	0	0	285	0	1,365	3,626
Henry Clay	0	1,590	0	0	240	471	2,301
Lafayette	0	232	1,654	0	0	89	1,975
Paul Dunbar	0	0	276	1,111	0	0	1,386
Tates Creek	0	28	0	0	2,062	0	2,090
Total	1,976	1,850	1,929	1,396	2,302	1,925	11,378

Notes: This table shows the number of sales in each school catchment area in terms of its relative location before and after the rezoning. The first column lists the original five high schools and the top row shows the six schools under the approved rezoning plan. Diagonal numbers represent sales in a catchment area that is not subject to rezoning.

Table B3: Balance Test of Sales Prices in 2010 and 2013

	(1) Log sale price
2013-2010	-0.006
	(0.006)
Observations	5,371
R^2	0.765

Notes: This table presents additional evidence that sales prices for homes in rezoned and non-rezoned areas trended similarly prior to the announcement. The regression controls for house attributes including log square footage, age, age square, number of stories, number of full baths, all brick dummies, and urban status. Standard errors are in parentheses and clustered at the old high school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4: Rezoning Effect on the Number of Sales

	(1) Monthly sales	(2) Quarterly sales
Rezoned	-0.738*	-1.307
	(0.388)	(1.034)
Rezoned × *PostAnnounce*	0.557*	1.520
	(0.285)	(1.024)
Rezoned × *PostApprove*	0.984***	2.620***
	(0.241)	(0.790)
Rezoned × *PostOpen*	0.666***	1.829***
	(0.190)	(0.596)
Observations	6,684	2,651
R^2	0.601	0.785

Notes: This table presents the impact of rezoning on the number of houses sold at the tract level. The dependent variable is number of sales and the unit of observation is the census tract-month pair in column (1) and the tract-quarter pair in column (2). There are 82 tracts and we drop 17 that have both rezoned and non-rezoned houses. Because we use average monthly and quarterly sales data, we omit the approval month (quarter) and opening month (quarter). All specifications control for tract and month (quarter) fixed effects. Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B5: Rezoning Effects for Paul Dunbar to Lafayette

	(1)
Rezoned	-0.179***
	(0.031)
Buffer	-0.091***
	(0.023)
PostAnnounce	0.008
	(0.024)
PostApprove	0.042**
	(0.017)
PostOpen	0.051*
	(0.024)
Buffer×*PostAnnounce*	0.021
	(0.018)
Buffer×*PostApprove*	0.022
	(0.013)
Buffer×*PostOpen*	0.013
	(0.008)
Rezoned × *PostAnnouce*	-0.036
	(0.023)
Rezoned × *PostApprove*	0.007
	(0.013)
Rezoned × *PostOpen*	0.019
	(0.026)
Rezoned×Buffer	0.067**
	(0.028)
Rezoned×Buffer×*PostAnnounce*	-0.021
	(0.031)
Rezoned×Buffer×*PostApprove*	-0.037***
	(0.012)
Rezoned×Buffer×*PostOpen*	-0.057**
	(0.019)
Observations	4,621
R^2	0.908

Notes: This table shows the analysis of triple-difference-in-differences for homes in Paul Dunbar that are rezoned to Lafayette. Buffer is a dummy variable and is equal to one if a house is located within 0.35 miles from the Paul Dunbar-Lafayette old boundary. All control variables and fixed effects follow the main specification. Robust standard errors are clustered at the census tract level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$