Market-Based Policy Promoting Diversity and Equity:
Evidence from the Housing Market

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Abstract

The increased awareness of the importance of diversity, equity, and inclusion (DEI) in recent years has prompted organizations to embrace this social movement. One such organization is GreatSchools (GS), which provides nationwide school-quality ratings disseminated across the largest PropTech brokerage platforms in the US. At the end of 2017, GS changed its rating system away from focusing exclusively on test scores (TS) by incorporating a DEI measure. I exploit this discrete one-time change and deconstruct the rating into TS-based and DEI-based components to evaluate the effect of GS rating's DEI integration on households' financial decisions via home prices. Overall, the change ultimately makes GS rating less relevant, as home prices become much less responsive to the new rating index than to the previous one. Similar homes in the same zip code are then carefully matched to draw a meaningful comparison between transactions assigned to schools that experience GS rating changes and those in schools that see no changes. The results show significantly positive price premiums for properties in schools with negative GS rating change, in comparison to their control counterparts. To investigate the channel through which such results manifest, I conduct heterogeneity analyses that exploit cases when GS rating and TS move in opposite directions and show that price premiums are explained by the increased portion of GS rating that is attributable to the TS-based component. However, not all households prefer TS to GS rating as a signal of school quality, as preferences depend on homebuyer locality. House prices in markets that are heavily comprised of nonlocal homebuyers move in the same direction as GS rating changes, while those in markets with predominantly local homebuyers exhibit strong positive responses to TS changes regardless of any shifts in the third-party school rating. This evidence supports the notion that readily available heuristics are likely most valuable to informationally disadvantaged homebuyers, in accordance with the local network information channels and long-standing school reputational mechanisms.

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I. Introduction

Diversity, equity, and inclusion (DEI) has emerged as one of the most pressing issues in the U.S. today [**Figure 1**]. Leading institutions are seeking effective actions to promote DEI. However, DEI implementations are controversial. Many believe that organizations should embrace DEI for its benefits (Herring, 2009; Miller et al., 2009; Crosby et al., 2003). Others oppose this view, holding zero-sum beliefs in which costly resources benefiting the disadvantaged come at the expense of the advantaged (Wilkins et al., 2015; Iyer, 2022). There is hardly a neutral middle ground, since actions integrating DEI affect everyone. These heterogeneous beliefs pose an important question: how do people collectively respond to DEI?

Addressing such question is challenging in most settings. It is often not viable to directly identify DEI preferences as the decision is likely endogenously determined. Moreover, an organization's explicit DEI focus reflects the preferences of only the subset of individuals already interested in these causes, thereby not representing the average preference of all individuals. This study circumvents the challenges by exploiting a novel implementation whereby a popular nationwide school rating system, called GreatSchools (GS) rating, experienced a major change in November of 2017 (hereafter: YE2017). The change steers GS rating away from focusing exclusively on test score (TS) by incorporating a DEI component, designed by GS organization to promote equity in the U.S. public school system. Millions of current and prospective homeowners use GS rating since it is the only third-party rating displayed by the largest real estate listing platforms in the U.S., such as Zillow, Trulia, Realtor, Redfin, etc. [**Figure 2**].

The GS rating change studied in this research is unique in that it yields a quasi-exogenous shock that does not impact the schools' fundamentals or the properties' characteristics. The shock is GS incorporating a measure of DEI by repackaging the weights that make up its GS rating. Since the historic GS rating consists of solely TS, the difference-in-differences methodology allows me to compare the new GS rating to the historical one before and after YE2017, which identifies the impact of the added DEI component.

The linkage between home location and school attendance assignment in the U.S. makes household's locational choice important. A home is also the largest asset in an average household's balance sheet, implying home purchase being one of the most essential decisions by households. For that reason, I use home prices to capture the outcome of such decisions in measuring the preference in the DEI component. I utilize a sample of ZTRAX single-family transactions in Atlanta CBSA. Matched samples are constructed for each transaction within school zones experiencing no GS change to compare with similar assets in schools undergoing rating changes, before and after YE2017. The home price for a closely matched transaction reflects households' revealed preferences for the DEI component post implementation.

The first part of this paper provides evidence highlighting the major GS rating change and confirming that the nature of this change is about promoting DEI. Evidences from school-level analyses reflect GS' social mission in "creating a more equitable future for all children" and suggest that this change can potentially be the driver of DEI promotion.[1] As an overview, schools that are more likely to get a rating boost following the GS rating change are comprised of more disadvantaged students with lower academic performance, while newly downgraded schools tend to be located in affluent neighborhoods with a fewer share of minority groups.

The second research section investigates the public responses to the new DEI component in GS rating to understand whether the change reflects an average household's preference. Based on the new GS rating change, home prices appear to be stable in upgraded school zones but

[1] For more information about GreatSchools' vision and values, see https://www.greatschools.org/gk/about/.

significantly increase in areas of lower GS ratings. Via placebo and heterogeneity tests, the result is further explained by households' demand for academic quality, measured by the TS-based component. That is, the average household prioritizes academic quality over DEI performance.

I further explore the nature of such responses in a series of subsamples in the third segment of the paper. By exploiting the divergent signals of school quality that emerge when the revised GS rating and updated TS move in opposite directions, I find that only home prices in markets dominated by non-local buyers from out-of-county move in the same direction as GS rating. These are uninformed buyers who are most likely dependent on easily accessible third-party school ratings like GS, as opposed to the locals whose established knowledge about the local schools has been passed through generations of people in their towns. Across different spectra of neighborhood characteristics, households consistently reveal preferences for high academic standards.

This study provides new evidence of households' revealed preferences in DEI performances of public schools reflected via home prices. GS rating change is the first and leading implementation that addresses the long-overdue criticisms of TS being discriminatory as a school-quality rating. While my research documents short-term impacts of the implementation, GS rating deserves further attention in future studies as a potential engine of upward equitable growth.

The remainder of this study is organized as follows. The next section reviews the literature and draws on the contributions of this study. Section III elaborates GS as an organization and details the GS rating change. Section IV describes the data and outlines the matched sample methodology. Section V presents the main empirical methodology. The main results are discussed in section VI, within which subsections 1-4 respectively entail validation, households' responses, mechanisms, and broad outcomes. Section VII provides robustness tests. The final section provides concluding remarks.

II. Literature Review

Government policies have been the center of attention as potential solutions in addressing the issues of equity and inclusion. Decades of multi-billion dollars were invested in legislations designed to support the disadvantaged. For example, the Low-Income Housing Tax Credit (LIHTC) aimed to enable affordable housing for low-income tenants (Diamond and McQuade, 2019). Various place-based tax credit policies are designed to incentivize investments into distressed areas (Freedman et al., 2021; Neumark and Simpson, 2014).

Unfortunately, these policies don't always work as intended. Studies document that LIHTC was effective in some locations, but not all (Woo et al., 2016). Location-based policies such as Enterprise Zones and New Market Tax Credit predominantly benefited business recipients rather than targeted residents (Peters and Fisher, 2004; Neumark and Simpson, 2014). One of the largest and most recent Federal tax-credit legislations, the 2017 Opportunity Zone program, has thus far delivered limited effects on employment, earnings, or poverty (Atkins et al., 2021; Freedman et al., 2021).

There are also controlled experiments offering supports to only a certain group of disadvantaged families, such as the Moving to Opportunity (MTO) experiment, the Creating Moves to Opportunity (CMTO), Housing Opportunity Program, Chicago Regional Housing Choice Initiative, etc. (Chetty et al., 2014, Ludwig et al., 2013; Sanbonmatsu et al., 2006). Even though these experiments showed positive results, they are extremely costly, often reaching more than $3,000 per move (Bergman et al., 2019, Feins et al., 1997).

The discussed drawbacks of government-based policies and experiments above leave a gap and an opportunity for this paper to explore whether the GS rating change can be the driver for upward equitable growth. GS rating change is a novel approach of a national scale. This implementation plays a role as an instrument that uses school rating to provide incentives for the market to reward schools with higher share of diverse and economically disadvantaged students. My paper aims to be the first to investigate the impacts of this unique and innovative change.

This study naturally belongs to the literature on household preferences in location choice. Specifically, these are preferences of school quality, racial composition, and school reputation. Most empirical studies use house prices to infer the value placed on school quality. A rich literature has documented significant home price premium in areas of higher school quality (Black, 1999; Bayer et al., 2007; Kane et al., 2006). Distinctively, Barrow (2002) uses household-level locational decisions to quantify the monetary value of school quality: White households with children are more likely to locate in and are willing to pay more for areas of better school quality. Meanwhile, African American households with children put significantly less weight on school quality.

In this line of research, the definition of school quality has mostly been directly associated with standardized TS, which is often criticized for its high correlation with neighborhood sociodemographic (Downes and Zabel, 2002). My study contributes to the literature in investigating household preference when school quality is a multidimensional measure of both standardized academic performance and DEI achievement. Additionally, I identify the equity component to tease out households' specific preference of DEI when making home purchase decisions.

School reputation is sometimes preferable to school quality by households. The definition of reputation in the economics literature forms on the basis of past actions and correlates positively to the organization's performance or ability to produce quality products (Roberts and Dowling, 2002; Clark and Montgomery, 1998; Shapiro, 1983). Meanwhile, the literature in Industrial Organization (IO) defines reputation as a result of influential third parties' evaluations on the organization (Rao, 1994; Rindova and Fombrun, 1999; Stuart, 2000). Rindova et al. (2005) finds that media rankings have the largest significant effect on school prominence, while school prominence has the largest significant effect on price premium of students' starting salary. In other words, being known or famous (evaluated via the third parties) surpasses being good (signaled by the organization's performance). The study of Jacob and Lefgren (2007) specifies that only higher-income school parents seek out teachers of good reputation, while low-income school parents choose teachers based on their perceived ability.

My study resonates with the previous economics studies, as it documents evidence of long-standing reputational effect as a mechanism through which local homebuyers evaluate school quality. That is, school reputation for the informed, local investors connotates prolonged past performance. Meanwhile, the finding that uninformed investors, such as non-local buyers, following influential third-party (i.e., GS) rating resonates with the IO literature. Different from other studies, my focus on GS rating provides insights into households' preference of reputation in earlier-stage education (i.e., K-12) within the public school system in the U.S.

Besides school quality and reputation, racial composition is another important attribute. In fact, it is one of the most commonly observed housing sorting patterns (Aliprantis et al., 2022). When there are changes in the neighborhoods' racial compositions, households sort accordingly. For example, in the 1970s, desegregation led to the phenomenon of "White flight" - as the Blacks moved to the cities, the Whites took flight to neighboring suburbs (Boustan, 2010). Such a large-scale migration resulted in fallen housing prices in the cities and widen racial gaps in public-school enrollments (Boustan, 2012; Baum-Snow and Lutz, 2011).

In this study, GS rating change is deemed to be an equalizer that "will help uncover the strengths of schools successfully serving Black, Latinx, Native American and low-income students", according to GS' statement of purpose for the change.[2] If people believe in the change, the demand for homes in neighborhoods of newly boosted GS ratings, due to increases in the DEI component rating, will rise. However, I show that these neighborhoods are likely to be low-income with a higher share of minority groups, reflecting the "White flight" phenomenon above. Studying how the housing demand in those areas changes contributes to a better understanding of the tradeoffs between the preference of school quality and that of racial composition.

Finally, this work pertains to the literature in behavioral bias that examines the tendency of retailed investors to succumb to biases such as availability heuristic, salience, and herding mentality. A series of seminal work of Nobel laureates Tversky and Kahnerman (1973, 1974, 1979) has made ways for researchers to further investigate how people's judgements often rely on shortcuts and rules of thumb, or so-called heuristics (Benartzi and Thaler, 2007; Thakor, 2015; Kliger and Kudryavtsev, 2010; Stango and Zinman, 2009). In essence, GS rating is the shortcut to school ranking that is immediately available and free to look up. Meanwhile, obtaining TS requires costly and tedious search. Even though the theory of availability heuristic expects homebuyers to count on GS rating as a shortcut regardless of its informativeness relative to TS, this study finds that households show resistance to this bias by using TS as the signal of school quality.

Studies in Economics and Finance literature often leverage a shock to the salience of a rating to calibrate its value. For example, Hartzmark and Sussman (2019) appraises investors' valuation of sustainability when Morningstar converted difficult to easy-to-understanding sustainability rating. Dessaint and Matray (2017) quantifies the reactions to liquidity risk by managers whose firms directly endure hurricane shocks. Bordalo et al. (2013) explains the context-dependent choice of consumers overweighting salient attributes of goods. Parallel to the previous

[2] For more information about the rating change, see https://www.greatschools.org/gk/ratings/.

studies, mine exploits the event of GS rating change to assess homebuyers' preference in the DEI component of school rating.

This study also teases out an information channel that has an implication on herding behavior. More than two decades of studies have documented that retailed investors do tend to herd when making financial decisions (Shiller, 1984; Amihud et al., 2003; Chen, 2008; Avery and Zemsky, 1998; Cipriani and Guarino, 2014). Following the literature, one expects homebuyers to succumb to the herd mentality and base their location decisions on the popular GS rating. Instead, this paper finds some resiliency in local homebuyers, who are informed investors and not passive followers of GS rating.

III. GS Organization and GS Rating Change

Since school performance like TS often involves onerous search and varies widely across states, GS standardizes K-12 public school quality ratings to inform families and education stakeholders of how schools are serving all students. The organization reduces thousands of schools' TS across subjects and grades into a natural number rating system between 1 and 10 (highest). It is by far the most visible source of school rating, attracting more than 49 million users to its website each year. With a nationwide coverage of schools in the U.S., GS is the only third-party school rating displayed by the seven largest real estate listing platforms in the U.S.

On November, 2017 (hereafter: YE2017), GS launched a new rating to reflect school quality that "prioritizes equitable outcomes", aligning with its social mission of "creating a more equitable future for all children".[3] Before this change, GS rating consists of 100% TS. Post-YE2017, the rating contains only 19% TS, while the remaining weights are distributed to equity

[3] For more information about the GS rating change, see https://www.greatschools.org/gk/ratings-methodology/ and https://www.prnewswire.com/news-releases/greatschoolsorg-launches-nationwide-ratings-update-for-public-schools-301137183.html.

component (26%), student progress (36%), and college readiness (20%) [**Figure 3**]. Since GS is an independent non-profit organization, the YE2017 event of rating change is arguably an exogenous implementation free of political bias.

The component weightings can vary, depending on school level and data availability. College readiness is only applicable for high schools, thereby shifting the component weightings of elementary and middle schools to 30% test score, 31% equity, and 39% student progress. At the end of each school year, GS takes the weighted average of the components to form the final summary rating (i.e., GS rating). According to GS' classification, a rating of 7-10 is "above average", 5-6 is "average", and 1-4 is "below average". GS rating is ubiquitously displayed under the section for schools on national brokerage websites, where users can click on the ratings of schools associated with the listed property to be directed to the details on GreatSchools.org website [**Figure 4**].

The following segment describes the construction of GS component ratings.[4] As a general rule, each component is assigned a 1-10 GS value, basing upon the school's average percentile performance relative to others in a state. Specifically, the 1st to 9th percentiles receives a "1", while the 90th to 99th get a "10". Test score component is computed as a weighted average percentile of a school's proficiency rate in state standardized exams across grades and subjects. Student progress is the relative academic progression from one year to the next, capturing student improvement regardless of academic starting points. College readiness is measured by graduation rate and SAT performance, indicating the degree to which high schools prepare their students for colleges.

[4] The description in this section was obtained from GreatSchools.org in 2021, reflecting the relevant methodology applied to the GS ratings within the sample periods of this study. In 2022, GS website updated its methodology displays that show nuanced differences from the previous computations of the components.

The remaining component, equity, is the focus on this paper. It reflects how well schools serve disadvantaged students, defined by the racial and socioeconomic backgrounds that historically show persistent gaps. It is the ranked performance in proficiency tests, student progress, and college readiness of a school's disadvantaged group compared to all other students in the state. The economic meaning behind the equity component provides an opportunity for me to explore the degree to which people collectively value DEI. By including TS and TS percentage change in my regressions, I control for the academic-only components in GS rating and effectively identify the DEI component to tease out households' preference of equity performance.

IV. Data and Matching Methodology

GS organization displays the most updated cross-sectional ratings but does not keep a time-series record. As a result, I obtain proprietary GS data over the years from a national homebuilder, of which Atlanta office has the most comprehensive archive. For that reason, my sample focuses on primarily Atlanta-CBSA. The analysis in this paper centers on elementary schools, since it is the smallest unit of division for school attendance assignment [**Figure 5**]. In the end, I collect and analyze GS ratings for 435 elementary schools, representing 100% coverage within Atlanta-CBSA, during 2015-2018 [**Figure 6**].

Residential home price is the main dependent variable of interest. Price data and housing characteristics are provided by Zillow Transaction and Assessment Database (ZTRAX). Since yearly updated GS ratings are distributed to homebuilders and listing platforms on December 31st of each year, homebuyers rely on the previous-year ratings to make location decisions. For example, 2017 sales are affected by 2016 GS rating. Overall, I collect 2017-2019 data of 103,207 single-family, arm's length transactions within GS-available districts.

For the same years and schools, I obtain TS data from the Georgia Governor's Office of Student Achievement. This is the one and only source of Georgia state standardized TS used by all institutions. TS is a continuous rating system from 0 to 100, accompanied with the discrete letter grade ranking system from A (above or equal to 90) to F (below 60). The combination of directions of change in GS rating and TS produces four social phenomena, illustrated in Panel A of Figure 7. I map the locations of schools that experience these phenomena in the next panel.

[**Figure 7**]

In the top half of Panel A, the patterns of change are consistent. Thus, in the "social progress" phenomenon, when both GS and TS are increasing, demand for homes in these areas should increase, leading to higher house price. The other way applies to "social regress". However, when the directions of change are different between GS rating and TS, the resulting deviation reflects DEI and home prices are unpredictable. Therefore, in my analysis, I focus on only the bottom two quadrants of Panel A to observe the change of course in price, which essentially indicates households' respond to DEI.

In both phenomena "academic growth" and "non-academic growth" of Panel A's bottom quadrants, if house price changes in the same direction of TS performance change, this implies households' belief in TS as the signal of school quality that triumphs GS rating. Otherwise, if price follows GS rating change, it is hypothesized that GS rating is dominant and that households care more about DEI than academic performance, as shown in Panel C of Figure 7.

In the next step, I collect shapefile-format data of school attendance boundaries from the National Center for Education Statistics and Census block group boundaries from the U.S. Census Bureau. In ArcGIS, I joint these boundaries and housing coordinates to identify 1:1 matching of a residential property to its assigned elementary school and unique block group. Data of neighborhood demographics is also measured at the Census block group level and collected from the American Community Survey (ACS). For the analysis of 'local' versus 'non-local' homebuyers, I utilize 2015-2019 ACS county-to-county migration flow data where 'local' is defined as within-state in-migration.

Full Sample:

Table 1 displays summary statistics for school performance by GS rating and TS, property characteristics, and neighborhood demographics. The first column of Table 1 describes the full sample, of which 44% of homes are assigned to schools that experience GS rating change (i.e., $\triangle GS_{i,s,b}=1$), hereafter called the treated group, as opposed to the control group that sees no change in GS rating (i.e., $\triangle GS_{i,s,b}=0$). Properties sold post-implementation at YE2017 (i.e., $post_t=1$) are subject to the GS rating that incorporates other components including DEI.

[**Table 1**]

In the full sample, the average GS rating is 6, consistent with the "average" classification by GS, while the mean TS is 77, comparable to a C in letter grade. The average sale price is $127 per SF and the average size of the house is about 2,500 SF. A typical home in this sample is a 4-bed, 3-bath structure in 22,000-SF lot, constructed 28 years before the transaction date (prop age). These households reside in neighborhoods of the following average statistics: $86,000 median income, 50% white, 44% obtaining at least college degrees, 69% employed, and 2% growth in population annually.

Separating into pre-implementation (2017) versus post-implementation (2018-2019) periods respectively, the second and third columns of Table 1 display summary statistics from transactions in the control groups, along with the fourth and fifth columns for the treated ones. The final columns of Table 1 summarize the transactions in the split treated group, within which positive GS change (i.e., △GS+) and negative GS change (i.e., △GS-) show considerable heterogeneity in neighborhood characteristics. As a result, I carefully construct matched samples in an effort to draw a meaningful comparison between the treated and the control, before versus after the GS rating change.

Matched Sample:

There are four empirical matching methods that alleviate selection bias and heterogeneity: (1) repeat sales price indices, (2) spatial regression discontinuity design (RDD), (3) manual characteristic match, and (4) propensity-score matching (PSM). This paper adopts the manual characteristic match and PSM methods for a couple of reasons. First, due to the limited number of years in my sample, the total repeat sales are insufficient to apply method (1). Specifically, 77% of properties in the sample are sold once during 2017-2019. Second, the geographical focus on Atlanta-CBSA prevents the use of boundary discontinuity design - a type of spatial RDD often used in the residential real estate literature - because the total number of similar properties within a 5-mile-buffer across spatial school attendance boundaries makes up only 1% of the full sample.

I use manual characteristic matching as the main methodological approach to measure the change in home prices relative to closely comparable transactions. The treated is separated into positive treated group (i.e., △GS (+)) and negative treated group (i.e., △GS (-)). Supportively, McMillen (2012) demonstrates that a matching estimator produces similar results to repeat sales in the context of constructing housing price indices. Thus, I follow McMillen (2012) to create a 4-way match, whereby one transaction from the control pre-implementation (hereafter: the subject) is matched with one treated pre-implementation, one control post-implementation, and one treated post-implementation. Specifically, I apply a matching procedure that follow the order of importance of USPAP criteria, which are the most recognized appraisal standards in the U.S.

For each subject, matched transactions must be assigned to schools that share similar starting baseline in academic performance, particularly within ±2 GS ratings and ±15% test score in 2016. The transactions must occur in the same zip code within ±4 calendar quarters of the treated transaction sale date. These criteria facilitate comparable locations and market conditions. To be included in the matched group, the transaction must be a single-family home like the subject property, has the same number of bedrooms, house size is within ±50% of the subject size, and the structure is constructed within ±20 years of the property age. I then conduct the nearest-neighbor PSM matching by median income and apply the geodesic method by Karney (2013) to select the properties closest in distance to the subject and narrow down to exactly four transactions per matched sample.

Based on the matching process above, there are 4 matches per sample multiplied by 2,115 samples for the positive treated group, and 4 matches multiplied by 5,509 samples for the negative treated group. Table 2 provides summary statistics of the matched samples and displays sample means for the treated and control groups, of which the treated are split into positive and negative groupings, within the pre-implementation versus post-implementation periods.

[**Table 2**]

Across several variables, the insignificant sample means indicate fine comparability between the matched treated and control transactions. Other variables are close in magnitude, but the smaller sample size due to tight matching criteria can make small differences significant. In the positive treatment groupings, the average price per SF is $115 for treated transactions and $110 for control transactions before YE2017. Applying the same process to the post-implementation period, treated transaction prices are \$116 per SF on average, which is also not significantly different from the control average of \$114 per SF. A similar story obtains for the negative treated group. These summary statistics validate that the matched sample procedure alleviates sample heterogeneity.

In the robustness section, I conduct PSM as the alternative matching process. Even though PSM does not perform as well as characteristic matching in identifying comparable transactions that have similar locational, physical, and transactional characteristics, it performs well in matching zip codes based on median income, test score, and share of majority while allowing for a larger sample size. In the next section, I further apply the difference-in-differences framework to estimate home price changes as a result of the GS rating change.

V. Empirical Methodology

For property transaction i assigned to school s and located in Census block group b at time t, the difference-in-differences framework is as followed:

$$\ln\left(price_{i,s,b,t}\right) = \kappa \times treated_{i,s,b} + \xi \times post_t + \beta \times treated_{i,s,b} \times post_t + \epsilon_{i,s,b,t} \qquad (1)$$

where the dependent variable is the natural log of transaction price $\ln\left(price_{i,s,b,t}\right)$. Housing transactions within an attendance boundary of a school that receives GS rating change from one year to another is indicated by $treated_{i,s,b} = 1$. The control group, $treated_{i,s,b} = 0$, includes households that attend schools experiencing no GS rating change. These transactions take place either prior to the YE2017 GS rating change ($post_t = 0$), or after the change ($post_t = 1$). For the control group pre-implementation, I construct matched sample counterparts, the characteristics of which are highly comparable. $\epsilon_{i,s,b,t}$ is the error term.

With two periods $post_t \in \{0,1\}$, the coefficient of interest is a double difference in means:

$$\beta = \left(\mathbb{E}\left[price_{i,s,b,\mathbf{1}} | treated_{i,s,b} = \mathbf{1}\right] - \mathbb{E}\left[price_{i,s,b,\mathbf{0}} | treated_{i,s,b} = \mathbf{1}\right]\right) -$$

$$\left(\mathbb{E}\left[price_{i,s,b,\mathbf{1}} | treated_{i,s,b} = \mathbf{0}\right] - \mathbb{E}\left[price_{i,s,b,\mathbf{0}} | treated_{i,s,b} = \mathbf{0}\right]\right),$$

where β is the average treatment effect (ATE), in other words. One can only observe $price_{i,s,b,\mathbf{1}}$ if the property is in the treated group, or $price_{i,s,b,\mathbf{0}}$ if not treated. Since the counterfactual of what would have been absent treatment cannot be observed, average treatment effect β is our coefficient of interest. The ATE assumes that both treatment and control groups share similar characteristics. To alleviate potential violations in this parallel trend assumption, I follow Abadie (2005) to include a series of covariates. Accordingly, the main empirical analyses in this study apply the following regression:

$$\ln\left(price_{i,s,b,t}\right) = \beta \times treated_{i,s,b} \times post_t + X'_{i,t}\gamma + Z'_{b,t}\delta + \lambda_t + \alpha_s + \sigma_b + \epsilon_{i,s,b,t} \quad (2)$$

where the coefficient of interest, β, captures the degree of pricing effect on the school rating deviation between the historic GS rating and the YE2017 GS one, compared to the pricing of constant-rating schools, essentially reflecting households' preference of DEI performance. $X'_{i,t}\gamma$ is a vector of control variables for property characteristics, while $Z'_{b,t}\delta$ controls for the neighborhood demographics that vary through time, including academic performance such as test scores and percentage change in test scores. Month fixed effects, λ_t, account for economic conditions and cycles. School fixed effects, α_s, control for time-invariant school features that may affect the prices of homes assigned to the schools. Both the λ_t and α_s fixed effects absorb the individual $post_t$ and $treated_{i,s,b}$ terms, respectively.

The school level is larger than block group level, since multiple block groups are assigned to one school attendance zone. Thus, Census block group fixed effects, σ_b, are important to account for time-invariant neighborhood characteristics, which are some determining factors of households' location decisions. I also include fixed effects at an additional level, zip by quarter, since this is a more restrictive control that includes local level economic conditions as well as time-varying changes per quarter within the zip codes. Finally, in order to verify that the price effects originate from the demand, rather than the supply side, I incorporate variable "building permits" to one of the specifications. Data of the number of building permits, by city by year, are obtained from the State of the Cities Data Systems by the U.S. Department of Housing and Urban Development.

VI. Results

1) Validation

First, I provide evidence of a major GS rating change in 2017, which is shown in the coefficient plot of the estimated GS rating against year dummies, controlling for school-level characteristics. 2016 is the base case, of which coefficient is set at 0.

[**Figure 8**]

The plot shows that GS rating in 2017 is about -26% different from 2016, statistically significant at the 1% level. The coefficient for year 2018 is very similar to that of 2017. Meanwhile, from 2015 to 2016, the confidence interval overlaps with 0, meaning that the 6% higher in 2015 GS rating is not statistically significant from year 2016's rating. The regression illustrated by this plot explains 82% of GS ratings.

Via the following logistic functions, I examine the characteristics of the student bodies whose schools' likelihood of getting GS rating change:

$$\mathbb{I}_{\Delta GS>0} = \frac{1}{1+e^{-\left(X'_{i,b,t}\gamma+\gamma_0\right)}} + \epsilon_{i,b,t} \quad (3)$$

$$\mathbb{I}_{\Delta GS<0} = \frac{1}{1+e^{-\left(X'_{i,b,t}\gamma+\gamma_0\right)}} + \epsilon_{i,b,t} \quad (4)$$

where $\mathbb{I}_{\Delta GS>0}$ is an indicator variable of one if the school gets GS rating upgraded. $\mathbb{I}_{\Delta GS<0}$ is a one if the school received a GS rating downgrade. $\boldsymbol{X}_{i,b,t}$ is a vector of school-level characteristics, including percentage change in TS, percentage of Black students, percentage of White students, percentage of families receiving SNAP, percentage of students with disability, log of median income, percentage of employment in the neighborhood in which the school is located, and population growth of the neighborhood.

[**Table 3**]

Table 3 shows evidence that in the new GS rating change, schools that are more likely to get GS rating boost are comprised of more Black students, more children in families receiving SNAP food stamp, lower income families, and they tend to perform worse in academic performance, reflected in TS change. The opposite is true in the case of downgraded GS in the new implementation.

It is possible that the prominent characteristics above are cofounded by changes in TS performances. Figure 9 examines the differences between the distribution of GS rating in Panel A and that of TS in Panel B.

[**Figure 9**]

In Panel A, comparing the GS rating distribution from before (in green) versus after the change (in red), there are a lot fewer 1's, 2's, and 10's. In order words, schools that used to have extremely low rating now got upgraded, while those with high rating now got downgraded. This action of the GS rating change is consistent with the universal definition of equity, where the most economically disadvantaged students got boosted the most, while the most advantaged students are taken away assistance. However, when comparing TS distribution in Panel B, there is not much change before versus after the implementation. This graphical illustration thus alleviates the concern that TS and GS change concurrently in the same manner.

Figure 10 illustrates GS rating categories and characteristics. Top-rating schools, or those classified as “above average” with GS ratings 10-7, are located in much more advantaged neighborhoods as opposed to bottom-rating schools, or “below average” with GS ratings 4-1: higher median income ($93,384 vs. $56,907), more whites (65% vs. 11%), and more educated (49% vs. 29% with at least college education). Top-rating schools are also more likely to be downgraded (65% vs. 15%), while bottom-rating schools are much more likely to get upgraded (64% vs. 11%).

[**Figure 10**]

While the section above analyzes the characteristics of schools in the new GS rating system and validates its pro-DEI nature, it is also important to understand the relative differences in school features between the historic GS rating and the YE2017 GS rating. Figure 11 serves this purpose.

[**Figure 11**]

Historically, GS rating is perfectly corresponded with TS. Therefore, the largest category of positive change, represented by the grey bars in Panel A, took place in predominantly white areas. In the period after GS added the DEI component, the positive GS rating change was much more likely to concentrate in non-white areas. On the other hand, in Panel B, schools that received negative change historically concentrated in non-white areas. If the schools were in mostly white areas, they are more likely to get downgraded after YE2017. The relative comparison in Figure 11 confirms that the pro-DEI nature of GS rating was non-existent until GS incorporates a DEI measure for school quality from initially focusing exclusively on test scores.

2) Households' responses

How do people collectively respond to the DEI component? To address this question, I examine households' responses via home prices to the new GS rating change. If the DEI component is viewed as more desirable than the TS component, people will demand houses in areas where schools experience positive GS rating change and negative TS change, raising home prices there. Instead, if the DEI component is viewed as less desirable, home prices will grow in areas of schools with negative GS rating change and positive TS change.

In Figure 12, I graph coefficient plots of home price against rating dummies of GS in Panel A and of TS in Panel B. Panel A shows that people still respond to the new GS rating but not as much as before. Households' sensitivity to the new GS rating decreases. In other words, when GS incorporates other components into its rating, it makes the rating less relevant to households. Panel B plots home price against TS, measured in discrete letter grade categories. Households respond to TS similarly before and after. The graph of Panel B is purposefully designed to be on a similar scale to Panel A to emphasize the resemblance between all price coefficients in Panel B and the price coefficient of GS rating before YE2017 in Panel A. Such resemblance is explained by their complete correspondence to TS.

[**Figure 12**]

Putting the results above into a more scientific framework to explore the general responses of homebuyers to the DEI component, I then conduct difference-in-differences regressions in Table 4 where the dependent variable is log of home price. There are eight different specifications in each group with different fixed effects and added controls. The preferred specification is column

(8), or (16), where the fixed effects are the most restrictive and where TS and percentage change in TS are included as controls. These controls effectively account for the 'test score' and 'academic progress' components in the new GS rating, thereby isolating the response on specifically the DEI component of interest. Based on the coefficient of the interactions term, treated*post, home premiums in Panel A are positive at 1.8% and mildly significant at the 10% level for homes assigned to schools with new GS rating changes, when the treated group includes both positive and negative changes. This effect is minimized since prices of the two treated groups have the opposite signs.

[**Table 4**]

Thus, I separate the treated into positive and negative groupings in Panel B. Results in the left-hand group show coefficients not statistically different from zero as more controls and fixed effects are added. The preferred specification in column (8) indicates a price coefficient of 3.1%, not statistically different from 0, comparing homes in schools with positive GS rating change to their control counterparts. In other words, prices do not change significantly in areas of upgraded schools. However, all specifications in the right-hand panel consistently exhibit a pattern: prices increase significantly in areas of downgraded schools. Specifically, column (16) illustrates positive home price increase of 2.4% in areas containing schools with negative GS rating change, statistically significant at the 5% level. These results do not paint the complete picture without incorporating TS, which is the next step of my analysis.

To better understand the results above, I first conduct a placebo test. In that, I create a counterfactual group representing the hypothetical case in which GS never changed its rating system. In this placebo test, the new 2017 and 2018 GS score are based on the older rating system, where 100% of the component is TS. Figure 13 demonstrates the comparison between the actual versus the counterfactual data.

[**Figure 13**]

Since the 2016 data is in-sample, the actual and counterfactual ratings align perfectly at 45 degrees. 2017 is the first year of the new GS rating, hence the counterfactual rating does not align perfectly with the actual rating. In fact, actual 2017 GS rating over-rated scores at the lower end, and under-rated scores at the higher end. For example, a 1 counterfactual GS rating, which consists of 100% TS, is actually rated as a 2 GS rating in the new GS rating system, when the DEI component is added.

In Table 5, I run the same regression specifications on the placebo test. Since this placebo test uses counterfactual GS rating that consists of 100% TS, I no longer include TS and percentage change in TS as controls. Hence, the preferred specifications are now columns (6), or (12). Across all specifications, the signs of prices are consistent to the direction of TS change, reflecting that home prices are moving in the same direction as TS performance, or that households use the signal of academic performance to make location decisions.

[**Table 5**]

Specifically, for homes located in school zones with positive counterfactual GS rating, or increasing TS performance, the price premium is 9.1%, statistically significant at the 1% level, compared to homes attending schools experiencing no GS rating change. Meanwhile, negative counterfactual GS rating, or decreasing TS performance, leads to discounted home price of 8.4% in the area – a number statistically significant at the 10% level.

To confirm the results of the placebo test, I then conduct another test - a heterogeneity test where the sample is split by TS. The results show that the sign of home price coefficient consistently follows the direction of TS change: if TS increases, price premium is positive, and vice versa. The results are statistically significant at the 1% level in the case of negative GS rating change, equaling 11.8% for homes assigned to schools receiving positive TS and -9% for those in areas with negative TS.

[**Table 6**]

Combining the results presented in this section, I conclude that home prices move accordingly to the direction of TS change, instead of the direction of GS rating, after controlling for relevant factors. The observed revealed preferences suggest that DEI performance is not the top criteria for households when choosing good schools; test score, or academic performance, is.

3) The nature of households' responses

In the case that the patterns of change in GS rating and TS are consistent, I expect home price to follow accordingly. However, to capture households' responses to the DEI component of the new GS rating, I only focus on the cases in which the changes in GS rating and TS are contradictory. As a result, in this section, I conduct heterogeneity tests where GS rating change and TS change are different.

[**Table 7**]

Table 7 displays the regression results of samples split by migration type. Within areas of GS increase and TS decrease, I find property prices to be positive, or consistent to GS rating change, in markets dominated by non-local buyers, while prices are statistically significant and negative, or consistent to TS change, in areas predominantly consisting local residents. Within areas of GS decrease and TS increase, a similar story takes place. Property prices are statistically significant at the 1% level, either negative for non-local buyers and positive for local ones. These results support the hypothesis that heuristics are likely most valuable to informationally disadvantaged buyers such as non-local ones whose knowledge of the town is not yet established. Since the non-locals are uninformed, they are likely to be dependent on the most visible source of school quality, such as GS rating, which is conveniently available on major real estate listing websites. Meanwhile, the locals are informed buyers whose established knowledge about the local schools may have been passed through generations of people in their towns. Hence, they most likely know where to look for TS information in order to follow this metric.

I then split in the matched samples by different neighborhood characteristics: [**Table 8**] by share of minority, [**Table 9**] by median income, [**Table 10**] by education level, and [**Table 11**] by median age of the neighborhood population. The results mostly show signs consistent to changes in TS, more statistically significant in cases of GS decrease and TS increase. That is, home prices in each split group, regardless of the extreme high or extreme low level of a certain characteristic above, consistently follow TS performance change. These results prompt to a conclusion that households across race, income, education, and age use TS as a preferred signal of school quality.

In [**Table 12**], I split the matched samples by homeownership rate. Home prices for the group of owner occupants are significant and positive when TS is up, negative when TS is down, regardless of GS rating change. Meanwhile, prices in neighborhoods dominated by renters are negative when GS rating is down, and positive when GS rating is up, regarding of TS performance change. These results imply similar notion of readily available heuristics as in the case of local versus non-local buyers. Homeowners are more likely familiar to the local schools, while renters tend to be dependent on third-party school quality rating like GS for easily accessible school-quality information.

VII. Conclusion

GS is the most popular school rating that provide free and convenient access to public schools' quality in the US. This paper first studies the nature of GS rating change in YE2017, where GS organization incorporates a DEI-based component into its rating. Post major GS change in YE2017, schools that receive positive GS rating change are likely to comprise of more Blacks, more SNAP students, and more children from lower income families. These schools perform worse academically, as justified by TS, and are located in neighborhoods with lower employment. The opposite characteristics are reflected in the case of schools that receive negative GS change in the new rating system.

However, historically, when GS rating is perfectly corresponded with TS, the largest category of positive GS rating change took place in predominantly White areas. In other words, the new GS rating redistributes schools from the tails (i.e. before-YE2017 ratings of 1's, 2's, 10's) to the middle (i.e. after-YE2017 ratings of 3's, 4's, 5's, 8's). This action is consistent with the definition of equity, in which the most economically disadvantaged students get upgraded the most, while the most advantaged ones are downgraded.

This paper also investigates the effect of GS rating's DEI integration on households' financial decisions via home prices. The YE2017 GS rating change made GS rating less relevant, since home prices are less responsive to changes in the rating index. The market follows TS as a signal of school quality, instead of GS rating. Prices of homes assigned to schools with negative GS rating changes are positively and significantly impacted by increases in the rating portion that is attributable to the TS-based component, when compared to matched samples of home prices in nearby areas that did not experience a change in TS.

When conducting heterogeneity analyses that exploit cases when GS rating and TS move in opposite directions, I find that home premiums move in the same direction as GS rating changes in markets that are heavily comprised of nonlocal homebuyers. Markets with high proportions of local homebuyers see home premiums move in the same direction as TS, irrespective of the third-party school rating changes. Moreover, there is a lack of evidence to suggest that buyers are willing to pay a significant premium in home prices when the sample is divided into breakpoints for share of minority, median income, education level, median age, and homeownership rate. These findings suggest that the pricing premiums evident in this study are closely linked to the value of availability heuristic associated with informationally disadvantaged homebuyers.

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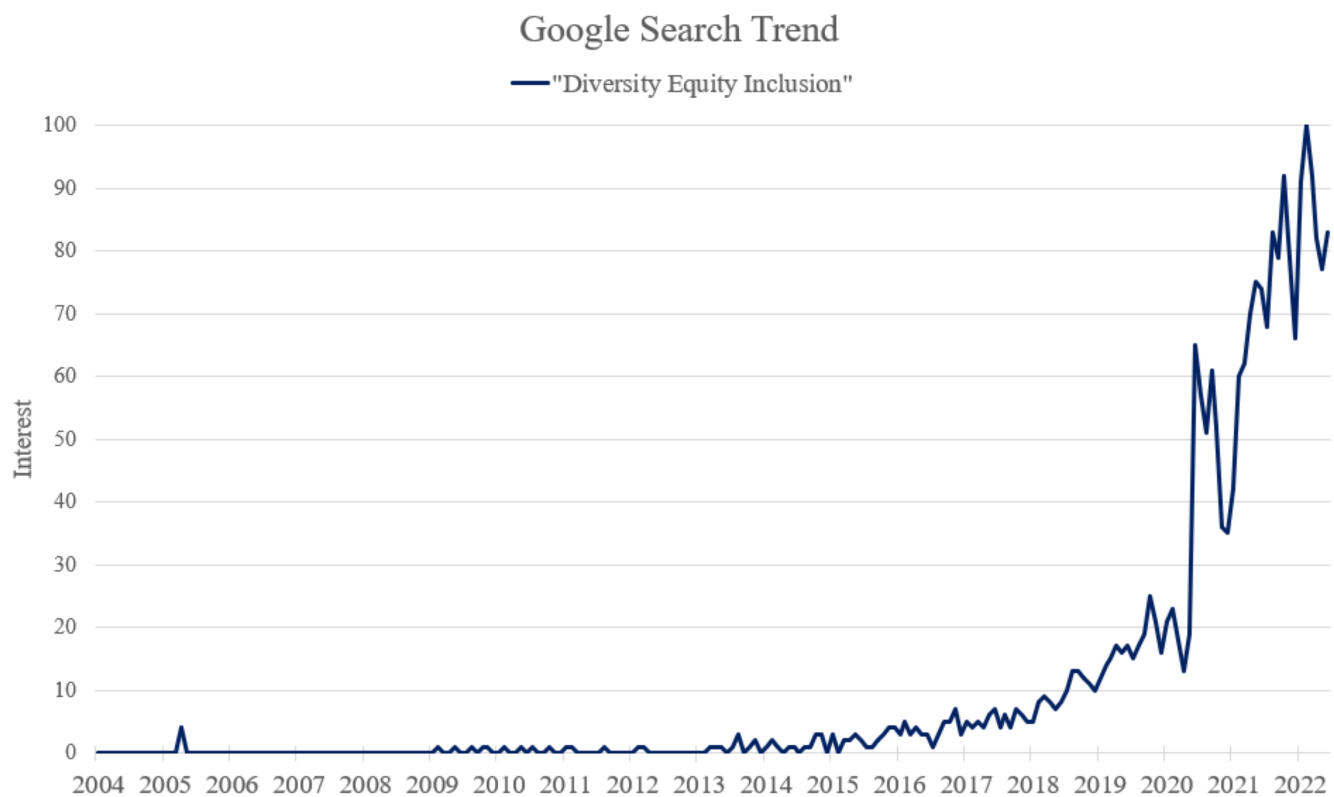
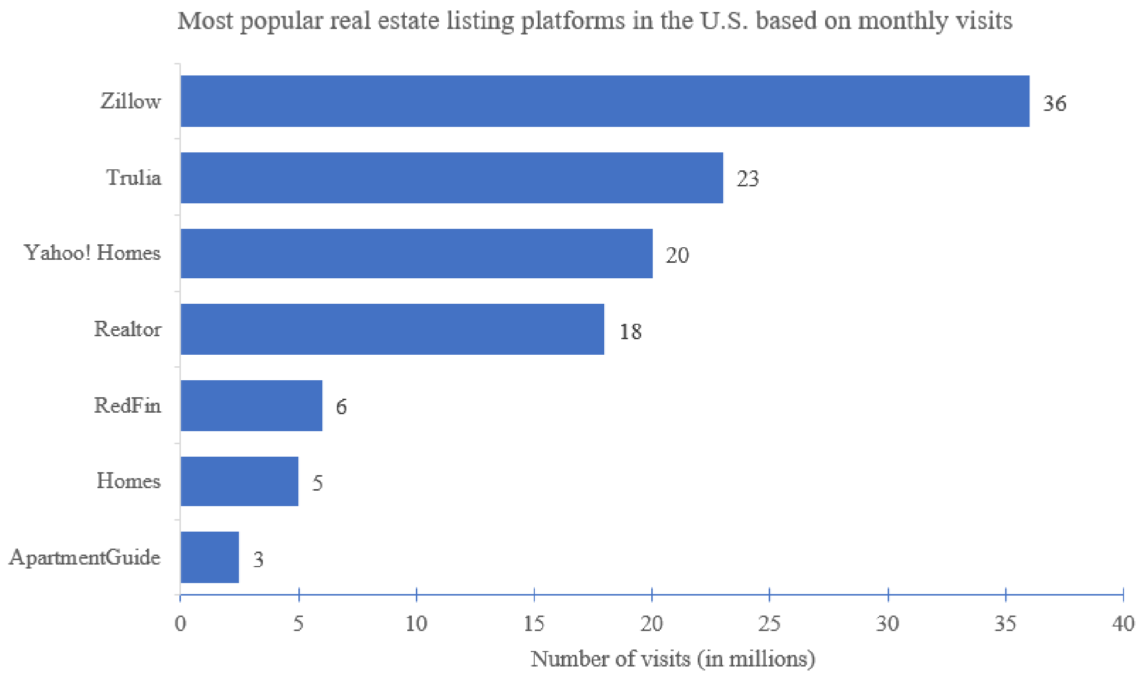
Figure 1. Illustration of the rise of DEI movement



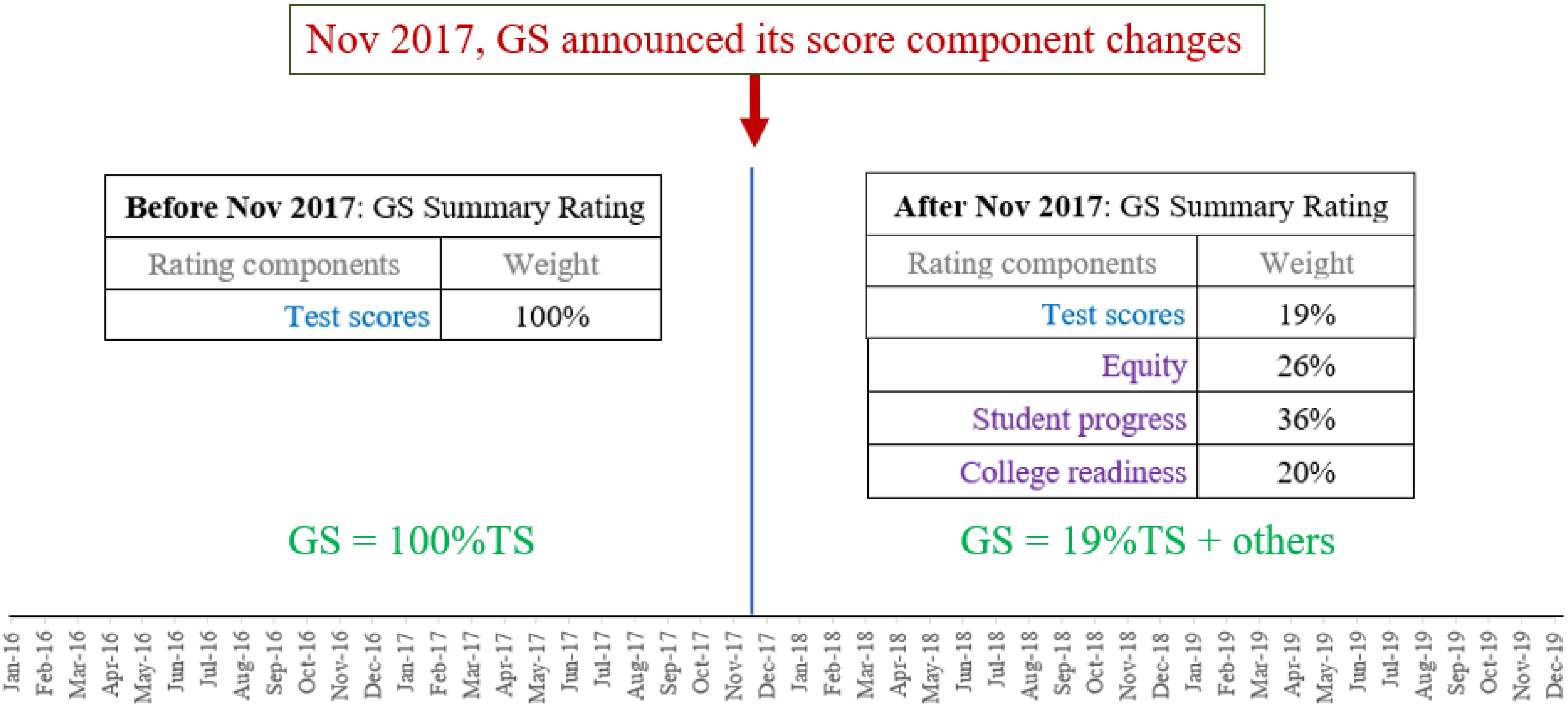
Notes: This figure demonstrates the sharp growth of public interest in the matter of diversity, equity, and inclusion (DEI) in the U.S. Using Google search trend algorithm, terms similar to "diversity equity inclusion" such as "Critical race theory", "Black Lives Matter", "equity inclusion", or "racial justice" show similar trends. This figure illustrates the urgency of the DEI movement that leads to considerable resources and policies from both the public and private institutions to address the issues.

Figure 2. The list of major real estate listing websites in the U.S.



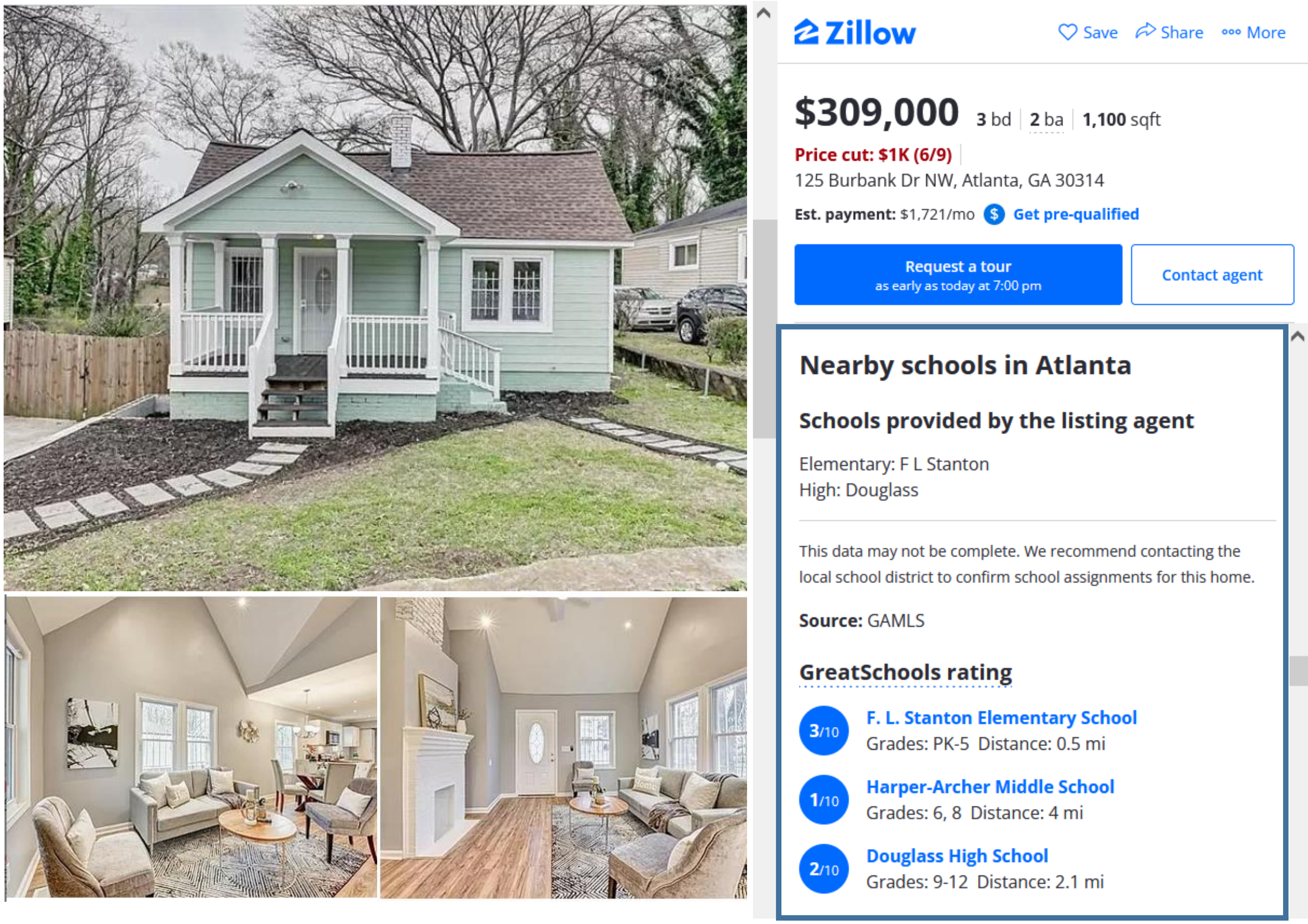
Notes: This figure shows the seven largest real estate listing platforms in the U.S., based on the number of monthly website visits. All of these platforms use GreatSchools as the only third-party partner to display school-quality rating of the public schools relevant to each listing.

Figure 3. GreatSchools rating change policy



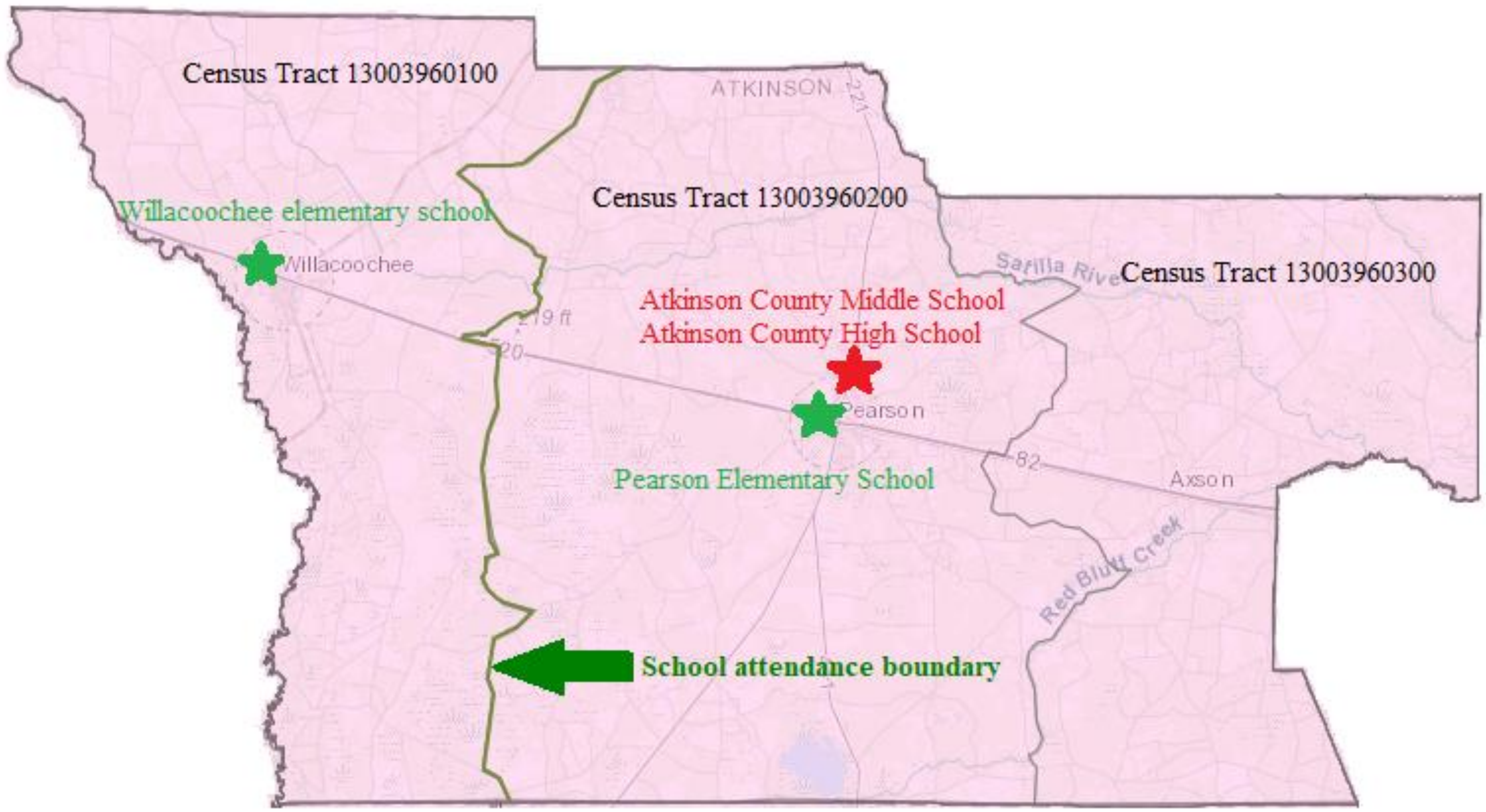
Notes: Figure 3 illustrates the timeline of the event of GS policy change and specifies the components that make up the historic vs. the current GS rating. GS rating for each K-12 public school is released in December 31st of each year. As a result, the third-party PropTech listing platforms and homebuyers rely on GS ratings of the previous year. For example, 2017 home sales are affected by the 2016 GS ratings.

Figure 4. An example of GreatSchools rating in Zillow



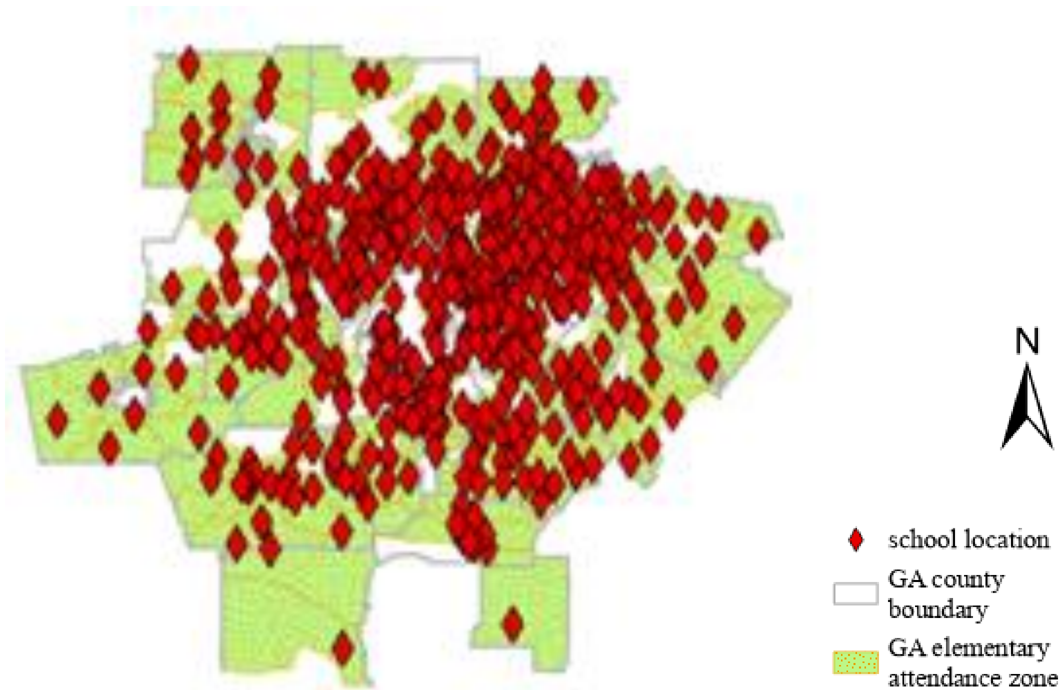
Notes: This figure shows a typical listing for sale on Zillow. GreatSchools rating is under the "Nearby schools" section. Each K-12 public school within the school attendance boundary associated with the listing is assigned a GreatSchools rating. Each school's GS summary rating is displayed as a clickable link that directly leads prospective buyers to GreatSchools website, within which specific breakdowns of the rating components are specified. This section in Zillow also includes a disclaimer and a brief description about GreatSchools.

Figure 5: An example school attendance assignment



Notes: This figure demonstrates school attendance assignment in the U.S., using Atkinson County as an example. Atkinson County happens to be the school district as well - Atkinson County School District. The county is divided into 3 Census Tracts and 2 separate school attendance zones. Within the school district, all children of 11-14 years old go to the one and only Atkinson County Middle School. Those of 15-18 ages attend the one and only Atkinson County High School. However, there are 2 elementary schools in the county, between which the school attendance boundary lies. 6-to-10-year-old children whose households belong to Census Tract 13003960100 attend Willacoochee Elementary, while those reside in Tracts 13003960200 and 13003960300 can only go to Pearson Elementary.

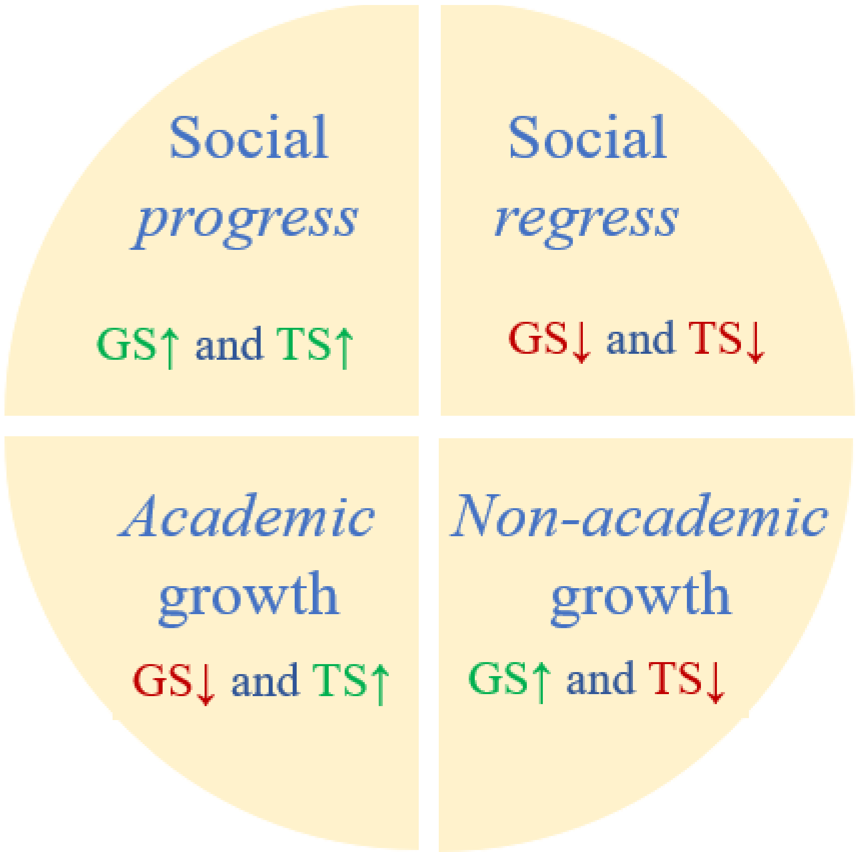
Figure 6. GS data coverage in metro Atlanta-CBSA



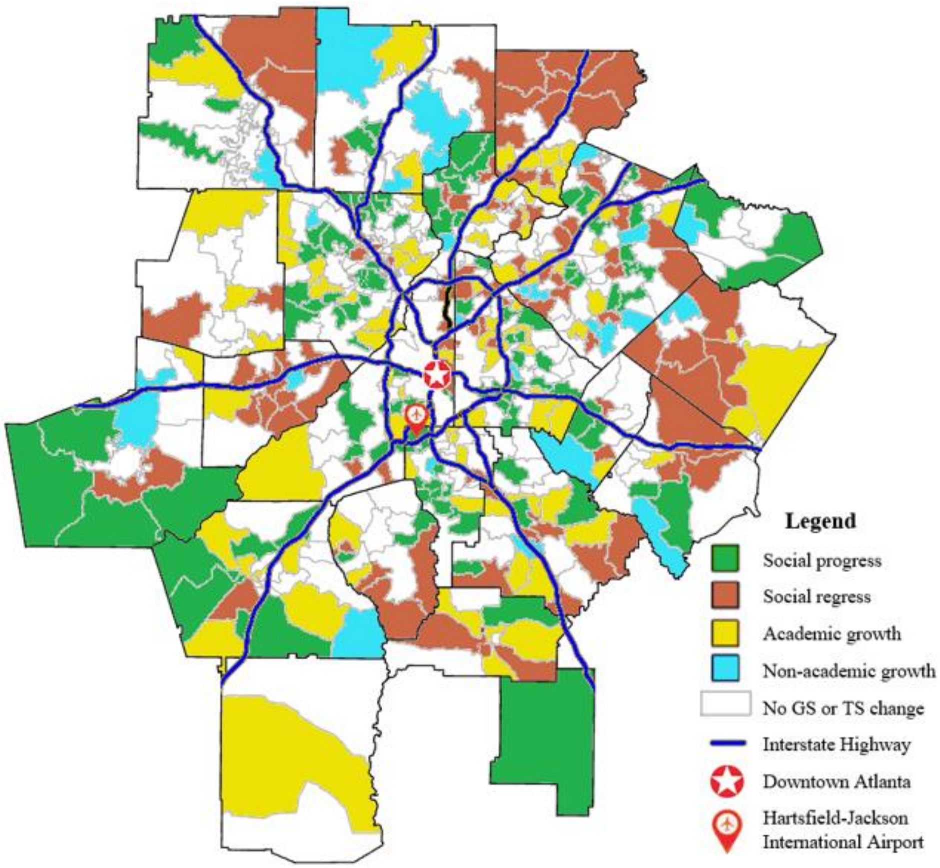
Notes: This map illustrates the locations of 435 elementary schools in the research sample, representing 100% coverage within Atlanta-CBSA. School attendance zone is a smaller unit than school district and country. The specific school to which a child attend is associated with the attendance boundary within which the child's house is located.

Figure 7. Social phenomena and hypotheses

Panel A. The four social phenomena by GS rating and TS



Panel B. Locations of schools experiencing the four social phenomena



Panel C. Hypotheses in cases of divergent signals between GS rating and TS

Scenario:	*Academic* growth (GS↓, TS↑)	
Price response:	P ↑	P ↓
H_0:	TS dominant	GS dominant
Implication:	people follow TS	people follow GS rating
Scenario:	*Non-academic* growth (GS↑, TS↓)	
Price response:	P ↓	P ↑

Notes: Figure 7 is divided into three panels. Panel A represents the four social phenomena divided by the change in direction of GS rating and test score. Social progress is the phenomenon in which both GS rating and test score improve over the academic year. Social regress is the opposite, where both GS rating and test score perform worse than the previous year. Academic growth phenomenon occurs when GS rating is decreasing but test score improves. This shows that the school does well academically, hence the name. Non-academic growth is a phenomenon that take place when GS rating improves but test score regresses. Since GS rating includes both academic and non-academic performance, the difference shows that only non-academic performance has grown. Both bottom quadrants represent the deviation between test score and GS rating, reflecting the DEI component, or equitable growth/decline of the school.

Panel B is a map of the locations of schools experiencing the four phenomena. The schools in the sample are bounded by Atlanta-CBSA. The map of Interstate 285, Atlanta downtown, and Hartsfield-Jackson International Airport visualize the relative locations between the city of Atlanta and its metropolitan areas.

Panel C summarizes the main hypotheses, in which GS rating and test score performance are different in their patterns of change. The first column displays the content of each row. The second column contains scenarios where the direction of home prices are consistent with test score performance change. These scenarios make up the first hypothesis, implying that people use test score as the main indicator of school quality. The third column show scenarios where the direction of home prices follows GS rating change. These scenarios refer to the second hypothesis: household follow GS rating, or that they care more about DEI performance than academic achievement.

Table 1. Summary Statistics: Unmatched Sample

variable	sample:	Full sample	Full sample				Treated sample			
		Combined control & treated	Control △GS=0		Treated △GS<>0		△GS+		△GS-	
	period:	2017, 2018,2019	pre	post	pre	post	pre	post	pre	post
	stat:	mean	mean	mean	mean	mean	mean	mean	mean	mean
variable	unit	(stdev)	(stdev)	(stdev)	(stdev)	(stdev)	(stdev)	(stdev)	(stdev)	(stdev)
△GS	0,1	0.44	0	0	1	1	1	1	1	1
post	0,1	0.66	0	1	0	1	0	1	0	1
GS	score	6	7	6	6	6	6	5	6	8
		(3)	(3)	(3)	(2)	(3)	(2)	(2)	(2)	(2)
TS	score	77	79	77	76	76	74	73	77	78
		(14)	(15)	(14)	(14)	(14)	(15)	(15)	(13)	(13)
price	per SF	$127	$118	$131	$118	$131	$141	$114	$104	$146
		($186)	($135)	($120)	($140)	($299)	($203)	($172)	($73)	($374)
house size	SF	2,511	2,647	2,514	2,462	2,468	2,485	2,453	2,447	2,481
		(1,119)	(1,132)	(1,116)	(1,091)	(1,132)	(1,237)	(1,185)	(987)	(1,085)
lot size	SF	22,111	21,366	22,432	21,588	22,228	25,176	23,475	20,006	21,214
		(72,032)	(52,244)	(91,909)	(41,973)	(61,696)	(56,384)	(64,844)	(33,595)	(58,997)
bedrooms	count	4	4	4	4	4	4	4	4	4
		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
bathrooms	count	3	3	3	3	3	3	3	3	3
		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
prop age	yrs	28	25	29	28	29	33	28	25	30
		(21)	(21)	(21)	(21)	(22)	(24)	(21)	(19)	(24)
median income	$	86,463	84,880	90,078	81,296	85,500	88,842	83,125	76,374	87,557
		(38,890)	(34,112)	(40,091)	(38,046)	(39,505)	(48,360)	(41,049)	(28,373)	(37,999)
white	%	0.50	0.52	0.49	0.51	0.50	0.53	0.44	0.51	0.55
		(0.28)	(0.29)	(0.28)	(0.27)	(0.29)	(0.33)	(0.31)	(0.22)	(0.26)
college degrees	%	0.44	0.45	0.45	0.43	0.44	0.51	0.41	0.38	0.47
		(0.20)	(0.19)	(0.20)	(0.20)	(0.20)	(0.22)	(0.19)	(0.17)	(0.21)
employment	%	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.69
		(0.08)	(0.08)	(0.08)	(0.09)	(0.08)	(0.10)	(0.09)	(0.08)	(0.08)
population growth	%	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.02
		(0.11)	(0.11)	(0.11)	(0.12)	(0.12)	(0.11)	(0.13)	(0.12)	(0.11)
	obs	103,207	14,523	42,917	20,350	25,417	7,891	11,714	12,459	13,703

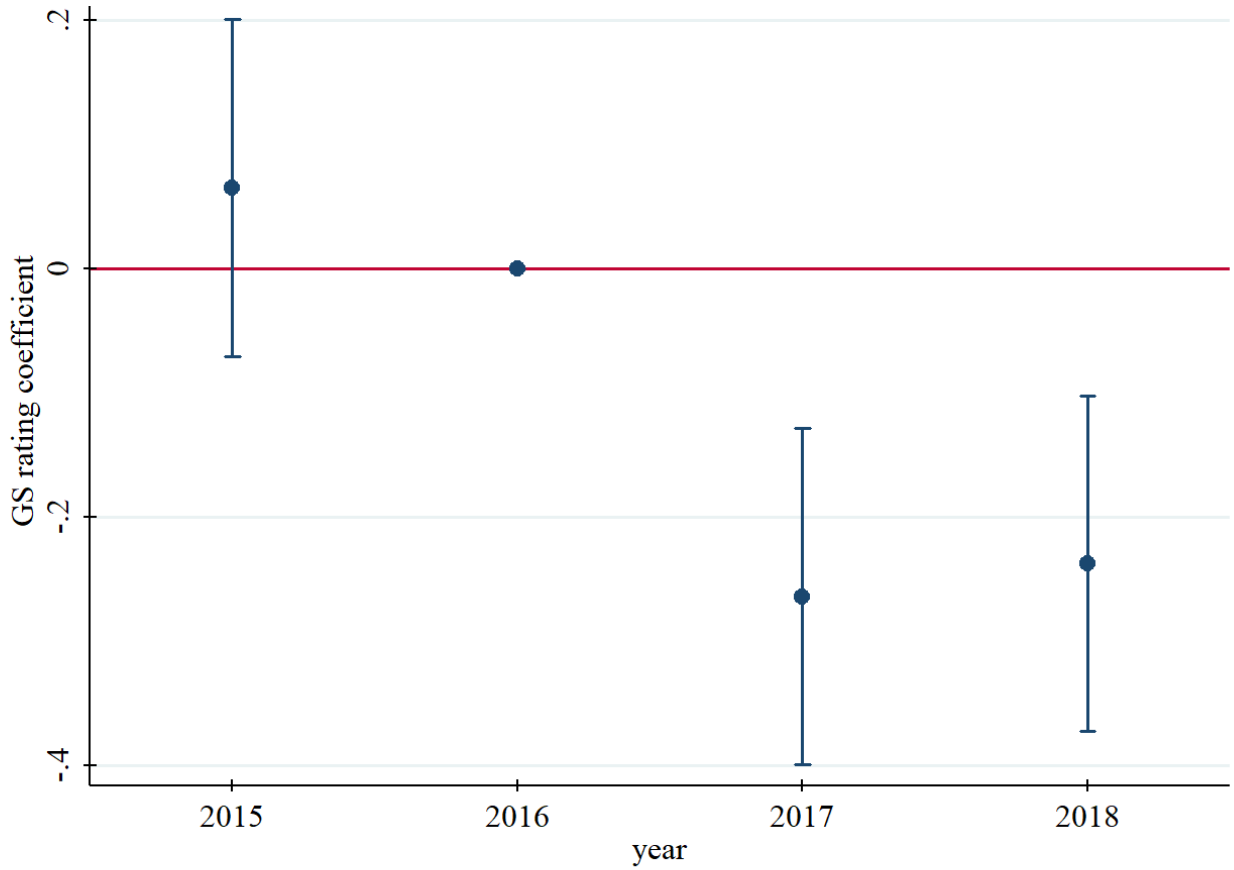
Notes: Table 1 provides summary statistics, including the mean and standard deviation (stdev) for the sample of residential transactions from ZTRAX during 2017 to 2019, prior to applying any matched sample process. The first column displays the full sample, including transactions in the control group, positive treated group, and negative treated group. The second to third columns summarize transactions assigned to schools that experience no GS rating change, before (2017) and after (2018-2019) the GS rating change policy. The fourth to fifth columns deliver similar summary statistics for transactions assigned to schools that experience any GS rating change, either positive or negative. The final four columns summarize transactions in split treatment groups of positive GS change only and negative GS change only, before and after GS policy. △GS is an indicator for transactions in schools that were ultimately receive GS rating change (△GS =1). Post is an indicator for transactions occurring after 2017 (post=1), when GS rating system change took effect. GS is the GS rating in natural number from 1 to 10, and TS is the continuous test score from 0 to 100. Price is the transaction price, displayed on a per square foot (SF) basis. House size is the rentable building area of the structure, displayed in SF. Lot size equals the land area. Bedrooms is the number of bedrooms. Bathrooms equal the total number of full and half baths. Prop age equals the year of the transaction date minus the year built, displayed in years (yrs). Median income is the median dollar amount earn yearly at the Census block group level. White is the percentage of people whose race is white in the block group. College degrees represent the percentage of block group residences whose education attainment reaches at least college level. Employment is the rate calculated by the number of employed people divided by the total labor force in the neighborhood. Population growth is the change in population in percentage term from one year to another. Obs is the number of transaction observations in each subsample.

Table 2. Summary Statistics: Matched Sample

	match process:	△GS (+)								△GS (-)							
	period:	before				after				before				after			
	variable △GS	0	1	difference		0	1	difference		0	1	difference		0	1	difference	
PROPERTY	price per SF	$110	$115	5		$114	$116	2		$105	$103	(2)		$111	$109	(2)	
	test score	74.6	76.1	2	***	77.9	80.1	2	***	84.2	82.8	(1)	***	82.8	83.4	1	***
	house size	2,525	2,542	17		2,436	2,466	30		2,497	2,598	102	***	2,525	2,472	(53)	***
	bedrooms	4	4	0		4	4	0		4	4	0		4	4	0	
	bathrooms	3	3	(0)		3	3	(0)	***	4	3	(0)		3	3	(0)	***
	prop age	27	26	(1)	**	27	27	(1)		20	19	(1)	***	20	20	1	**
DEMOGRAPHIC	median income	89,610	88,688	(922)		88,271	90,602	2,331	*	82,388	82,468	80		85,566	80,733	(4,834)	***
	white	0.45	0.43	(0)	*	0.42	0.41	(0)		0.58	0.54	(0)	***	0.53	0.52	(0)	
	college degrees	0.46	0.48	0	**	0.49	0.47	(0)	***	0.40	0.40	(0)	***	0.41	0.39	(0)	***
	employment	0.67	0.68	0	***	0.68	0.68	(0)		0.69	0.70	0		0.70	0.68	(0)	***
	population growth	0.02	0.02	(0)		0.02	0.01	(0)	***	0.04	0.03	(0)	***	0.05	0.06	0	**
	obs	2,115	2,115			2,115	2,115			5,509	5,509			5,509	5,509		

Notes: Table 2 displays summary statistics based on the matching procedure used to generate the matched sample. Based on the matching process, a matched sample must contain one control transaction pre-policy, one control transaction post-policy, one treated transaction pre-policy, one treated transaction post-policy – a total of four transactions that satisfy the following restrictions: ±2 GS ratings and ±15% test score in 2016, ±4 calendar quarters, same zip code, same number of bedrooms, ±50% of the subject's house size, ±20 years of the property age, arm's length transaction and single family only. The first column lists the variable names, defined in the notes for Table 1. The second to seven columns are matched samples of the positive-only treated group (△GS (+)). Specifically, the second column designates the subsample means for the control (△GS=0) observations, while the third column contains those for the treated (△GS=1). The fourth column equals the difference, along with ***, **, and * denoting statistical significance for the *t*-test of difference in means between △GS=1 and △GS=0 subsamples at the 1%, 5%, and 10% levels, respectively. For each match group of positive and negative GS rating change, the subsamples are divided into observations pre-policy (before) and post-policy (after). Columns eighth to thirteenth provide similar statistics for the negative-only treatment group (△GS (-)).

Figure 8. Coefficient Plot of GS Rating by Year



Notes: Figure 8 provides an evidence of major GS rating change in 2017. The blue dots represent the coefficients of GS rating running against the year dummies from 2015 to 2018, with the year immediately before the GS rating change, 2016, being the base case. Characteristics at the school-level are included as controls. The blue bars are 95% confidence bands for the estimated GS ratings.

Table 3. Characteristics of Schools with High Likelihood of GS rating change

Panel A. Characteristics of schools with high likelihood of increased GS rating

Dependent variable	$\mathbb{1}_{\triangle GS>0}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
△% test score	-1.978*** (0.08)								-2.247*** (0.08)
% Black		0.736*** (0.03)							0.798 *** (0.03)
% White			-0.557*** (0.03)						
% SNAP families				1.199*** (0.04)					
% disability					-0.261 (0.30)				-0.015 (0.31)
log(median income)						-0.169*** (0.02)			
% employment							-1.565*** (0.11)		-1.393*** (0.11)
population growth								-0.064 (0.08)	-0.071 (0.08)
Observations	17,493	17,493	17,493	17,493	17,493	17,493	17,493	17,493	17,493
Pseudo R-squared	1%	1%	1%	0%	0%	0%	0%	0%	2%
AIC	73,725	73,683	73,291	73,458	74,342	74,276	74,139	74,342	72,752

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Characteristics of schools with high likelihood of decreased GS rating

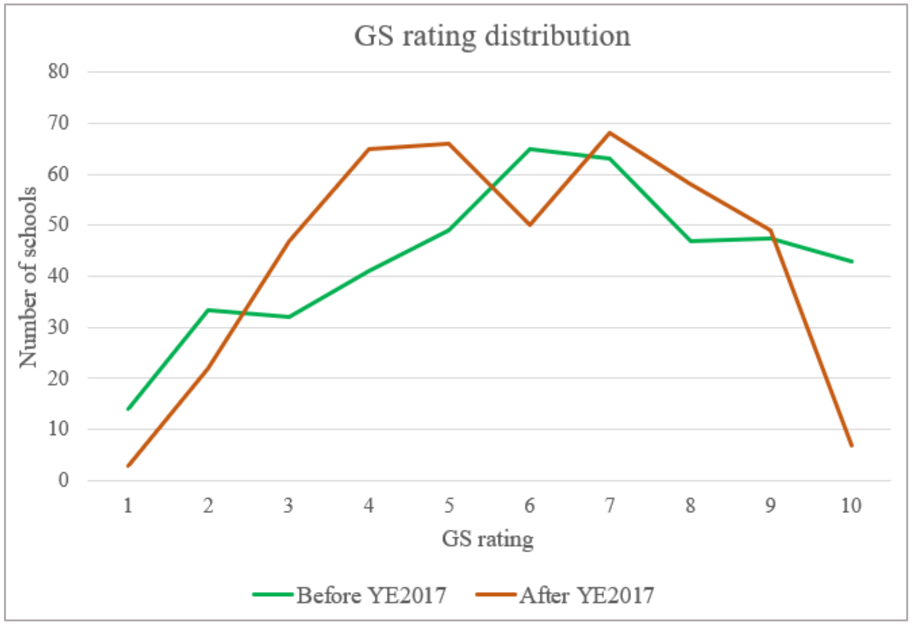
Dependent variable					$\mathbb{1}_{\triangle GS<0}$				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
△% test score	1.468***								1.913***
	(0.07)								(0.07)
% Black		-0.928***							-1.042 ***
		(0.03)							(0.03)
% White			0.701***						
			(0.03)						
% SNAP families				-0.547***					
				(0.04)					
% disability					0.775***				0.404
					(0.28)				(0.28)
log(median income)						0.049**			
						(0.02)			
% employment							0.296***		0.005
							(0.10)		(0.10)
population growth								0.223	0.239***
								(0.07)	(0.07)
Observations	23,385	23,385	23,385	23,385	23,385	23,385	23,385	23,385	23,385
Pseudo R-squared	1%	1%	1%	0%	0%	0%	0%	0%	2%
AIC	82,547	81,859	82,421	82,775	82,970	82,972	82,970	82,969	81,185

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

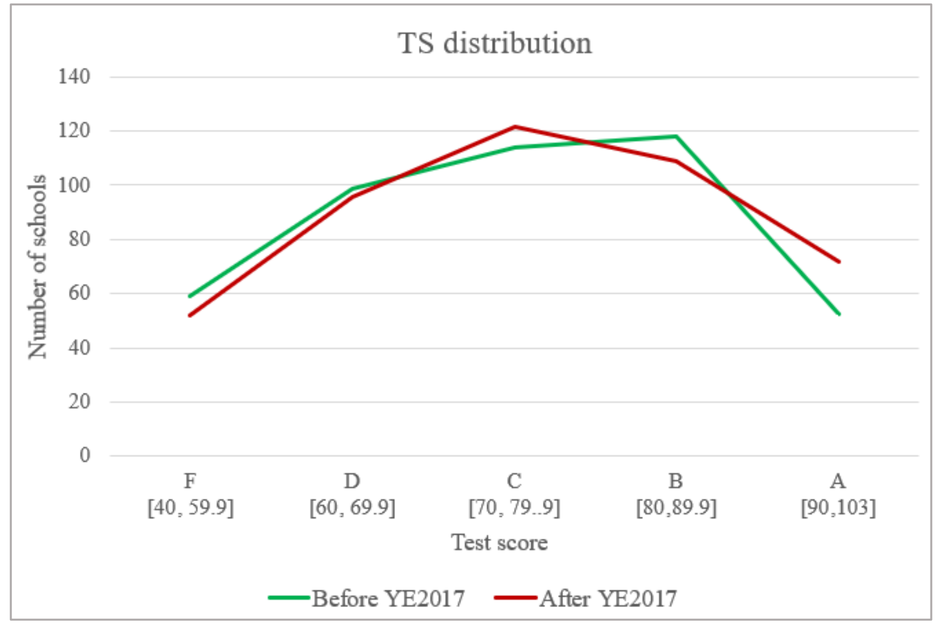
Notes: Table 3 reports results from the logistic estimation of the characteristics of the student bodies in schools with high likelihood of GS rating change. Panel A displays results from the estimation of equation (3), with the indicator variable, $\mathbb{I}_{\Delta GS>0}$, equaling one for schools getting GS rating upgrades. Panel B displays results from the estimation of equation (4), with the indicator variable, $\mathbb{I}_{\Delta GS>0}$, equaling one for schools getting GS rating downgrades. Δ% test score is the annual percentage change of the school-level test score. % Black is the portion of students identified as African Americans in the student body. % White is the proportion of students whose race is Caucasian. % SNAP families is the percentage of students whose families are so economically disadvantaged that they are eligible to receive food stamps. % disability is the percentage of students with disability within the school population. Log(median income) is the log of median income of the neighborhoods in which the according schools are located. % employment is the employment rate of the neighborhood. Population growth is the percentage change in neighborhood's population. Standard errors (s.e.) are displayed in parentheses. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively. Pseudo R-squared is an analogue to R-squared for logistic regressions. AIC is the Akaike information criterion that estimates the prediction error of the statistical models.

Figure 9. Rating Distribution

Panel A. GS rating distribution



Panel B. TS distribution



Notes: Figure 9 displays the distributions of ratings by the number of schools. Panel A represents GS rating distribution, which shows the number of schools in each of the 1-10 categories of GS rating. Panel B shows TS distribution, in which TS is classified by the discrete letter grades F-A. For each graph, the green line demonstrates the distribution before YE2017, and the red line is for the period after the GS rating change by YE2017.

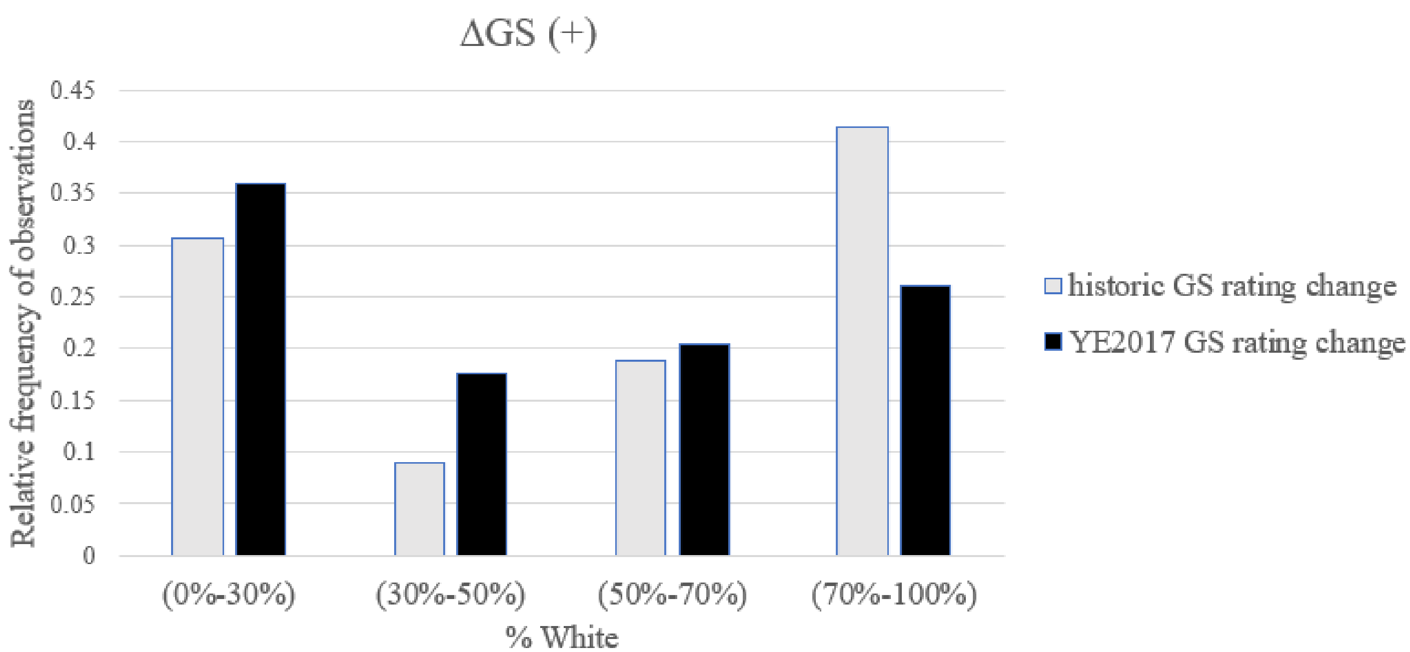
Figure 10. GS Rating Categories

GS	# schools	median income	median %white	median college education	% GS ↑	% GS ↓
10 9 8 7	202	$93,384	65%	49%	11%	65%
6 5	104	$71,528	45%	35%	34%	42%
4 3 2 1	129	$56,907	11%	29%	64%	15%

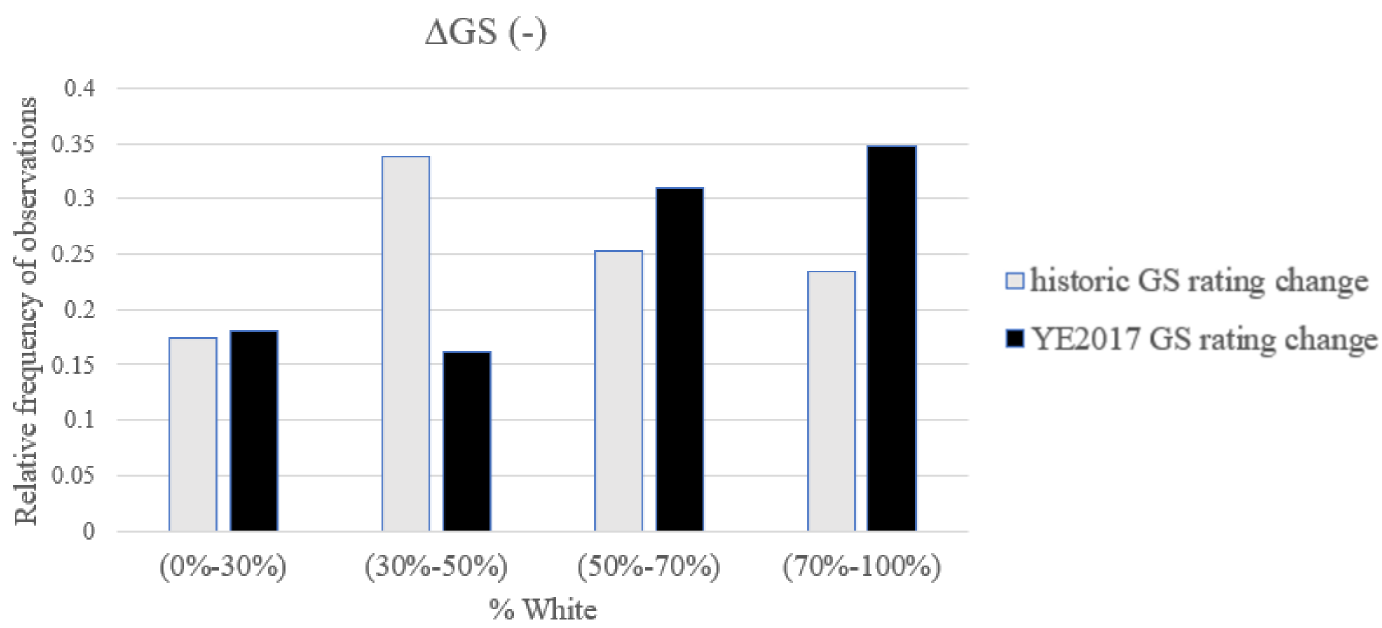
Notes: Figure 10 presents the characteristics of GS rating categories. The first column shows GS rating categories from 10 to 1. According to GS' classification, 10-7 is "above average", 6-5 is "average", and 4-1 is "below average". Figure 10 is thus divided accordingly, into three groups. The second column is the number of schools in each classification. The third column represents the median income of neighborhoods in which schools in each classification are located. The fourth column is the median percentage of White population. The fifth column show the median percentage of population within the neighborhoods that obtains at least a college education. The last two columns are the percentages of schools with GS rating increases, and those with GS rating decreases. The color green is used to highlight the numbers that stand out from one group to the other.

Figure 11. Historic GS rating change vs. YE2017 GS rating change

Panel A. Which schools got ΔGS (+), before vs. after YE2017?



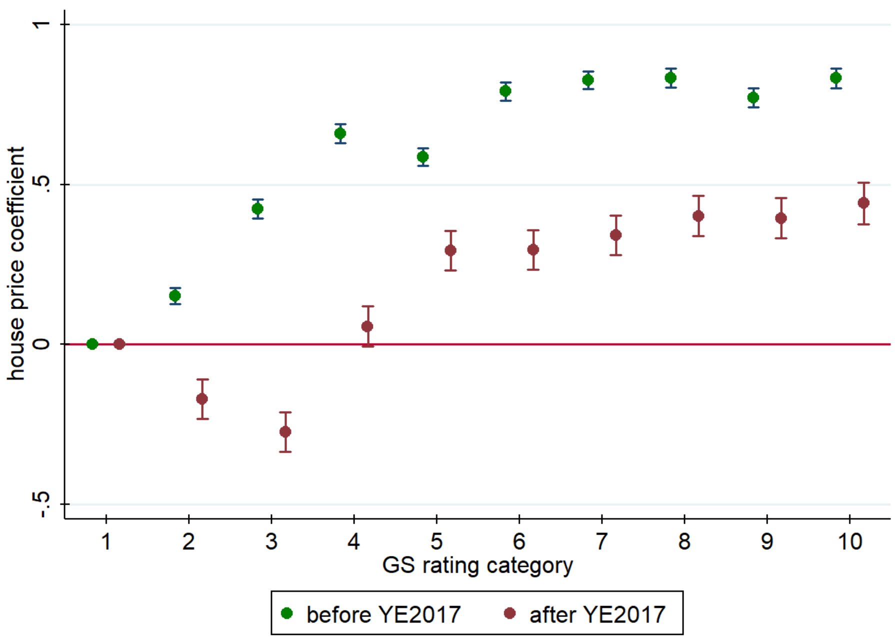
Panel B. Which schools got ΔGS (-), before vs. after YE2017?



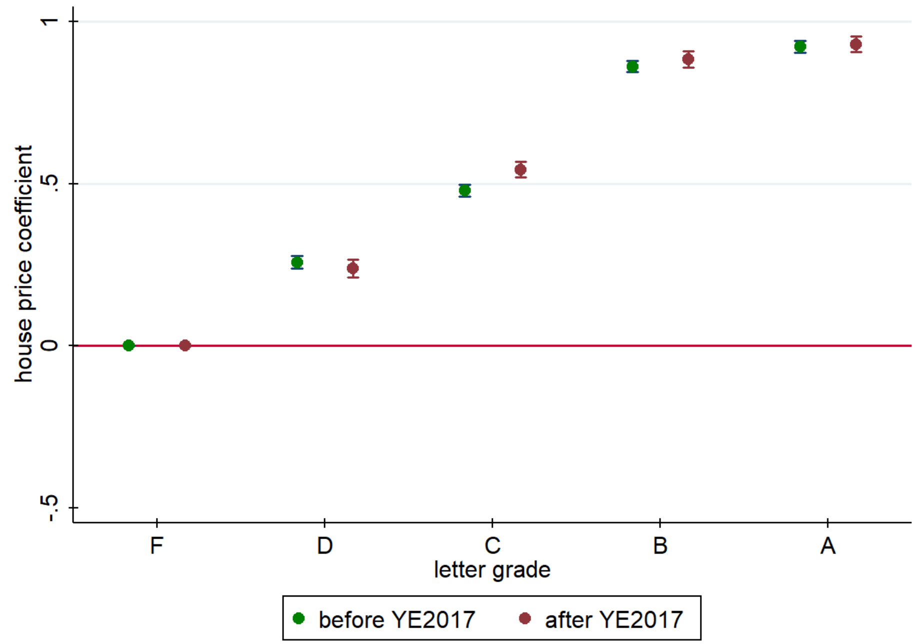
Notes: Figure 11 shows which schools receive positive GS rating changes in Panel A and negative GS rating changes in Panel B, before versus after YE2017. The grey bars represent the relative frequency of school observations by percentage of Whites (% White) historically, or before the GS rating change. The black bars show similar content for the period after YE2017, when GS incorporated other components including a DEI measure for school quality.

Figure 12. Home price and rating coefficients

Panel A. Home price against GS rating categories



Panel B. Home price against TS categories



Notes: Figure 12 plots transaction prices estimated for each rating category, controlling for property-level characteristics, neighborhood, and year fixed effects. Panel A is for GS rating categories, ranging from 1 to 10, with GS=1 being the base case. Panel B is estimated price for TS, which is divided by the letter grade categories from F to A, with F being the base case. The red reference line is set at the price coefficient of zero. The green dots represent price coefficient for ratings before YE2017, while the red dots show those after YE2017. The bar across each dot displays 95% confidence band for the estimated home price.

Table 4. Estimated Premiums: Home Prices in Schools with GS Rating Changes

Panel A. Equations (1) and (2) – combined treatment groups

	△GS+ and △GS-							
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
post	0.047***	0.045***						
	(0.01)	(0.01)						
treated	0.010	-0.019**						
	(0.01)	(0.01)						
treated*post	-0.015	0.027**	0.020**	0.015	0.015	0.019*	0.019*	0.018*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Hedonic controls		X	X	X	X	X	X	X
Month FE			X	X	X	X	X	X
School FE			X	X	X	X	X	X
Block group FE				X	X	X	X	X
Building permits					X	X	X	X
Zip x quarter FE						X	X	X
TS control							X	X
% TS change								X
Observations	30,496	30,496	30,496	30,496	30,496	30,496	30,496	30,496
Match samples	7,624	7,624	7,624	7,624	7,624	7,624	7,624	7,624
Adj R-squared	0%	37%	60%	64%	64%	66%	66%	66%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Equations (1) and (2) – separated treatment groups

Dependent variable: **log(price)**	△GS+ (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	△GS- (9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
post	0.077***	0.103***							0.036***	0.032***						
	(0.02)	(0.02)							(0.01)	(0.01)						
treated	0.026	0.022							0.003	-0.023***						
	(0.02)	(0.02)							(0.01)	(0.01)						
treated*post	-0.056*	-0.045*	-0.024	-0.032	-0.031	0.008	0.023	0.031	0.000	0.041***	0.026***	0.031***	0.031***	0.022*	0.022**	0.024**
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Hedonic controls		X	X	X	X	X	X	X		X	X	X	X	X	X	X
Month FE			X	X	X	X	X	X			X	X	X	X	X	X
School FE			X	X	X	X	X	X			X	X	X	X	X	X
Block group FE				X	X	X	X	X				X	X	X	X	X
Building permits					X	X	X	X					X	X	X	X
Zip x quarter FE						X	X	X						X	X	X
TS control							X	X							X	X
% TS change								X								X
Observations	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	22,036	22,036	22,036	22,036	22,036	22,036	22,036	22,036
Match samples	2,115	2,115	2,115	2,115	2,115	2,115	2,115	2,115	5,509	5,509	5,509	5,509	5,509	5,509	5,509	5,509
Adj R-squared	0%	43%	67%	70%	70%	73%	73%	73%	0%	36%	55%	59%	59%	62%	62%	62%

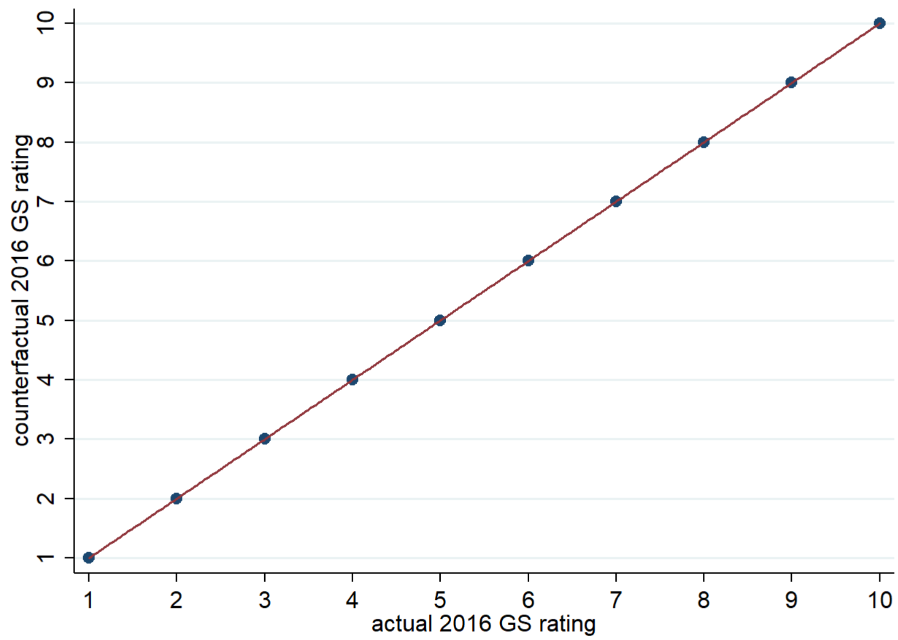
Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

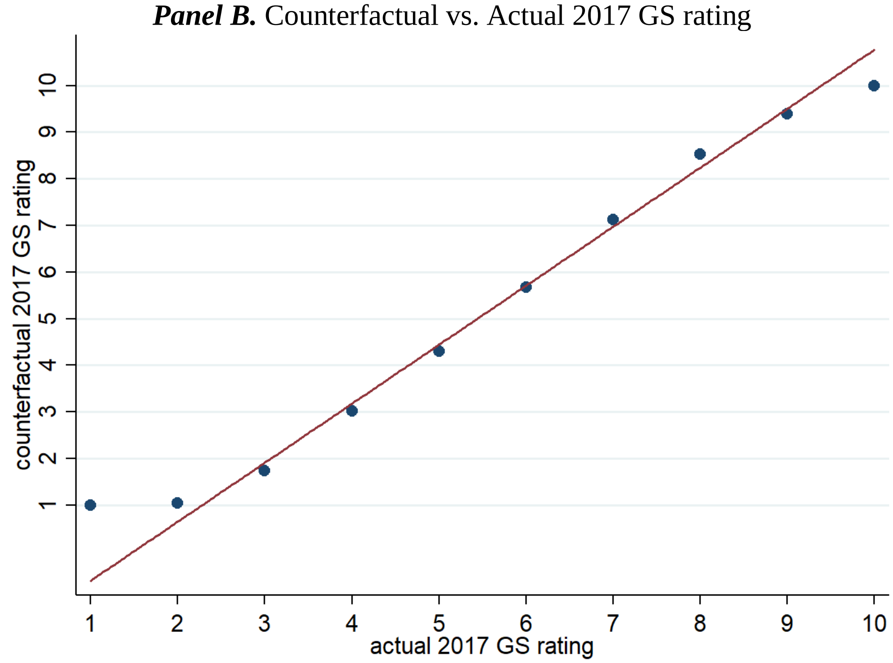
Notes: Table 4 studies home price estimations using equation (1) for column (1) and equation (2) for columns (2) to (8). The sample is constructed from the manual characteristic matching process, as described in the notes to Table 2. Observations are at the property-year level. Panel A displays results of combined treatment groups, including both the negative treatment group of decreasing GS rating and the positive treatment group of increasing GS rating, compared to the control group of no GS rating change. Running the same specifications, Panel B displays results for separate treatment groups: positive treatment on the left-hand side, and negative treatment on the right-hand side. Hedonic controls include the house size, property age and its square, median income, employment rate, along with indicator variables for month fixed effects, school fixed effects, block group fixed effects, building permits to control for housing supply side, zip by quarter fixed effects, TS and percentage change in TS (% TS change) to control for academic performance. In each model, the dependent variable is the housing transaction price, log(price), and indicator variables are included for post, treated, along with the interaction term treated*post, which measures the price impact of the new GS rating implemented in YE2017. All variables are defined in the notes to Table 1. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Figure 13. Counterfactual Ratings in Placebo Design

Panel A. Counterfactual vs. Actual 2016 GS rating



Panel B. Counterfactual vs. Actual 2017 GS rating



Notes: Figure 13 compares counterfactual GS rating that uses 100% TS to the actual rating that GS organization adopts during a particular year. Panel A is for 2016, the year immediately before the event of GS rating change. Panel B is for 2017, the first year that the actual GS rating incorporates a DEI measure from focusing exclusively on test scores. The red line is a reference line of 45 degrees.

Table 5. Estimated Price Premiums: Placebo Test

	△GS+ (or TS↑)						△GS- (or TS↓)					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.001	0.016					0.238***	0.230***				
	(0.01)	(0.01)					(0.03)	(0.03)				
treated	-0.051***	-0.103***					0.264***	0.171***				
	(0.01)	(0.01)					(0.03)	(0.03)				
treated*post	0.057***	0.051***	0.060***	0.096***	0.097***	0.091***	-0.167***	-0.115***	-0.100**	-0.121***	-0.121***	-0.084*
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	19,956	19,956	19,956	19,956	19,956	19,956	2,244	2,244	2,244	2,244	2,244	2,244
Match samples	4,989	4,989	4,989	4,989	4,989	4,989	561	561	561	561	561	561
Adj R-squared	0%	26%	54%	56%	56%	61%	5%	23%	52%	59%	59%	64%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 5 reports the results of the placebo test, which estimates prices for houses located in areas with positive counterfactual GS rating change in the left-hand side and negative counterfactual rating change in the right-hand one. The sample is constructed from the manual characteristic matching process, as described in the notes to Table 2. Observations are at the property-year level. The covariates are specified in the notes to Table 4, but TS and percentage change in TS are not included, due to counterfactual GS ratings already being made up by 100% TS in this placebo test. All variables are defined in the notes to Table 1. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 6. Heterogeneity Test by Test Score

Panel A. Home price by TS change in positive GS rating group

	△GS+											
	△TS+						△TS-					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.041	0.101***					0.174***	0.125***				
	(0.03)	(0.02)					(0.04)	(0.03)				
treated	-0.027	0.002					0.167***	0.090***				
	(0.03)	(0.02)					(0.04)	(0.03)				
treated*post	-0.001	-0.023	0.011	-0.001	0.005	0.040	-0.201***	-0.120***	-0.112**	-0.087*	-0.103**	-0.093
	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.06)	(0.04)	(0.05)	(0.05)	(0.05)	(0.08)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	6,136	6,136	6,136	6,136	6,136	6,136	2,324	2,324	2,324	2,324	2,324	2,324
Match samples	1,534	1,534	1,534	1,534	1,534	1,534	581	581	581	581	581	581
Adj R-squared	0%	40%	64%	66%	66%	69%	1%	54%	72%	77%	77%	80%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by TS change in negative GS rating group

	△GS-											
	△TS+						△TS-					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.027*	0.047***					0.043***	0.009				
	(0.01)	(0.01)					(0.01)	(0.01)				
treated	0.012	0.003					-0.005	-0.061***				
	(0.01)	(0.01)					(0.01)	(0.01)				
treated*post	0.030	0.053***	0.105***	0.128***	0.132***	0.118***	-0.025	0.046***	-0.061***	-0.078***	-0.079***	-0.090***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	10,348	10,348	10,348	10,348	10,348	10,348	11,688	11,688	11,688	11,688	11,688	11,688
Match samples	2,587	2,587	2,587	2,587	2,587	2,587	2,922	2,922	2,922	2,922	2,922	2,922
Adj R-squared	0%	34%	61%	65%	65%	69%	0%	37%	52%	55%	55%	58%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 6 presents the estimated prices when the matched sample is divided based on the subject's positive TS (reported in the left-hand side) versus negative TS (reported in the right-hand side). The regressions are based on the model for log(price) in equation (2). Panel A is for homes attending schools experiencing positive GS rating change, and Panel B is for those with negative GS rating change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 7. Heterogeneity Test by Migration Type

Panel A. Home price by migration type in positive ΔGS rating and negative ΔTS group

	△GS+ and △TS-											
	Local						Non-local					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.274***	0.234***					0.118**	0.109***				
	(0.04)	(0.03)					(0.05)	(0.03)				
treated	0.064	0.027					0.224***	0.132***				
	(0.04)	(0.03)					(0.05)	(0.03)				
treated*post	-0.246***	-0.157***	-0.052	-0.068	-0.108	-0.179*	0.176**	0.143***	0.026	0.035	0.044	0.001
	(0.06)	(0.05)	(0.06)	(0.06)	(0.08)	(0.10)	(0.07)	(0.05)	(0.12)	(0.12)	(0.12)	(0.12)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	832	832	832	832	832	832	1,492	1,492	1,492	1,492	1,492	1,492
Match samples	208	208	208	208	208	208	373	373	373	373	373	373
Adj R-squared	5%	41%	60%	67%	67%	71%	1%	60%	74%	78%	78%	82%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by migration type in negative ΔGS rating and positive ΔTS group

	△GS- and △TS+											
	Local						Non-local					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	-0.040***	-0.015					0.137***	0.147***				
	(0.01)	(0.01)					(0.03)	(0.02)				
treated	-0.037***	-0.039***					0.092**	0.080***				
	(0.01)	(0.01)					(0.03)	(0.02)				
treated*post	0.112***	0.125***	0.176***	0.204***	0.207***	0.187***	-0.104**	-0.083***	-0.034	-0.049*	-0.046*	-0.219***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	6,408	6,408	6,408	6,408	6,408	6,408	3,940	3,940	3,940	3,940	3,940	3,940
Match samples	1,602	1,602	1,602	1,602	1,602	1,602	985	985	985	985	985	985
Adj R-squared	1%	19%	35%	41%	41%	47%	1%	54%	77%	80%	80%	84%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 7 displays results from treated and treated*post coefficients from the base model for log(price), when the matched sample is divided into two groupings based on the composition of predominantly local (>50% local) and predominantly nonlocal (<50% local) homebuyers. Panel A reports home prices in areas where schools experience positive GS rating change and negative TS change. Panel B is home prices in areas where schools experience negative GS rating change and positive TS change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 8. Heterogeneity Test by Share of Minority

Panel A. Home price by share of minority in positive ΔGS rating and negative ΔTS group

	△GS+ and △TS-											
	Majority majority						**Majority minority**					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.078*	0.050*					0.260***	0.194***				
	(0.05)	(0.03)					(0.06)	(0.04)				
treated	-0.013	-0.072***					0.328***	0.208***				
	(0.05)	(0.03)					(0.06)	(0.04)				
treated*post	-0.042	-0.017	-0.040	-0.040	-0.072	-0.079	-0.344***	-0.210***	-0.305***	-0.235**	-0.226**	-0.101
	(0.06)	(0.04)	(0.05)	(0.06)	(0.06)	(0.10)	(0.09)	(0.06)	(0.11)	(0.10)	(0.10)	(0.17)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	1,100	1,100	1,100	1,100	1,100	1,100	1,224	1,224	1,224	1,224	1,224	1,224
Match samples	275	275	275	275	275	275	306	306	306	306	306	306
Adj R-squared	0%	67%	72%	74%	74%	78%	2%	55%	75%	80%	80%	84%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by share of minority in negative ΔGS rating and positive ΔTS group

	△GS- and △TS+											
	Majority majority						Majority minority					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.015	0.039***					0.040*	0.060***				
	(0.02)	(0.01)					(0.02)	(0.02)				
treated	0.038**	0.016					-0.013	-0.008				
	(0.02)	(0.01)					(0.02)	(0.02)				
treated*post	-0.025	0.010	0.063***	0.080***	0.088***	0.061***	0.083***	0.087***	0.122***	0.142***	0.146***	0.188***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	5,136	5,136	5,136	5,136	5,136	5,136	5,212	5,212	5,212	5,212	5,212	5,212
Match samples	1,284	1,284	1,284	1,284	1,284	1,284	1,303	1,303	1,303	1,303	1,303	1,303
Adj R-squared	0%	37%	64%	69%	69%	73%	1%	36%	61%	63%	63%	69%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 8 displays results from treated and treated*post coefficients from the base model for log(price), when the matched sample is divided into two groupings of majority majority and majority minority based on the 30% cutoff of share of minority in the neighborhood. Panel A reports home prices in areas where schools experience positive GS rating change and negative TS change. Panel B is home prices in areas where schools experience negative GS rating change and positive TS change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 9. Heterogeneity Test by Median Income

Panel A. Home price by median income in positive ΔGS rating and negative ΔTS group

	△GS+ and △TS-											
	High-income neighborhood						Low-income neighborhood					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.221***	0.198***					0.124**	0.052				
	(0.04)	(0.03)					(0.06)	(0.04)				
treated	0.294***	0.226***					0.031	-0.049				
	(0.04)	(0.03)					(0.06)	(0.04)				
treated*post	-0.221***	-0.213***	-0.141*	-0.130	-0.092	-0.068	-0.181**	0.000	-0.115*	-0.083	-0.057	-0.175
	(0.06)	(0.05)	(0.08)	(0.08)	(0.08)	(0.11)	(0.08)	(0.06)	(0.07)	(0.06)	(0.08)	(0.13)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	1,200	1,200	1,200	1,200	1,200	1,200	1,124	1,124	1,124	1,124	1,124	1,124
Match samples	300	300	300	300	300	300	281	281	281	281	281	281
Adj R-squared	5%	39%	54%	66%	66%	71%	0%	51%	80%	84%	84%	86%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by median income in negative ΔGS rating and positive ΔTS group

	△GS- and △TS+											
	High-income neighborhood						**Low-income neighborhood**					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.010	0.041**					0.044**	0.041***				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated	-0.065***	-0.044***					0.086***	0.041***				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated*post	0.098***	0.103***	0.119***	0.115***	0.116***	0.180***	-0.036	0.005	0.087***	0.121***	0.119***	0.057**
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	5,064	5,064	5,064	5,064	5,064	5,064	5,284	5,284	5,284	5,284	5,284	5,284
Match samples	1,266	1,266	1,266	1,266	1,266	1,266	1,321	1,321	1,321	1,321	1,321	1,321
Adj R-squared	1%	25%	50%	54%	54%	60%	1%	35%	63%	68%	68%	72%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 9 displays results from treated and treated*post coefficients from the base model for log(price), when the matched sample is divided into two groupings of high-income neighborhood and low-income neighborhood based on the 50th percentile of income in the neighborhood. Panel A reports home prices in areas where schools experience positive GS rating change and negative TS change. Panel B is home prices in areas where schools experience negative GS rating change and positive TS change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 10. Heterogeneity Test by Education Level

Panel A. Home price by education level in positive ΔGS rating and negative ΔTS group

	△GS+ and △TS-											
	High-education neighborhood						Low-education neighborhood					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.135***	0.114***					0.215***	0.132***				
	(0.04)	(0.03)					(0.05)	(0.04)				
treated	0.322***	0.232***					0.006	-0.034				
	(0.04)	(0.03)					(0.05)	(0.04)				
treated*post	-0.207***	-0.184***	-0.079	0.057	0.105	0.075	-0.196***	-0.044	-0.097*	-0.072	-0.091	-0.182*
	(0.06)	(0.05)	(0.12)	(0.11)	(0.11)	(0.12)	(0.07)	(0.06)	(0.06)	(0.06)	(0.08)	(0.11)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	1,184	1,184	1,184	1,184	1,184	1,184	1,140	1,140	1,140	1,140	1,140	1,140
Match samples	296	296	296	296	296	296	285	285	285	285	285	285
Adj R-squared	6%	32%	49%	64%	64%	70%	2%	41%	75%	79%	79%	82%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by education level in negative ΔGS rating and positive ΔTS group

	△GS- and △TS+											
	High-education neighborhood						**Low-education neighborhood**					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.015	0.028*					0.040**	0.054***				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated	0.082***	0.052***					-0.057***	-0.052***				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated*post	-0.009	0.023	0.109***	0.135***	0.138***	0.075***	0.068**	0.088***	0.071***	0.118***	0.121***	0.155***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	5,136	5,136	5,136	5,136	5,136	5,136	5,212	5,212	5,212	5,212	5,212	5,212
Match samples	1,284	1,284	1,284	1,284	1,284	1,284	1,303	1,303	1,303	1,303	1,303	1,303
Adj R-squared	1%	38%	67%	70%	70%	75%	1%	26%	49%	54%	54%	60%

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 10 displays results from treated and treated*post coefficients from the base model for log(price), when the matched sample is divided into two groupings of high-education and low-education neighborhood based on the 50th percentile of education level in the neighborhood. Panel A reports home prices in areas where schools experience positive GS rating change and negative TS change. Panel B is home prices in areas where schools experience negative GS rating change and positive TS change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 11. Heterogeneity Test by Median Age

Panel A. Home price by median age in positive ΔGS rating and negative ΔTS group

	△GS+ and △TS-											
	High median age (older) neighborhood						Low median age (younger) neighborhood					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.133***	0.116***					0.212***	0.128***				
	(0.04)	(0.03)					(0.06)	(0.04)				
treated	0.324***	0.222***					0.023	0.000				
	(0.04)	(0.03)					(0.06)	(0.04)				
treated*post	-0.136**	-0.120***	-0.094	-0.132**	-0.116**	-0.216**	-0.260***	-0.085	-0.085	-0.037	-0.012	0.144
	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.09)	(0.08)	(0.06)	(0.09)	(0.10)	(0.10)	(0.15)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	1,108	1,108	1,108	1,108	1,108	1,108	1,216	1,216	1,216	1,216	1,216	1,216
Match samples	277	277	277	277	277	277	304	304	304	304	304	304
Adj R-squared	6%	50%	67%	76%	77%	81%	1%	55%	76%	79%	79%	83%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by median age in negative ΔGS rating and positive ΔTS group

	△GS- and △TS+											
	High median age (older) neighborhood						**Low median age (younger) neighborhood**					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.038*	0.048***					0.017	0.042***				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated	0.050**	0.023					-0.025	-0.021				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated*post	-0.025	0.019	0.068***	0.112***	0.106***	0.076***	0.084***	0.091***	0.125***	0.156***	0.156***	0.157***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	5,144	5,144	5,144	5,144	5,144	5,144	5,204	5,204	5,204	5,204	5,204	5,204
Match samples	1,286	1,286	1,286	1,286	1,286	1,286	1,301	1,301	1,301	1,301	1,301	1,301
Adj R-squared	0%	47%	71%	74%	74%	79%	1%	23%	49%	53%	53%	60%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 11 displays results from treated and treated*post coefficients from the base model for log(price), when the matched sample is divided into two groupings of older and younger neighborhood based on the 50th percentile of median age in the neighborhood. Panel A reports home prices in areas where schools experience positive GS rating change and negative TS change. Panel B is home prices in areas where schools experience negative GS rating change and positive TS change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.

Table 12. Heterogeneity Test by Homeownership Rate

Panel A. Home price by homeownership rate in positive ΔGS rating and negative ΔTS group

	△GS+ and △TS-											
	High homeownership rate						Low homeownership rate					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.258***	0.254***					0.101*	0.006				
	(0.05)	(0.04)					(0.06)	(0.04)				
treated	0.298***	0.242***					0.052	-0.042				
	(0.05)	(0.04)					(0.06)	(0.04)				
treated*post	-0.272***	-0.276***	-0.154**	-0.141**	-0.139**	-0.035	-0.140	0.029	-0.117	-0.077	-0.064	0.064
	(0.06)	(0.05)	(0.07)	(0.07)	(0.07)	(0.13)	(0.09)	(0.05)	(0.08)	(0.08)	(0.08)	(0.12)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	1,080	1,080	1,080	1,080	1,080	1,080	1,244	1,244	1,244	1,244	1,244	1,244
Match samples	270	270	270	270	270	270	311	311	311	311	311	311
Adj R-squared	5%	38%	55%	65%	65%	71%	0%	62%	85%	87%	87%	90%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Home price by homeownership rate in negative ΔGS rating and positive ΔTS group

	△GS- and △TS+											
	High homeownership rate (owner occupants)						**Low homeownership rate (renters)**					
Dependent variable: **log(price)**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
post	0.000	0.020					0.055**	0.080***				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated	-0.019	-0.023					0.044**	0.033**				
	(0.02)	(0.02)					(0.02)	(0.02)				
treated*post	0.042	0.076***	0.170***	0.217***	0.209***	0.162***	0.017	0.006	0.022	0.034	0.035	-0.016
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Hedonic controls		X	X	X	X	X		X	X	X	X	X
Month FE			X	X	X	X			X	X	X	X
School FE			X	X	X	X			X	X	X	X
Block group FE				X	X	X				X	X	X
Building permits					X	X					X	X
Zip x quarter FE						X						X
Observations	5,208	5,208	5,208	5,208	5,208	5,208	5,140	5,140	5,140	5,140	5,140	5,140
Match samples	1,302	1,302	1,302	1,302	1,302	1,302	1,285	1,285	1,285	1,285	1,285	1,285
Adj R-squared	0%	21%	51%	54%	54%	60%	1%	47%	72%	76%	76%	80%

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 12 displays results from treated and treated*post coefficients from the base model for log(price), when the matched sample is divided into two groupings of owner occupants and renters based on the 50th percentile of homeownership rate in the neighborhood. Panel A reports home prices in areas where schools experience positive GS rating change and negative TS change. Panel B is home prices in areas where schools experience negative GS rating change and positive TS change. The estimations include the same covariates described in the notes to Table 5. Standard errors (s.e.) displayed in parentheses are heteroskedasticity robust. ***, **, and * denote statistical significance for the estimated coefficient at the 1%, 5%, and 10% levels, respectively.