Home Purchase Appraisals in Minority Neighborhoods

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Abstract

We study how a neighborhood's share of African American residents enters an appraiser's assessment of value for home purchase transactions. Unconditionally, low appraisals (below the contract price) are at least 68 percent likelier in majority African American neighborhoods relative to White neighborhoods. Accounting for many appraisal inputs, including the appraiser themselves, reduces this "low appraisal gap" by 56 percent. A factor decomposition reveals differences in non-race neighborhood characteristics and appraiser type as principal factors driving this attenuation. Moreover, the role of neighborhood race fades almost entirely when the appraiser works in very familiar neighborhoods, a finding consistent with information-based theories of discrimination.

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1 Introduction

The Fair Housing Act (FHAct) of 1968 and the Equal Credit Opportunity Act (ECOA) of 1974 prohibit decisions in the financing of home sales on the basis of race or color. Nevertheless, differences in outcomes have been shown to persist. Documenting and uncovering the reasons underlying them is of perennial interest to academics and policymakers alike (i.e., Yinger (1999); Hanson et al. (2016); Bayer et al. (2017, 2018); Bartlett et al. (2022); Bowen III et al. (2024)). Yet, the mortgage process is complex. A key step in it, the appraisal, has until recently received less attention.

In this paper, we examine appraisers' use of race in their assessment of value for home purchase transactions. Most existing work on race and appraisal outcomes for purchases takes the form of popular press articles (Kamin, 2020; Mock, 2020; Edwards, 2021; Choe, 2022) or policy reports. Some of these have shown differences persist (Rothwell and Perry, 2022; Howell and Korver-Glenn, 2021; Williamson and Palim, 2022; Narragon et al., 2022), while some have argued otherwise (Peter and Pinto, 2023). A few academic studies showing differential outcomes by race have appeared as well (Howell, 2023a; Jackson, 2024).

This emergent evidence often relies on aggregated outcomes, limited information about the appraisal, or on appraisals of originated mortgages. Aggregation and limited information blur the link between input factors and the appraiser's ultimate valuation. Lack of visibility into the role these factors play narrows examination of the relationship between appraisals and race, especially of the underlying channels. Reliance on originated mortgage transactions biases any conclusions. This is because the appraisal outcome predicts whether or not a mortgage is ultimately originated (Fout and Yao, 2016).

Our paper forges a tighter empirical link between appraisal outcomes and race. In particular, we document how the many factors entering an appraiser's assessment, including the appraiser themselves, explain differences in outcomes by race. We then decompose the role of each factor in moderating this association. Going further, we show that heterogeneity in appraisers' past experiences plays a critical role in explaining observed differences. Lying at the heart of our contribution, this accounting of experience also sheds new light on the mechanisms underlying appraisers' incorporation of race into their assessment of value.

The findings here are rooted in our analysis of the Federal Housing Finance Agency's (FHFA) Uniform Appraisal Dataset (UAD), a repository of millions of appraisals nationwide. The UAD is uniquely suited to this analysis for three main reasons. First, for each appraisal the UAD collects detailed information on the property, the assessment process, including all comparables and adjustments, and the final outcome. Second, it also collects information on the appraiser themselves, which we use to construct a unique and anonymous identifier for them in the data. New to the literature, this identifier allows us to account for appraiser sorting, using an appraiser fixed effect, and to track each appraiser's experiences across

neighborhoods and over time. Third, the UAD includes appraisals that led to a mortgage being originated and those that did not, side-stepping the issue of selection in the data.

Our main outcome of interest is the likelihood of a low appraisal – below the a-priori agreed upon contract price. Low appraisals can trigger higher upfront payment, worse loan terms, or denial of credit altogether. This is because lenders must adhere to a minimum value rule, whereby the lower of appraisal and contract price determines the collateral value for underwriting the loan. Though we also document how race relates to the entire distribution of appraisal values, appraisals at or above the contract price very rarely alter the parameters of a transaction.

Throughout, we consider the race composition of the neighborhood, or neighborhood race, as the most relevant source of demographic information used by the appraiser. This is because, unlike other aspects of financing a home purchase, a property's value is intimately connected to the neighborhood. The appraiser, who is hired and paid by the lender, likely never interacts with or knows much about either buyer or seller, who may even be of different races altogether. Yet, the appraiser almost always visits the property, and thus the neighborhood.

The data show that, unconditionally, low appraisals are at least 68 percent more likely in a neighborhood that is majority ($\geq 50\%$) African American compared to one with no African American residents. When we account for the numerous factors an appraiser uses to assess value, this low appraisal gap is attenuated by 56 percent. Unsurprisingly, the included input factors are systematically related to neighborhood race, driving the attenuation.

Properties appraised in neighborhoods with more African American residents are typically smaller, older, and of lower reported quality. Appraisers assigned to these properties use comparables that are nearer and less likely to have been sold recently, thereby trading off market information for proximity and making fewer adjustments. These appraisers are also more likely to assess low generally. Moreover, the neighborhoods themselves have fewer desirable non-race characteristics, like poorer air quality and lower home-ownership rates.

An application of the decomposition method in Gelbach (2016) reveals that two of these factors particularly stand out in attenuating the low appraisal gap. The first is non-race neighborhood characteristics, which accounts for about 39 percent of the attenuation. The second is the appraiser themselves, which accounts for another 39 percent – and is almost entirely driven by the fixed effect. Only a minority of the attenuation, about 22 percent, is attributed to variation in property characteristics, the use of comparable properties, and local housing market trends.

Accounting for input factors does not entirely eliminate the low appraisal gap. Significant differences in the likelihood of low appraisals by neighborhood race still remain. We try to explain these by incorporating heterogeneity in appraisers' past experience into the

conditional relationship between neighborhood race and low appraisals. Formally, we interact race with two measures of experience. The first is the overall number of appraisals previously completed. The second is the number of appraisals previously completed in the specific neighborhood where they are appraising.

The interaction of neighborhood race with an appraiser's overall experience does not substantially alter the likelihood of reporting low by race. However, interacting race with an appraiser's specific neighborhood experience significantly attenuates it. For an appraiser working where they have appraised many times before, the difference in their propensity to appraise low by race is not statistically distinguishable from zero. Since our specifications include appraiser fixed effects, we interpret the interaction results as follows. When appraising in neighborhoods well known to them, a typical appraiser does not seem to incorporate neighborhood race into their assessment of value. However, more familiarity with appraising overall does not alter the appraiser's likelihood of reporting low by neighborhood race.

Finally, these results on experience also point to the mechanism underlying any use of race in appraisals. The established literature on the economics of discrimination has settled on two main views. The first is a preference based theory postulating an innate cost of trade with individuals of a different background or group (Becker, 1957). The second is information based, or statistical, and is premised on incomplete information vis-a-vis another group (Stiglitz, 1973; Arrow, 1998). Our finding that specific knowledge of the neighborhood matters for eliminating the low appraisal gap is consistent with information based models. Moreover, though cursory evidence, the fact that general experience does not alter the gap is somewhat inconsistent with preference based theories that predict inexperienced appraisers trying to establish a reputation may find it more costly not to be accurate.

2 Background

Appraisal standards were first codified as part of the Financial Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA) as a response to losses from the Savings and Loan crisis of the late 1980s (Getter, 2023).[1] They call for an appraisal report to be ordered by the lending institution (or its agent) once the buyer and seller reach a purchase agreement and a purchase (contract) price is determined. The objective is to provide a lender with the fair market value of a property that is to be the collateral for a new mortgage. Lenders are

[1]The rule covers conventional mortgages originated by regulated entities such as banks, credit unions, and mortgages eligible to be purchased by Government Sponsored Enterprises (GSE). It also covers mortgages underwritten by the Federal Housing Administration (FHA), Veterans Administration (VA), and the United States Department of Agriculture (USDA) Development backing. Certain loan program types (e.g., FHAct's streamline refinance) and transactions with loan sizes under a threshold are exempted from the requirement.

the clients. They select, review, and pay for appraisal services.[2]

The appraisal enters mortgage underwriting as part of the loan-to-value (LTV) calculation. The LTV is correlated with loan performance (Elul et al., 2010; Mayer et al., 2009). As a result, it determines GSE purchase eligibility and risk-pricing in privately securitized mortgage pools. In their calculation, lenders are required to follow the minimum value rule. The rule dictates that the property value be determined as the lesser of contract price and appraisal. An appraised value below the contract price, or low appraisal, thereby raises the LTV relative to that implied by the existing contract. This can trigger a mortgage insurance requirement and even a higher interest rate on the loan, adversely affecting the buyer's financial position and the viability of the transaction altogether.[3] In contrast, appraisals at or above the contract price do not functionally alter the transaction.[4]

The appraisal regulatory system is substantial. It is comprised of the Appraisal Foundation, the Appraisal Subcommittee (ASC) of the Financial Institutions Examinations Council (FFIEC), and state-level appraiser regulatory agencies. The Appraisal Foundation sets the standards for the real estate valuation profession and publishes the Uniform Standards of Professional Appraisal Practice (USPAP), which are generally recognized as the ethical and performance standards for the appraisal profession. The FFIEC oversees state-level licensing and certification standards, as well as appraisal management companies (AMCs). Licensing standards can vary across states. Since the adoption of the Home Valuation Code of Conduct (HVCC) in 2009, lenders often interact with appraisers through intermediary appraisal management companies (AMC).[5]

[2]Though, this cost is usually passed on to the borrower.

[3]In lieu of paying for mortgage insurance of a higher interest rate, a buyer can increase their cash down or re-negotiate the contract altogether. Further, upon review of the appraisal, if the buyer believes the appraisal failed to include relevant information about the property or improperly compared it to recent property sales, they have the option to initiate the Reconsideration of Value (ROV) process with the lender by submitting a written request with included evidence. The lender then may or may not order a second appraisal.

[4]As discussed in Eriksen et al. (2020), there are incentives for appraisers to avoid low appraisals and instead appraise at, or confirm, the contract price. As further evidence of these claims, Fout and Yao (2016) show that low appraisals lead to a higher incidence of transactions being delayed and canceled, which destroys value for all parties involved – including the lender (client). Calem et al. (2021) also explain via a stylized model how appraisers can have a strong incentive to distort a low appraised value by raising it to equal the contract price when acting as agents of the lender. Their model gives interpretation to the well known fact of asymmetric appraisal outcomes, whereby this asymmetry is especially prevalent at and below the contract price. However, this work provides less clarity on incentives above the contract price. Institutionally, high appraisals can generate additional scrutiny from the lender and GSEs, which may undo incentives to distort upwards. Nevertheless, for some marginal cases lenders may prefer higher appraisals to get borrowers into better loans, whereby this may be internalized by the appraiser. We discuss this more in Section 4.1 below.

[5]The literature has documented how prior to 2009 direct interaction between lenders and appraisers may have led to inflated housing values, potentially contributing to the 2007 financial crisis (Shi and Zhang, 2015). In 2009, FHFA adopted the Home Valuation Code of Conduct (HVCC). The HVCC was "based on an agreement between the Enterprises, the New York State Attorney General Andrew Cuomo, and FHFA to improve the reliability of home appraisals" (see FHFA's announcement: https://www.fhfa.gov/news/news-release/fhfa-announces-home-valuation-code-of-conduct). Attorney General Cuomo's

Of the three principal approaches to valuation identified by the USPAP, the sales comparison approach is by far the most common for residential mortgage transactions. This is in large part due to guidance from the GSEs and government insuring or guaranteeing agencies such as the U.S. Department of Housing and Urban Development (HUD), Veterans Administraion (VA), and US Department of Agriculture's Rural Housing Services (RHS).[6] It unfolds in four parts.

First, the appraiser may conduct an on-site inspection to collect information about the subject property. This includes the legal, site, neighborhood, and detailed physical characteristics of the property. Second, the appraiser identifies comparable properties that are most similar to the subject property.[7] Third, the appraiser analyzes each comparable property, price adjusts each attribute that is different from the subject, and calculates an adjusted sale price for each one. Fourth, the appraiser reconciles adjusted sale prices of the comparable properties to arrive at an assessment of value for the subject property.

There is no explicit formula for reconciliation. It is done by assigning discretionary and unreported "weights" of value to each comparable property's adjusted sale price. This means that, under the USPAP, the sales comparison approach affords appraisers substantial discretion in how they value homes. As an example, the literature has shown that following the adoption of the HVCC, which reduced lenders' direct contact with appraisers, indicators of inflated property prices waned. However, these indicators have climbed again in the years since (Ben-David, 2011; Eriksen et al., 2020). This suggests lenders and appraisers retained sufficient flexibility to allow for accommodation to the new regulatory regime.

In an arm's length home purchase the appraiser rarely interacts with either the buyer or the seller. They receive a contract from the lender, their client, that includes financial information about the purchase, often only a contract price and sometimes the name of the buyer. Nevertheless, a site visit is almost always required. Any information about the seller stems from this visit, at which point the appraiser may or may not meet the seller or learn about them if they enter the property.[8] The appraiser is thereby necessarily informed by the neighborhood in forming their opinion of value.

invovlement likely stemmed from a complaint, *People Cuomo v. First American Corporation*, filed in 2007.

[6]The cost approach is mostly applicable to proposed or new construction, while the income approach is relevant only for properties that are intended to be used for income-generating purposes (i.e., rental properties). If the appraiser develops more than one approach to value, the approaches are reconciled.

[7]They most commonly do so by researching county/municipal records, Multiple Listing Service (MLS) records, and other data services. Similarity is defined in terms of location, age, physical characteristics, and timing of the sale transaction. Appraisals for mortgages eligible to be purchased by Fannie Mae and Freddie Mac must contain at least three settled (closed) comparable sales, although listing or pending sales can also be included as comparables in the reports.

[8]Other than the lender, an appraiser might interact with the listing agent of the property to arrange a site visit. Frequently, listing agents advise sellers to not be present when the appraiser arrives. The appraiser may learn about their background from entering their home, if it is still occupied. They likely never learn anything about the sellers if the property has been vacated.

Appraising is an occupation entered largely through apprenticeship. An individual wanting to become an appraiser must first spend time as a trainee. They are required to complete hours of qualifying education and experience under a supervisory appraiser. Licensed residential appraisers can optionally pursue certification, which requires additional education and experience. This apprenticeship model lends itself to entering the job through an established network, whereby African American and other minority appraisers are heavily underrepresented. The education requirements mean that appraisers frequently have some college experience. Moreover, the typical appraiser is older than the average worker; nearly two thirds are more than 45 years old.[9]

Over this past decade, the question of race and appraisals has taken hold in the policy sphere (Howell, 2023a,b) and even as part of litigation (Edwards, 2021; Choe, 2022). Notably, cases involving alleged malfeasance by appraisers have exclusively referred to refinance appraisals. Unlike for purchase transactions that form the basis of our study, there is only one party and no contract price in a refinancing. This presents a different problem for the appraiser than is considered here. The case of appraisals on refinance transactions is treated nicely in Ambrose et al. (2025).

3 Data

Our analysis combines several sources of data. Principal among these is the Federal Housing Finance Agency's Uniform Appraisal Dataset (UAD). The UAD comprises the universe of home appraisals submitted to the Uniform Collateral Data Portal (UCDP). It is part of the Uniform Mortgage Data Program (UMDP), an effort undertaken jointly by Fannie Mae and Freddie Mac at the direction of the Federal Housing Finance Agency to enhance mortgage data quality and standardization. The UAD represents the standard for data entry for home appraisals. It has been required by Fannie Mae and Freddie Mac since 2011 for all mortgages intended to be delivered to them for acquisition. We analyze all UAD purchase appraisal records for 1-unit single-family properties, including 1-unit properties with an accessory unit or a unit in a planned unit development (PUD).[10]

[9] Appendix A.1 we compile detailed appraiser demographics in the United States from the Bureau of Labor Statistics for our period of analysis.

[10] These are digitized from the Uniform Residential Appraisal Report (URAR) for purchase mortgage applications requiring a traditional home appraisal. It excludes hybrid or desktop appraisals, exterior-only appraisals, and appraisals for a manufactured home or a unit in a condominium or cooperative project. The data is collected using Fannie Mae Form 1004/Freddie Mac Form 60. For details, see: `singlefamily.fanniemae.com/delivering/uniform-mortgage-data-program/uniform-appraisal-dataset`, and `sf.freddiemac.com/tools-learning/uniform-mortgage-data-program/uad`. In Appendix A.2, we detail the market coverage of the UAD. Over our period of analysis, UAD appraisals account for up to 47%-58% of mortgaged single family sales and 40%-50% of overall single family home sales.

Each UAD record contains a wealth of information about the subject property, the comparable properties used, and their reconciliation. In addition to the appraisal outcome, this includes extraordinarily detailed information on the location, contract price and characteristics of the subject property, sale price and characteristics of each comparable property, and concession, or adjustment, amount.[11] The appraiser is also required to provide standardized ratings on the property condition, construction quality, and an indication on whether there was any recent upgrade. We use information on comparable properties to calculate the distance between the subject and comparable properties, differences in attributes, and adjustments made by the appraiser. Using information about the appraiser, we construct a unique anonymous identifier to track them across space and over time.

The regulation of appraisers occurs in large part at the state level. As a result, appraisers must register in each state where they are working and receive a certification number. However, it is not uncommon for appraisers to work across state lines, especially in large metropolitan areas that cross borders – of which there are several in the United States. In addition to this state identification number, the UAD collects information on the appraiser directly, such as name, address, phone number, and email. We develop an algorithm that uses this information to create a true unique identifier for the appraiser - one that is not confined to state lines. To the best of our knowledge, this has not been done previously.

A critical feature of the UAD is that it comprises appraisals that led to a mortgage origination as well as appraisals that did not. Once an appraisal is ordered by the lender as part of the mortgage application process and the report has been completed and submitted to the UCDP system by the appraiser, a UAD record is generated and kept in the system. This is an important feature of the data because a low appraisal substantially raises the likelihood a sale is not completed and the loan is not made. As a result, analyses relying on data from originated mortgages can lead to severely biased estimates on the relationship between appraisal outcomes and race. Analyses using the UAD are not prone to this missing data problem.

Our definition of the neighborhood is a Census tract, and we obtain demographics at the tract level from the American Community Survey's (ACS) five-year averages.[12] These include population density, education, income, take up of public assistance, home ownership rates, and age of homes in the neighborhood. We include information on these for the analysis period (2015-2019) and also for the previous 5-year period (2010-2014). Including this historic information allows us to control for the medium-term growth or decline of the neighborhood.

Air quality is an important neighborhood amenity and, more importantly, a determinant

[11] See Appendix B.1 for more information.

[12] We use the ACS five-year data available through the University of Minnesota's Integrated Public Use Micro-data Series (IPUMS). The data can be obtained at usa.ipums.org.

of property values (Chay and Greenstone, 2005). It is not explicitly captured in the appraiser's report, though it can form part of their valuation decision. We obtain air quality data from the Centers for Disease Control and Prevention's (CDC) modeled predictions from the EPA's *Downscaler* model. Specifically, we use the $PM_{2.5}$ daily forecast at the Census tract level.[13] We include both mean and standard deviation of this measure over our five year analysis period. The latter accounts for the significant chance of bad quality days even when the average air quality is fair. Finally, we use the monthly Zillow Home Value Index (ZHVI) at the County level to track local market fluctuations.[14] These are merged at the tract and county-month level, respectively.

Our period of analysis spans January 2015 to December 2019, inclusive. We choose this period because it coincides with the 2015-2019 American Community Survey (ACS) 5-year average. This is the most recent ACS release prior to the beginning of the COVID-19 pandemic. It thereby avoids complications to our analysis brought on by market disruptions stemming from the pandemic shock.[15] Summary statistics of the data are reported in Table 1. The analysis data includes a little over 10 million appraisal records completed in 67,369 tracts.

As shown in the table, about 7.8 percent of appraisals are below the contract price, or are low appraisals. The typical low appraisal is nearly 5 percent lower than the contract price. For more than 75 percent of low appraisals in our sample, the appraised value is more than 1.8 percentage point (p.p.) lower than the contract price.[16] Of the remaining 92.2 percent of appraisals in our sample, 26.8 percent are exactly equal to the contract price and 65.4 percent are above.

The large mass of appraisals exactly equal to the contract price has long been a source of interest in the literature. In particular, it is a USPAP requirement for an appraiser to have knowledge of the contract price. This is confirmed in the data. For nearly all appraisals ($> 99\%$), the appraiser reports having previous knowledge of the contract price. Prevalence of high appraisals has also been documented in previous work, though it has been analyzed less.

The average contract price in our sample is \$338,900, with an inter-quartile range of about \$226,500. For just over nine in ten properties of our sample, 80 percent of the contract price

[13] More information on the *Downscaler* model and these data can be found in data.cdc.gov/Environmental-Health-Toxicology/Daily-Census-Tract-Level-Ozone-Concentrations-2016/hf2a-3ebq/about_data

[14] Specifically, we use the smoothed ZHVI time series for all homes. The data can be obtained at https://www.zillow.com/research/data/.

[15] During this time, many appraisals were not conducted on site and numerous exceptions to the regular process were given. Many of these, though not all, have dissipated since.

[16] Not shown in the table, about 90 percent of low appraisals are at least 1 percent below the contract price.

Table 1: Summary Statistics

	Mean	SD	P25	P50	P75
Appraisal Outcomes					
Low Appraisals	7.84				
Difference | Low	-4.93	5.24	-6.25	-3.45	-1.84
Equal Appraisals	27.17				
High Appraisals	64.99				
Subject Property					
Contract Price ($)	338,900	291,307	178,398	269,900	404,980
% Financial Assistance	42.36				
% Over Conforming Limit	8.63				
Quality Score (1-5)	3.57	0.58	3	4	4
Condition Score (1-5)	2.84	0.91	3	3	3
% For Sale Last 3 Years	25.26				
Effective Age (Years)	13.04	10.49	5	10	20
Comparables					
Comparable Prop. for Sale ≤ 2	22.90				
Number of Comparable Properties Used	5.16	1.34	4	5	6
Calc. Avg Proximity of Comps (Miles)	1.21	2.21	0.31	0.54	1.09
Avg. Gross Adjustment (%)	10.64	6.96	5.88	9.10	13.64
Appraiser					
Number of Completed Appraisals	304.41	344.35	77	197	409
Number of Completed Appraisals in Neighborhood	5.53	14.12	0	1	5
Tract/Neighborhood					
% African American	13.60	21.48	0.99	4.26	15.24
Pop. Density (1k/mi^2)	4.67	8.79	0.33	2.23	5.26
% Bachelors or Higher	39.04	18.71	24.61	35.61	51.33
Median Annual Household Income ($)	67,380	33,241	44,783	49,875	81,866
% Owner Occupied	64.63	21.72	50.44	69.25	81.93
% Public Assistance	2.51	2.85	0.71	1.68	3.31
% Constructed Pre 1970	42.91	28.41	18.05	40.66	66.80
Mean Predicted Daily $PM_{2.5}$ Level	8.54	1.49	7.59	8.64	9.37
SD Predicted Daily $PM_{2.5}$ Level	4.26	1.22	3.52	4.11	4.69
Market					
$\%\Delta$ZHI	0.56	0.46	0.29	0.54	0.81
$\%\Delta\text{ZHI}_{t-1}$	0.56	0.47	0.29	0.54	0.81
Number of Observations	10,440,118				
Number of Tracts	67,369				

falls above the conforming limit in that county-year. This indicates that our sample is made up largely of properties in the middle range of the home value distribution, in line with the construction of the UAD described above. While some properties may be high value, they

are a minority.

Condition and quality scores are important variables in our analysis because they provide a standardized scale of assessment for the property. The appraiser reports these scores based on a holistic view of the property and any improvements. The measurements range from C1-C6 and Q1-Q6 for condition and quality ratings, respectively. The median condition score in our sample is C3 while the median quality score is Q4. These metrics are recorded for both subject properties and comparable sales.[17]

The typical subject property in our sample was built 35 years prior to its appraisal, and 75 percent were built fewer than 54 years prior. However, many improvements are made to homes after their construction. These changes are reflected in the effective age variable, which captures the appraiser's assessment of what age the property best compares to in its current condition. As shown in Table 1, the effective age for a typical property in our sample is just 13 years, whereas about 75 percent of homes are "effectively" less than 20 years old.

On average, five comparable properties are used in an appraisal and at least 4 are used in 75 percent of appraisals.[18] Moreover, for most appraisals, more than 2 comparable properties used have been recently or are currently for sale. On average, a comparable property is less than a mile away from the subject, though this also varies by neighborhood. The average gross adjustment of comparable property values made by an appraiser is a little over 10 percent of the contract price. This is a substantial amount underscored by the fact that its coefficient of variation is nearly two thirds of the mean. Such significant variation in the appraisers' gross adjustment highlights their flexibility in determining property values.

The average share of African Americans in a tract is 13.6 percent. However, this distribution is highly skewed. At the 25^{th} percentiles, fewer than 1 percent of tract residents are African American. Only 5 percent of tracts are majority African American (not shown). In an average tract, about 42 percent have a college degree and average annual income is \$63,380. About 64 percent of homes are owner occupied and just over 57 percent were constructed prior to 1970.[19]

High levels of particulate matter in the air are hazardous to health and are correlated

[17] A lower number indicates a higher quality/construction. For example, a "custom" home has quality rating Q2, whereas a standard tract home has a quality rating of Q4. A condition score of C1 refers to a home that is entirely new and has not yet been occupied. A home with condition rating C4 features minor deferred maintenance and physical deterioration due to normal wear and tear. For exact definitions, see: singlefamily.fanniemae.com/media/21731/display, and sf.freddiemac.com/docs/pdf/requirements/uad_appendix_d_field_specific_standardization_requirements.pdf.

[18] This is in line with estimates from Cannon and Fischler (2024) showing that the modal appraisal is based on 5 comparable properties.

[19] Note this statistic is distinct to actual age reported in UAD. This reflects all housing units in a tract, regardless of whether or not they have been put up for sale. As might be expected, homes put up for sale are on average younger (about 25 percent of properties appraised were for sale in the previous 3 years). This is reflected in the difference between these two variables shown in Table 1.

with housing prices. They also disproportionately negatively affect communities with higher shares of African American residents (Tessum et al., 2021). In our analysis sample, the average daily level of $PM_{2.5}$ is 8.88 $\mu g/m^3$. To put this in context, the Environmental Protection Agency (EPA) sets a daily $PM_{2.5}$ standard of 35 $\mu g/m^3$ and recently lowered the standard for annual $PM_{2.5}$ emissions from 12 $\mu g/m^3$ to 9 $\mu g/m^3$.

We use a 5-year average of daily particulate matter in order to be consistent with ACS 5-year estimates and the 5-year averages of UAD data included in the sample. While not an exact comparison to the annual standard, we note that each individual annual mean $PM_{2.5}$ estimate ranges only between 8.5 and 8.6 $\mu g/m^3$, similar to the overall average of 8.56 $\mu g/m^3$. Moreover, a (mean) standard deviation of 4.26 $\mu g/m^3$ suggests the average census tract often rises above the annual standard but does not often go over the daily standard.

4 Main Empirical Results

4.1 Appraisal Outcomes and Neighborhood Race

We begin the analysis by documenting the basic relationship between the likelihood of low appraisals and the percent of African American residents in a neighborhood, i.e. neighborhood race. This is frequently referred to as the low appraisal gap. As shown in Column 1 of

Table 2: Low Appraisals and Neighborhood Race

	(1) Low Appraisal	(2) Low Appraisal	(3) %Difference	(4) Equal Appraisal	(5) High Appraisal
% African American (A_g)	0.1060**	0.0470**	-0.0268**	0.0133**	-0.0603**
	(0.0019)	(0.0015)	(0.0008)	(0.0016)	(0.0023)
County-Qtr-Yr FE	✓	✓	✓	✓	✓
Controls for Input Categories					
Property (R)		✓	✓	✓	✓
Comparables (S)		✓	✓	✓	✓
Appraiser (E)		✓	✓	✓	✓
Tract (G)		✓	✓	✓	✓
Market (M)		✓	✓	✓	✓
Mean of Dependent Variable	7.8356	7.8356	-4.9288	27.1653	64.9991
Observations	10,440,118	10,440,118	812,386	10,440,118	10,440,118

Notes: *Data are from the UAD and include appraisals completed between 2015 and 2019, inclusive. See Section 3 for full description on data construction. See Appendix B.2 for complete regression results including the full set of estimates for controls. Standard errors in parentheses are clustered at the Census tract level.* $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$

Table 2, the unconditional association is quantitatively large: a one p.p. higher proportion

of African American residents in a tract is associated with a 0.106 p.p. higher likelihood of a low appraisal. As compared to a tract with few or no African American residents, the likelihood of a low appraisal is at least $0.106 \times 50 \approx 5.3$ p.p., or $5.3/7.8 \approx 68$ percent, higher in a tract that is majority African American.

As noted in Section 2, an appraiser follows the USPAP in reaching their value estimate. This means they consider the subject property's attributes, find comparable sales that best match the subject property, adjust for differences, and reconcile these based on physical property, neighborhood, and market characteristics. This process requires the appraiser to consider a great many factors into their decision rule, the quality and quantity of which may themselves be associated with neighborhood race. We organize these factors into five categories: (1) characteristics of the subject property (R), (2) characteristics (S) of the comparables used and their reconciliation, (3) the appraiser (E) themselves, (4) characteristics and amenities of the neighborhood (G), and (5) local housing market conditions (M).

The first of these, characteristics of the subject property (R), is captured by the UAD in extraordinary detail. We account for total number of rooms, bedrooms, bathroom, half bathrooms, total lot size, gross living area, basement, below-grade finished and unfinished area, central air conditioning system, swimming pool, fireplace, parking garage, number of stories, quality and condition ratings, and whether the unit has a water view or is situated in a water-view location. We also control for the appraiser's determination of the property's effective age, and their assessment of its overall quality and construction.[20]

Information about comparable properties (S) is also well represented in the UAD. We control for the number of comparable properties used by the appraiser. This accounts for the quantity of information solicited by the appraiser. We also control for their average distance from the subject property and how many were recently for sale, both elements of the type of comparable properties chosen. We also account for the adjustment process. Specifically, we include controls for the gross price adjustment (as a share of the sale price) made by the appraiser.

Under very similar circumstances, different appraisers (E) can systematically differ in how they assess a property's value. These differences can be informed by heterogeneity in their innate type or their evolving experience. It follows that appraisers of varying type and experiences may be differently assigned to properties in neighborhoods with more or fewer African American residents. We account for this heterogeneity, and sorting, using our unique, anonymous, appraiser identifier. We apply this identifier in two ways.

First, we include a fixed effect to account for time invariant differences across appraisers. This implies our estimates are of the low appraisal gap within appraiser over time. Second, we track appraisers' previously gained experience, or the number of already completed appraisals

[20] See Section 3 and Appendix B.1 for details.

during the period of analysis; this period is fairly long at 5 years.[21] We count two forms of experience. The first is overall, or the total number of appraisal previously completed during the sample period. The second is the number of completed appraisals in the specific neighborhood where they are appraising.

Qualities of a neighborhood (G) other than its share of African American residents likely also play an important role. For example, properties in low-income neighborhoods with low home-ownership rates may attract fewer future home buyers, and thereby may be more likely to be appraised below the contract price. In addition, medium term changes to the tract's character, such as increases in median income or education, can also signal a neighborhood's renewed desirability and a potential rise in expected property values, or its decline.

Our analysis accounts for tract-level population density, residents' education level, median household income, home ownership rates, shares of residents receiving public assistance, and neighborhood air quality. We also include controls for the share of homes built prior to 1970. These measures absorb any long-term stability and longevity of home ownership in the neighborhood. We further include controls for each of these characteristics recorded in the previous 5-year period.[22] These account for changes in neighborhood characteristics over the medium term, a factor that accounts for neighborhood trends.

An appraiser is also compelled to incorporate local real-estate market conditions (M) into their valuation of the subject property. Principal among these is house price growth trends, which we construct using the Zillow Home Value Index (ZHVI). Specifically, we incorporate the monthly ZHVI growth rate and the lagged growth rate in the regressions. The ZHVI is the most granular house price index available with sufficient coverage for our sample. It varies at the County level and at a monthly cadence. We also control for the volume of appraisals in the neighborhood over the past three months. This captures overall thickness of mortgage transactions in the neighborhood.

As shown in Column 2 of Table 2, accounting for these factors attenuates the association between low appraisals and neighborhood race by $(.106 - .047)/.106 \approx 56$ percent. It also shows that the remaining gap is both quantitatively meaningful and precisely estimated. All else equal, an appraisal in a tract that is majority ($\geq 50\%$) African American is at least $0.047 \times 50 \approx 2.4$ p.p. ($2.4\%/7.8\% \approx 31\%$) more likely to be below the contract price relative to an appraisal in an otherwise similar tract with no African American residents.

Column 3 of Table 2 reports the association of neighborhood race and the percent difference between the appraisal and contract price among low appraisals. It shows that a

[21] Note that an appraiser's baseline experience is absorbed by the fixed effect, whether we add it to the count or not. This is because it is not changing in the sample. As a result, we can only measure how the experience they acquire throughout the study period relates to their value assessment.

[22] Since our period of analysis spans Jan 2015 - Dec 2019, the previous 5-year period includes Jan 2010 - Dec 2014, inclusive. See Section 3 and Appendix B.2 for details.

one p.p. increase in the proportion of African Americans is associated with a 0.027 p.p. decline in the relative appraised value on a low appraisal. As compared to a neighborhood with few or no African American residents, a low appraisal in a majority African American neighborhood values the property $50 \times 0.027 \approx 1.35$ p.p. lower relative to the agreed upon contract price, all else equal. This amounts to $1.35\% \times 338,900 \approx \$4,575$, or just under 7 percent of a 20 percent down payment on a typical property in the sample. The minimum value rules implies that the amount by which a low appraisal lies below the contract price is also material to the transaction. A buyer may need to come up with the additional amount to restore the original LTV of the loan, pay private mortgage insurance, or face a higher interest rate. Conversely, the seller may need to lower the sale price of the property, thereby reducing the loan size.

Columns 4 and 5 of Table 2 document the association between neighborhood race and remaining appraisal outcomes. While the appraiser reports an exact dollar value, much of the policy and academic discussions highlight three important outcome regions. The first is the low appraisal, or values below the contract price. Second is the equal appraisal, or the case of a home being appraised at exactly the contract price. A well known and highly cited statistic in this market is that nearly a third of properties are appraised at *exactly* the contract price. Excess mass at the contract price has motivated speculation about both the accuracy and independence of appraisals.

The third region contains appraisals above the contract price, or high appraisals. As shown in Table 1, they are most common in our data. High appraisals have no direct functional impact on the transaction, though they can nevertheless indirectly affect the surplus from it. Previous work has not provided clear articulation of incentives to appraise high. On the one hand, appraisers may in some circumstances have incentive to assess slightly above the contract price to signal they are not simply confirming the contract. On the other hand, they may be reticent to do so because high appraisals generally do not affect the transaction, but they may trigger an overvaluation flag from the GSEs who purchase these mortgages.[23] Another reason for the prevalence of high valuation might be that appraisers are incorporating information about nominal price growth into the assessment of value. This can be indirectly or directly through the use of time adjustments.[24]

As shown in the table, a higher share of African American residents is associated with

[23]Overvaluation flags can lead to an audit of the appraiser and even the expulsion of a mortgage from a GSE pool altogether.

[24]We note that over our period of analysis, the median high appraisal is 1.4% higher than the contract price, with an inter-quartile range of 0.51%-3.23%. According to the BLS, consumer prices over that period hovered range between 1.6% and 2.3% annually. Moreover, according to the FHFA, house prices for purchases grew at 5%-6% annually. This then somewhat aligns with inflationary pressure on home prices. See Doerner and Susin (2024) for a discussion of how time value is incorporated into assessments of value. In particular, see their discussion of how this varies by neighborhood race.

more equal and fewer high appraisals. Following arguments in Calem et al. (2021), Conklin et al. (2020), and Eriksen et al. (2020) more low valuations likely implies fewer upward distortions to the contract price. We would thereby expect these additional low appraisals in minority neighborhoods to supplant reported valuations at the contract price. To the extent that appraisers worry more about triggering overvaluation flags in minority neighborhoods, or use time adjustments less there, we might also expect fewer high and more equal appraisals. The data indicate that the rise in low appraisals is smaller than the decrease in high appraisals, whereby on balance the likelihood of an equal appraisal is higher in minority neighborhoods.

4.2 Decomposing the Low Appraisal Gap

Having documented the low appraisal gap, we turn to detailing the association between each factor entering the appraisal and neighborhood race. We do so through a series of regressions relating an input factor $F \in \{R, S, E, G, M\}$ and the percent of residents in a tract that are African American (A_g) as follows:

$$F = \sum_{b=1}^{5} \eta_b \cdot \mathbb{1}(A_g \in P_b) + \tau_c + \epsilon\,, \tag{1}$$

where we categorize Census tracts into five groups, $P_1 - P_5$, by percent of African American residents:

$$P_1 = (0, 10],\ P_2 = (10, 20],\ P_3 = (20, 30],\ P_4 = (30, 50],\ P_5 = (50, 100].$$

The term τ_c denotes state by quarter fixed effects.

Table 3 reports results from these regressions. Each row of the table shows estimates from an individual regression. Looking first at elements of the subject property, we see that properties in neighborhoods with more African American residents have a smaller gross living area (GLA), smaller plots, and are effectively older. Notably, trends in these factors are largely monotonic across the neighborhood race distribution. A typical property in a tract with no African American residents has about 2,000 square feet of gross living area. The GLA for an average property appraised in a majority African American neighborhood is closer to 1,570 square feet - or has $100 \times 434/2,025 \approx 21\%$ less space. It is also effectively 2.83 years, or $2.83/13.39 \approx 21\%$ older.[25]

[25]Table 3 shows results from selected factors. Table B3 in Appendix B.3 reports complete results of each factor used in regressions in Table 2. The table indicates a typical home appraised in neighborhoods with a higher share of African American residents also has fewer rooms, bathrooms, and other amenities such as a pool, water view, a fireplace, or central air conditioning. However, for most of these individual amenities

Table 3: Factors Entering the Appraisal and Neighborhood Race

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)
	% African American (A_g) in range =					
	0	(0,10]	(10,20]	(20,30]	(30,50]	(50,100]
Subject Property						
Site Area (Acres)	1.4427	-0.6529	-1.0143	-1.0270	-1.0729	-1.2180
	(0.0291)	(0.0298)	(0.0304)	(0.0319)	(0.0323)	(0.0312)
Gross Living Area (1k Sqft)	2.0252	0.0180	-0.1442	-0.2291	-0.3332	-0.4335
	(0.0100)	(0.0105)	(0.0135)	(0.0183)	(0.0168)	(0.0147)
Quality Score (1-6)	3.5126	0.0244	0.1327	0.1654	0.2084	0.2483
	(0.0054)	(0.0057)	(0.0065)	(0.0080)	(0.0075)	(0.0070)
Condition Score (1-6)	2.9186	-0.0820	-0.0539	-0.0099	0.0494	0.0466
	(0.0109)	(0.0117)	(0.0159)	(0.0207)	(0.0186)	(0.0161)
Effective Age	13.3941	-0.5729	-0.1043	0.5303	1.7193	2.8318
	(0.1136)	(0.1227)	(0.1656)	(0.2153)	(0.2070)	(0.1769)
Over Conforming Limit	13.82	-3.23	-10.42	-10.92	-11.74	-12.94
	(0.43)	(0.44)	(0.47)	(0.48)	(0.47)	(0.47)
Comparables						
Comparable Prop. for Sale ≤ 2	0.2390	-0.0101	-0.0112	-0.0082	-0.0098	-0.0405
	(0.0022)	(0.0023)	(0.0028)	(0.0037)	(0.0035)	(0.0031)
# of Comparable Properties Used	5.0607	0.0527	0.0803	0.0722	0.0926	0.1402
	(0.0065)	(0.0068)	(0.0079)	(0.0098)	(0.0094)	(0.0085)
Calc Avg Proximity of Comps (Miles)	2.1015	-0.8552	-1.2744	-1.2578	-1.2810	-1.4448
	(0.0294)	(0.0301)	(0.0312)	(0.0344)	(0.0356)	(0.0333)
Avg Gross Adjustment (%)	12.7805	-2.2058	-3.0832	-2.7697	-2.2457	-1.4651
	(0.0759)	(0.0793)	(0.0887)	(0.1085)	(0.1169)	(0.1076)
Appraiser						
Appraiser Type (z-Score of FE)	-0.1328	0.0428	0.0917	0.1075	0.1298	0.2231
	(0.0045)	(0.0047)	(0.0062)	(0.0086)	(0.0085)	(0.0083)
# of Completed Appraisals	273.5206	33.5394	55.5844	48.8280	44.1097	38.1115
	(1.6585)	(1.7258)	(2.2276)	(2.8252)	(2.8223)	(2.3605)
# of Completed Appraisals	5.7679	0.3220	-1.1042	-1.6225	-2.8764	-4.6969
in Neighborhood	(0.1962)	(0.2185)	(0.2902)	(0.5442)	(0.3820)	(0.2468)
Neighborhood						
Pop. Density (1k/mi^2)	2.5768	1.4478	3.2494	3.8994	4.1694	5.3149
	(0.0724)	(0.0761)	(0.1056)	(0.1432)	(0.1616)	(0.1591)
% Bachelors or Higher	39.35	3.56	-1.75	-4.92	-8.63	-13.08
	(0.26)	(0.27)	(0.33)	(0.37)	(0.36)	(0.33)
Median Income	75,140	63	-13,636	-19,800	-26,400	-32,706
	(500)	(519)	(576)	(617)	(607)	(587)
% Owner Occupied	78.59	-8.75	-21.84	-26.00	-30.04	-33.00
	(0.20)	(0.22)	(0.30)	(0.38)	(0.39)	(0.36)
% Public Assistance	1.73	0.24	1.27	1.75	2.28	2.88
	(0.03)	(0.03)	(0.04)	(0.06)	(0.07)	(0.06)
Mean Daily $PM_{2.5}$	8.1776	0.2889	0.5769	0.6040	0.6327	0.7994
	(0.0165)	(0.0174)	(0.0191)	(0.0202)	(0.0199)	(0.0186)
Market						
Δ ZHVI	0.5056	0.0214	0.0499	0.0553	0.0684	0.1414
	(0.0010)	(0.0010)	(0.0012)	(0.0014)	(0.0015)	(0.0015)

Notes: *The table shows the relationship between selected appraisal inputs and neighborhood race. Each row of the data shows the results of a regression described in Equation 1. Standard errors are in parentheses. Regressions for subject property (R), comparable property (S), and appraiser (E) inputs are at the appraiser level (N = 10,440,118). These include standard errors clustered at the Census tract level. Appraiser fixed effects are calculated from regressing low appraisals on all controls except race. Regressions for neighborhood characteristics (G) are at the tract level (N = 67,369). Regressions for local housing market conditions are at the tract-month level (N = 2,793,354). Table B3 in Appendix B.3 provides a complete table relating all individual input and neighborhood race.*

the differences are fairly small.

Differences in property characteristics are also reflected in quality and condition scores the appraiser assigns to the property. This is notable because the two scores are meant to provide a standardized summary measure across neighborhoods on both the construction quality of the property and its current condition. As shown in the table, both scores are higher (worse quality and condition) for properties in majority African American neighborhoods. Nevertheless, the relationship is not entirely monotonic. While average construction quality is monotonically decreasing with the African American share, the current condition is on average better in neighborhoods with more than zero but less than 30 percent share of African American residents.

Table 3 also shows how appraisers' use of comparable properties varies by neighborhood race, which lies at the heart of the sales comparison approach. In particular, the number of comparable properties used for the assessment is not meaningfully different in majority African American neighborhoods, though it is somewhat higher in tracts with a moderate share of African Americans. Nevertheless, in neighborhoods with a higher share of African American residents, fewer of those comparable properties were sold recently and they are closer in distance to the subject property. This suggests that when appraising in minority neighborhoods, appraisers are less willing to trade-off better information from a more recently sold comparable for one that is farther away and potentially in a slightly different neighborhood. Moreover, appraisers make fewer adjustments on average in their comparison.

Appraisers are also sorted differently into neighborhoods with a higher share of African Americans, and they gain less experience in them on average. We show this first by regressing the Z-score of appraiser's fixed effect on the neighborhood race share. The fixed effect is calculated from a regression of low appraisals on all controls ($\{R, S, E, G, M\}$), similar to Table 2 Column 2, except it excludes A_g. This reveals that appraisers which are generally more likely to appraise low are differentially assigned to neighborhoods with a higher share of African American residents.

On average, appraisals in majority African American neighborhoods are 0.35 standard deviations more likely to appraise low generally. Moreover, while appraisals in minority neighborhoods are completed by appraisers with more gained experience, this is not the case for specific neighborhood experience. In neighborhoods with no African American residents, a typical appraisal is undertaken by an appraiser who from the start of the sample period until that point has completed 5.8 appraisals in that neighborhood. In a majority African American tract, this gained experience is closer to one appraisal.

Neighborhood amenities in minority neighborhoods are also very different, which can have a strong effect on assessed value. As shown in the table, minority neighborhoods are on average more dense, have fewer owner occupied properties, and a higher incidence of households receiving public assistance. They are also comprised of lower income and

less educated population.[26] Importantly, residents in minority neighborhoods enjoy worse air quality, the value of which may not be fully reflected in the contracted price and thus included in the appraisal. Finally, trends in house price values among Counties containing more minority tracts are in fact higher than among those containing fewer. This may be due to the fact that these are situated in denser urban areas with higher house price growth.

Next, we combine these findings and assign weights to their contribution in attenuating the low appraisal gap. For this, we apply the decomposition developed by Gelbach (2016). This method derives a linear component structure characterizing the distinct role each observable factor plays in moderating a coefficient of interest. Following a long standing tradition of discrimination studies dating to Oaxaca (1973) and Blinder (1973), it resolves the "order" problem frequently attributed to previous work.[27]

Equation 2 reports the results of this decomposition into the five aforementioned categories. The baseline (β_1^{base}) and full specification (β_1^{full}) estimates are those reported in Columns 1 and 2 of Table 2, respectively. Then, δ^k denotes the moderation estimated due to each factor k.

$$\begin{aligned} \beta_1^{base} - \quad \beta_1^{full} = \quad & \delta^{Property} + \delta^{Comps.} + \delta^{Appraiser} + \delta^{Tract} + \delta^{Market} \\ 0.1060 - 0.0470 = \quad & 0.0048 + 0.0048 + 0.0227 + 0.0234 + 0.0032 \end{aligned} \tag{2}$$

Two categories emerge as especially prominent: the neighborhood (tract) characteristics and the appraiser. All else equal, $0.023/0.059 \approx 39$ percent of this difference can be attributed to observed heterogeneity in neighborhood characteristics captured in the regression. Similarly, were all appraisals completed by "the same" appraiser the association would attenuate by $0.023/0.059 \approx 39$ percent. Nearly all of this ($> 99\%$) comes from inclusion of the appraiser fixed effect. Heterogeneity in the remaining factors accounts for $0.013/0.059 \approx 22\%$, with a similar weight on variation in the subject property and the comparable properties used and their reconciliation. Variation in County trends of property values from the ZHVI account for about 5 percent of the observed difference.

In all, accounting for these inputs substantially attenuates the low appraisal gap, whereby

[26] These neighborhoods show lower growth in these amenities. See Table B3 in Appendix B.3 for more details.

[27] When added covariates are correlated to each other, the order in which they are introduced plays an exceptionally important role in how they moderate a coefficient of interest. Gelbach (2016) exploits the well known omitted variable formula in a linear regression. Let $y = \beta_1 X_1 + \beta_2 X_2 + \epsilon$, and define β_1^{base} as $y = \beta_1^{base} X_1 + \epsilon$. Then,

$$\beta_1^{base} = \beta_1 + \Gamma\beta_2 = \beta_1 + \delta, \quad X_2 = X_1\Gamma + \nu.$$

It follows that the omitted variable can be written as the sum of individual factors, $\delta = \sum_{k=1}^{k_2} \Gamma\beta_{2k}$, whereby these are invariant to the order in which elements of X_2 are introduced. See paper for more details.

two categories of controls are shown as especially important: (1) observable neighborhood (tract) characteristics, and (2) appraisers' "type" and experience.

4.3 Heterogeneous Outcomes by Appraiser Experience

As we showed in Column 2 of Table 2, the low appraisal gap, after accounting for $F \in \{R, S, E, G, M\}$ is still both economically meaningful and precisely estimated. In this section, we attempt to further explain what remains of the low appraisal gap and glean insight about the potential mechanisms underlying the gap. For this, we leverage our measures of appraisers' past experiences in the data. More specifically, we include heterogeneity in the conditional relationship between neighborhood race and the likelihood of a low appraisal. This is implemented as an interaction between neighborhood race experience.

Each measure of experience is interacted with A_g in a separate regression of the following form:

$$\mathbb{1}(Low) = \eta_0 A_g + \sum_{i=1}^{5} \eta_i A_g \cdot Exp(i) + \mathbb{X} + \epsilon. \tag{3}$$

The term η_0 captures the conditional mean of the bottom half of the experience distribution we observe in the data, i.e. the baseline group. $Exp(i)$ represents a range of the remaining experience distribution. The term $\mathbb{X}$ denotes all other controls as included in Column 2 of Table 2. Figure 1 plots the calculated gap and 95 percent confidence interval for each region of the experience distribution.[28]

The right panel of the Figure plots how the gap changes across the overall, or general, experience distribution. As shown in the panel, the relationship between race and the likelihood

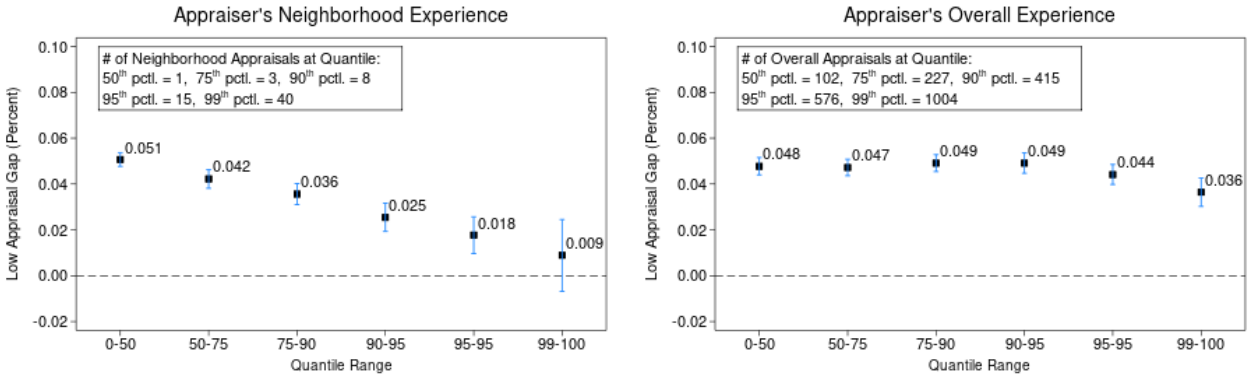


Figure 1: Low Appraisals and Appraiser Experience

Notes: *The figure plots the heterogeneous (conditional) relationship between appraiser experience and the likelihood of a low appraisal, as detailed in Equation 3. Full regression results, including individual η_j estimates, are reported in Table B4 in Appendix B.4. Confidence intervals are based on standard errors clustered at the Census tract level.*

[28] For complete regression results see Table B4 in Appendix B.4.

of a low appraisal does not seem to change when the appraiser has more general experience. The 1 p.p. increase in A_g is associated with a 0.048 p.p. increase in the likelihood of a low appraisal for a typical appraiser at the bottom half of the experience distribution, who has ≤ 102 appraisals completed. For an appraiser at the $90^{th} - 95^{th}$ percentile of the distribution, who has $415 - 576$ appraisals completed, a 1 p.p. rise in A_g is associated with a 0.44 p.p. increased in the rate of low appraisals. This difference is also not significant.[29].

We find some attenuation of the gap relative to the base group for the most experienced appraisers who have completed more than 1000 appraisals. This decline is statistically significant relative to the bottom half of the distribution (base). However, it is marginally economically meaningful. Moreover, the remaining gap is still economically large and statistically different from zero.

The left panel of Figure 1 plots the same specification from Equation 3, but with experience gained specifically in the appraised property's neighborhood. Using this measure, we find a meaningful, monotonic, and statistically significant decline in the gap when comparing appraisers across the experience distribution. For a typical appraiser at the bottom half of the distribution, who has completed at most one appraisal in the neighborhood, a 1 p.p. rise in A_g is associated with a 0.051 p.p. rise in the likelihood of appraising low. For an average appraiser at the top quantile, who has completed at least 40 appraisals in the neighborhood, this gap is no longer statistically distinguishable from zero.

The specification in Equation 3, like as that in Table 2, also includes appraiser fixed effects. This means we are still measuring within-appraiser differences, only now we allow for heterogeneity in the association between A_g and low appraisals by experience.[30] We thereby interpret these interaction results as follows. When a typical appraiser works in neighborhoods well known to them, they do not seem to incorporate neighborhood race into their assessment of value. However, more familiarity with the market or appraising overall does not seem to materially alter an appraiser's likelihood of reporting a low appraisal by neighborhood race.[31]

Put in context, these results provide insight regarding the mechanisms underlying the relationship between appraisal outcomes and neighborhood race. The literature on the economics of discrimination has largely converged on two views (Arrow, 1998). The first is taste-based (Becker, 1957; Krueger, 1963). Under this market based view, differences in outcomes are due to preferences that distort "trade" between groups. This is akin to a kind of tax on trade leaving a wedge between factors of production. The second mechanism is premised on incomplete information between parties, whereby decisions rely on prior beliefs

[29] See Table B4 in Appendix B.4

[30] The specification also includes both measures of experience as controls.

[31] In Appendix B.4 we also provide a more complete analysis of how the heterogeneity moderates equal and high appraisals.

or expectations (Phelps, 1972; Spence, 2002; Stiglitz, 1973). A known characteristics may be used to form expectations about those unobserved traits with which it is associated.

In our setting, the appraiser may incorporate neighborhood race into their assessment of value because, all else equal, they intrinsically values properties in those neighborhoods less. Alternatively, a lack of knowledge about actual resale values can lead them to use one characteristic of the neighborhood to establish beliefs that substitute for specific knowledge about the property value in it. Were they to have more knowledge of the neighborhood and its real-estate, we would expect the share of African Americans in the neighborhood to matter less for the outcome.

Our finding that specific knowledge of the neighborhood, rather than overall professional experience, is what matters for eliminating the low appraisal gap is more consistent with the informational (statistical) view. This is further highlighted by our finding that general experience in the appraisals market does not materially attenuate the appraisal gap. This last finding on overall experience also suggests that, all else equal, inexperienced appraisers do not seem to differ from more experienced ones in how they incorporate information about the share of African Americans in the neighborhood. Though this is cursory evidence, it is somewhat inconsistent with a preference based mechanism. This view would predict that inexperienced appraisers trying to establish a reputation may find it more costly to be inaccurate or report a low appraisal (Ben-David, 2011)

5 Conclusion

In this paper, we document the relationship between neighborhood race and the likelihood of low appraisals, often referred to as the low appraisal gap. We show that, unconditionally, purchase transactions in a majority African American neighborhood are at least 68 percent more likely to experience a low appraisal when compared to those in a neighborhood with no African American residents. However, property, neighborhood, appraiser, and market characteristics, all factors used by the appraiser to assess value, are markedly different across neighborhoods with varying race profiles. Accounting for these attenuates the low appraisal gap by 56 percent. The vast majority of this attenuation arises from heterogeneity in non-race neighborhood characteristics and appraiser sorting.

To better understand the remaining gap in low appraisals, we analyze appraisers' experiences across neighborhoods and over time. This reveals overall experience does not materially alter the low appraisal gap. Though, specific neighborhood experience significantly attenuates it. For an average appraiser working in neighborhoods where they have appraised many times before, the low appraisal gap is no longer distinguishable from zero. We argue that this finding is more consistent with information based models of discrimination, and somewhat

inconsistent with theories based on preference.

Lastly, the contributions of this paper come from analysis of the UAD, which is uniquely suited to our study. This is because the UAD includes extraordinary detail on factors entering the appraisal. It also contains appraisals regardless of whether or not they led to an origination, assuaging missing data concerns that posed limitations for previous work on this topic. Critically, the UAD's size and breadth give an expansive view of the market. This allows us to incorporate a rich set of factors into our analysis, forging a tighter empirical relationship between appraisals and race than previously shown.

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Appendix

A Additional Statistics on the Market

A.1 Demographics of an Appraiser

The following relevant question arises from our analysis: who becomes an appraiser? The appraisal field is one entered largely through apprenticeship. An individual wanting to become an appraiser must first spend time as a trainee. They are required to complete at least 150 hours of qualifying education and 1,000 hours of experience under a supervisory appraiser. Licensed residential appraisers can optionally pursue certification, which requires additional education and experience.[32] The apprenticeship model lends itself to entering the job through an established network.

To provide visibility into the characteristics of appraisers, we collected data from the Bureau of Labor Statistics (BLS) Current Population Survey estimates. BLS publishes employed persons by detailed occupation sex, race, and Hispanic or Latino ethnicity.[33] Historical estimates for the "Appraisers and assessors of real estate" occupation were available for our period of analysis, from 2015 to 2019. From 2015 to 2017, the "Appraisers and assessors of real estate" was published (code 13-2021). For 2018 and 2019, the "Property appraisers and assessors" occupation was published (code 13-2020). As these categories both represent property appraisers, we combine them in table A1.[34] We combine information on average annual employment population ratio, table estimates, and the average monthly surveyed persons (collected from correspondence with BLS) to infer annual appraiser sample size.[35]

The compiled distribution of appraiser demographics are shown in Table A1. The table reports basic demographics of property appraisers and assessors from 2015 to 2019. These are compiled from the Bureau of Labor Statistics' Current Population Survey (CPS) detailed occupation tables. The appraisal profession appears to be an older and racially homogeneous workforce. African American appraisers are heavily underrepresented in this field, with only about 6.7% of appraisers surveyed over our period of analysis identifying themselves as

[32] See appraisal institute materials at:
https://www.appraisalinstitute.org/the-appraisal-profession/become-an-appraiser/trainee-real-property-appraiser.

[33] See BLS: Table 11, https://www.bls.gov/cps/aa2019/cpsaat11.htm and Table 11b, https://www.bls.gov/cps/aa2019/cpsaat11b.htm. Data from Table 11b, originally shown as counts, was converted to percentages for consistency.

[34] Education statistics were only available for the most current year (See https://www.bls.gov/emp/tables/educational-attainment.htm). We used Wayback Machine to compile historical BLS data for educational attainment for workers 25 years and older by detailed occupation.

[35] See https://www.bls.gov/charts/employment-situation/employment-population-ratio.htm.

Table A1: Demographics of Appraisers

Year	(1) 2015	(2) 2016	(3) 2017	(4) 2018	(5) 2019
Race (%)					
Asian	0.9	2.2	1.8	4.0	4.1
Black or African American	5.9	5.5	9.0	10.7	2.7
Hispanic or Latino	3.9	9.5	11.0	4.2	8.3
Gender (%)					
Women	39.3	35.6	37.4	45.3	42.0
Age (%)					
16 to 19 Years	0.0	0.0	0.0	0.0	1.2
20 to 24 Years	0.0	1.4	2.0	2.4	0.0
25 to 34 Years	7.9	8.3	15.3	10.7	10.7
35 to 44 Years	23.7	22.2	22.4	19.0	21.4
45 to 54 Years	27.6	27.8	28.6	28.6	21.4
55 to 64 Years	30.3	30.6	20.4	26.2	33.3
65 Years and Over	10.5	9.7	11.2	13.1	11.9
Education(%)					
Associate's Degree	N/A	9.6	9.3	9.6	8.8
Bachelor's Degree	N/A	42.8	43.4	43.2	44.5
Doctoral or Professional Degree	N/A	2.0	2.7	3.1	2.1
High School Diploma or Equivalent	N/A	11.2	10.9	9.3	11.3
Less than High School Diploma	N/A	0.7	0.3	0.8	0.6
Master's Degree	N/A	9.0	9.3	8.0	10.2
Some College, No Degree	N/A	24.8	24.1	26.1	22.3
Total Appraisers (#)					
Total Employed	76,000	73,000	97,000	84,000	84,000

Notes: *These data are compiled from the Bureau of Labor Statistics' Occupational Employment and Wage Statistics Stables (OEWS). We compile tables from 2015 to 2019. We use the occupation code "Appraisers and assessors of real estate (13-2021)" for years 2015 to 2017, and the code "Property appraisers and assessors (13-2020)" for years 2018 and 2019.*

Black or African American.[36] This is about half the proportion of African Americans in the workforce in 2019 (13%).[37]

[36]Though always small, we note there is substantial variance in the proportion of respondent appraisers identifying as black or African American, with a range of 2.7%-10.7%. Through our conversations with the BLS, we have learned that these respondent cell sizes, especially for detailed occupations, can be small – which can then lead to variance in calculated mean. This may especially the case when the true proportions are very small – like for the proportion of African American appraisers. The BLS does not publish granular annual sample sizes by detailed occupation for demographic estimates. However, we can back this out using the total sample size of 100,000-105,000 monthly respondents. We calculated a sample size for the appraiser cell of about 409 sampled individuals.

[37]This is based on CPS estimates in 2019. See https://www.bls.gov/opub/reports/race-and-ethnicity/2019/.

About 66.2% of working appraisers are 45 or older.[38] The occupation is also male-dominated, with women comprising about 39.9% of those employed during this period. It is also more educated than the average population. A majority of appraisers sampled have either an associates, bachelor's, or graduate degree. The profession is marked by an aging demographic and the number of overall appraisers is poised to drop sharply as seasoned appraisers retire. Approximately 73 thousand to 97 thousand property appraisers and assessors were employed nationally during our analysis period.

These BLS statistics are consistent with an Appraisal Institute study on appraiser demographics conducted in 2022.[39] This study finds that 77% of the 2,631 appraisers surveyed identified as White(non-Hispanic), or 84% of those declared a race or ethnicity. About 66% were over 50 years old, 85% has a college degree, and 68% were men.

A.2 Market Coverage of the UAD

Here we look at the UAD in the context of the broader market for single family 1-4 unit property sales. For this we collect additional data on the mortgage market from the National Mortgage Database (NDMB) and on financed home sales from the National Association of Realtors' (NAR) annual survey on the profiles of home buyers and sellers.

Recall that the UAD captures single family home purchase appraisals submitted to the UCDP. These are for the most part meant to be originated and sold to the GSE's as conventional conforming mortgage loans. As shown in Table A2, the yearly number of purchase appraisals captured in the UAD lies between all the total number of newly originated purchase mortgages and purchase mortgages originated and acquired by the GSEs.[40] This helps to bound the reach of UAD in the context of the market for single family home sales in the United States. At the lower bound, the UAD encompasses all mortgage financed home sales whose mortgages are acquired by the GSEs. This is about half of mortgaged home sales, and 38%-42% of overall single family property sales. At the upper bound, in the case where all appraisals eventually result in an originated mortgage, the UAD accounts for 47%-58% of mortgaged home sales and 40%-50% of total home sales.

As discussed in Section 3, the UAD is comprised of properties with more modest value. High value properties are more often not conforming, whereby their appraisals are less likely to be reported through the UCDP. However, the NMDB is nationally representative and

[38] A point of discussion in the profession has been its aging demographic - whereby its numbers are poised to drop sharply as seasoned appraisers retire.

[39] For example see https://www.appraisalinstitute.org/getmedia/bf70e869-945f-4fab-851c-44204f971224/2023_AI_fact_sheet

[40] We note that a transaction can receive an appraisal waiver. Prior to 2020 this was extremely rare. Moreover, it is possible for more than one appraisal to occur for a transaction, such as if the borrower or lender requests it. As discussed earlier, this is also very rare and applies to a de minimis number of cases.

Table A2: The UAD in Context of the Market

(1) Year	(2) Pct.of Purchases Financed (NAR)	(3) # Purchase Appraisals in the UAD	(4) # New Mortgages (NMDB)	(5) # New Enterprise Mortgages (NMDB)
2015	86	1,606,405	3,440,184	1,554,000
2016	88	2,017,208	3,793,108	1,743,000
2017	88	2,194,642	3,942,000	1,882,000
2018	88	2,276,217	3,973,230	1,937,000
2019	86	2,345,646	4,053,330	1,996,000

Notes: *Data in this table are taken from several sources. The Percent of purchases financed by a mortgage are taken from the National Association of Realtors' annual profile of home buyers and sellers report. This is an annual survey of home buyers' and sellers' experiences. These can be found at https://www.nar.realtor/. The number of purchases appraisals in the UAD are taken directly from our data. The number of originated (and acquired) mortgages are taken from the National Mortgage Database Aggregate Statistics. These are available at: https://www.fhfa.gov/data/national-mortgage-database-aggregate-statistics. The NMDB is a nationally representative database of mortgages on single family properties in the United States.*

designed using a credit bureau frame. As a result it captures all but very few financed sales, regardless of value or lender. It misses very few mortgages that are never reported to the bureaus, into which there is very little visibility in the market. The NAR's annual profile of buyers and sellers report is based on a nationally representative survey.

B Complete Estimates Tables

B.1 Summary Statistics

Table B1 reports complete summary statistics of the data in our estimation sample. Our full UAD analysis sample is large and comprehensive. In total it represents 67,369 tracts and has 10,440,118 individual appraisal records. The median home in our full UAD analysis sample is a 1790 square foot single-family house with three bedrooms, two bathrooms, and a contract price of $269,900. A majority of the homes are of average quality and condition as determined by the appraiser based on a standardized scale.

The average effective age is 13.04, with a median of about 10 years. The median actual age of properties in the data is 28 years, as compared to a median effective age of 10 years. This is substantially less than the average age of properties in a tract overall and suggests that many properties in the UAD may have undergone renovations or improvements since being constructed. Majority of the properties have central air conditioning, a fireplace, and a garage. Around 25% of properties were previously for sale within the last three years of their respective appraisal. The median valuation uses five comparable properties, with the typical comparable being an average of 0.54 miles away. For a typical appraisal, the appraiser makes about 9.1% in gross adjustments.

Table B1: Complete Summary Statistics

	(1) Mean	(2) SD	(3) P25	(4) P50	(5) P75
Appraisal Outcomes					
Low Appraisals	7.78				
Difference | Low	-4.94	5.24	-6.25	-3.45	-1.84
Equal Appraisals	26.83				
High Appraisals	65.39				
Subject Property					
Contract Price ($)	338,900	291,307	178,398	269,900	404,980
View Type: Water	3.70				
Location: Water	1.35				
Total Rooms	6.86	1.66	6	7	8
Bathrooms	2.41	0.95	2	2	3
Bedrooms	3.26	0.82	3	3	4
Site Area (Acres)	0.74	2.89	0.15	0.22	0.40
Gross Living Area (1k Sqft)	1.98	0.84	1.37	1.79	2.40
Quality Score (1-5)	3.57	0.58	3	4	4
Condition Score (1-5)	2.84	0.91	3	3	3
Effective Age	13.04	10.49	5	10	20
Below Grade Total Sqft	447.70	632.08	0	0	912.00
Below Grade Finished Sqft	206.58	422.86	0	0	72
Has Central A/C (%)	85.60				
Has Pool (%)	8.95				
Has Fireplace (%)	58.16				
Has Basement (%)	40.95				
Has Garage (%)	84.05				
Has a Half Bathroom (%)	41.20				
2 or More Stories (%)	49.92				
Financial Assistance (%)	42.36				
Over Conforming Limit (%)	8.63				
Comparables					
Comparable Prop. for Sale ≤ 2 (%)	22.90				
Number of Comparable Properties Used	5.16	1.34	4	5	6
Calc Avg Proximity of Comps (Miles)	1.21	2.21	0.31	0.54	1.09
Avg Gross Adjustment Percent	10.64	6.96	5.88	9.10	13.64
Was for Sale Last 3 Years (%)	25.26				
Market					
%ΔZHI	0.56	0.46	0.29	0.54	0.81
%ΔZHI_{t-1}	0.56	0.47	0.29	0.54	0.81
Appraiser					
Number of Completed Appraisals	304.41	344.35	77	197	409
Number of Completed Appraisals in Neighborhood	5.53	14.12	0	1	5
Tract/Neighborhood					
% African American	13.60	21.48	0.99	4.26	15.24
% African American in 1970					
Pop. Density (1k/mi^2)	4.67	8.79	0.33	2.23	5.26
% Bachelors or Higher	39.04	18.71	24.61	35.61	51.33
% Bachelor or Higher 2014	35.91	18.36	21.73	32.25	47.55
Median Annual Household Income ($)	67,380	33,241	44,783	49,875	81,866
Median Annual Household Income 2014 ($)	57,579	28,284	38,388	51,285	70,035
% Owner Occupied	64.63	21.72	50.44	69.25	81.93
% Owner Occupied 2014	64.92	21.49	51.11	69.60	81.95
% Public Assistance	2.51	2.85	0.71	1.68	3.31
% Public Assistance 2014	3.00	3.29	0.90	2.05	3.95
Mean Predicted Daily $PM_{2.5}$ Level	8.54	1.49	7.59	8.64	9.37
SD Predicted Daily $PM_{2.5}$ Level	4.26	1.22	3.52	4.11	4.69
Mean Predicted Daily $PM_{2.5}$ Level 2014	9.43	1.62	8.42	9.59	10.45
SD Predicted Daily $PM_{2.5}$ Level 2014	4.46	1.17	3.77	4.31	5.20
% Constructed Pre 1970	42.91	28.41	18.05	40.66	66.80
Number of Observations	10,440,118				
Number of Tracts	67,369				

B.2 Main OLS Estimates

Table B2 reports the complete set of estimates for regressions shown in Table 2. Findings associated with the variable of interest (% African American) are discussed in Table 2 in Section 4. Looking at the remaining controls, we find that the signs of parameter estimates typically align with intuition.

For example, low appraisals are associated with less desirable properties that are farther from water, have fewer rooms and bathrooms, and are smaller. Low appraisals are also associated with contract prices likely above the FHFA conforming limit. One reason for this is that appraisers may be more careful when evaluating higher value property sale. Low appraisals are also associated with more adjustments made and more comparable properties being used. This indicates appraisers' need to incorporate more information to justify the assessment.

Low appraisals occur more often in areas with lower quality neighborhood amenities like owner occupancy and air quality. They also occur in lower income areas with older housing stock. The number of appraisals previously completed in the neighborhood, which captures market thickness, is unsurprisingly associated with less low appraisals. Moreover, local housing market price growth is associated with more low appraisals. This indicates appraisers' guarding against excessive price rises that is perhaps not warranted by broader and longer term housing fundamentals.

Table B2: Complete Regression Results

	(1) Low Appraisal	(2) Low Appraisal	(3) %Difference	(4) Equal Appraisal	(5) High Appraisal
% African American (A_g)	0.1060**	0.0470**	-0.0268**	0.0133**	-0.0603**
	(0.0019)	(0.0015)	(0.0008)	(0.0016)	(0.0023)
View Type: Water		-0.0130	-0.0477	-0.0556	0.0686
		(0.0655)	(0.0370)	(0.0909)	(0.1070)
Location: Water		-1.1715**	-0.0460	1.4437**	2.6152**
		(0.0950)	(0.0769)	(0.1386)	(0.1601)
Total Rooms		-0.1087**	0.1003**	-0.0686**	0.1773**
		(0.0125)	(0.0087)	(0.0197)	(0.0221)
Bathrooms		-0.0298**	0.0119	-0.7664**	0.7963**
		(0.0222)	(0.0156)	(0.0353)	(0.0405)
Bedrooms		0.0039	0.1430**	0.2994**	-0.3033**
		(0.0196)	(0.0130)	(0.0305)	(0.0356)
Site Area (Acres)		-0.0600**	0.0180**	-0.0420**	0.1020**

	(0.0032)	(0.0045)	(0.0051)	(0.0057)
Gross Living Area (1k Sqft)	-2.5863**	0.0178	-3.1476**	5.7339**
	(0.0319)	(0.0226)	(0.0495)	(0.0594)
Quality Score (1-6)	-0.3617**	-0.1100**	-1.6446**	2.0063**
	(0.0238)	(0.0172)	(0.0376)	(0.0428)
Condition Score (1-6)	0.4107**	-0.2808**	5.6939**	-6.1045**
	(0.0223)	(0.0106)	(0.0522)	(0.0642)
Effective Age	-0.0714**	-0.0397**	-0.1435**	0.2149**
	(0.0018)	(0.0011)	(0.0028)	(0.0032)
Below Grade Total Sqft	0.0004**	-0.0002**	-0.0010**	0.0006**
	(0.0000)	(0.0000)	(0.0001)	(0.0001)
Below Grade Finished Sqft	0.0005**	0.0001**	0.0007**	-0.0012**
	(0.0000)	(0.0000)	(0.0001)	(0.0001)
Central A/C	0.6651**	0.3883**	1.2101**	-1.8752**
	(0.0345)	(0.0289)	(0.0563)	(0.0629)
Pool	0.4679**	0.1139**	0.9836**	-1.4515**
	(0.0444)	(0.0188)	(0.0585)	(0.0727)
Fireplace	0.5666**	0.1333**	0.7188**	-1.2854**
	(0.0250)	(0.0150)	(0.0414)	(0.0493)
Basement	-1.5048**	0.4428**	-0.5651**	2.0700**
	(0.0462)	(0.0361)	(0.0733)	(0.0843)
Garage	0.1730**	0.5716**	-0.6625**	0.4896**
	(0.0333)	(0.0216)	(0.0462)	(0.0549)
Has a Half Bathroom	0.3608**	0.0735**	0.7808**	-1.1417**
	(0.0251)	(0.0171)	(0.0395)	(0.0453)
2 or More Stories	0.4174**	-0.1521**	0.3320**	-0.7494**
	(0.0297)	(0.0176)	(0.0433)	(0.0532)
Financial Assistance	-0.6497**	0.3028**	-1.1495**	1.7993**
	(0.0207)	(0.0133)	(0.0357)	(0.0411)
Over Conforming Limit	3.5534**	-2.2258**	3.3087**	-6.8621**
	(0.0578)	(0.0434)	(0.0849)	(0.1086)
Comparable Prop. for Sale ≤ 2	1.9044**	-0.0827**	0.8776**	-2.7821**
	(0.0275)	(0.0153)	(0.0408)	(0.0453)
Number of Comparable Properties Used	2.0269**	-0.0944**	0.2498**	-2.2767**
	(0.0124)	(0.0058)	(0.0157)	(0.0178)
Calc Avg Proximity of Comps (Miles)	-0.0525**	-0.0491**	0.0882**	-0.0357**
	(0.0053)	(0.0061)	(0.0083)	(0.0095)
Avg Gross Adjustment Percent	0.1454**	-0.1569**	-0.1522**	0.0068+
	(0.0021)	(0.0016)	(0.0029)	(0.0035)
Was for Sale Last 3 Years	1.2721**	-0.0791**	0.8676**	-2.1396**
	(0.0243)	(0.0124)	(0.0421)	(0.0491)
Pop. Density (1k/mi^2)	0.0542**	0.0104**	0.0940**	-0.1482**
	(0.0062)	(0.0028)	(0.0085)	(0.0114)
Pct Bachelors or Higher	-4.4833**	0.3291**	-3.2364**	7.7197**
	(0.2723)	(0.1211)	(0.3781)	(0.5039)
Pct Bachelor or Higher 2014	-0.8594**	0.0391	0.0159	0.8435+
	(0.2621)	(0.1196)	(0.3895)	(0.5096)
Log Median Annual Household Income ($)	-0.4232**	0.4189**	0.0110	0.4122+
	(0.1225)	(0.0577)	(0.1650)	(0.2229)
Log Median Annual Household Income 2014 ($)	0.0696	0.4369**	0.8804**	-0.9500**
	(.1237)	(0.0568)	(0.1702)	(0.2299)
Pct Owner Occupied	-1.0561**	-0.0135	-1.2437**	2.2998**
	(0.2545)	(0.1115)	(0.3506)	(0.4716)
Pct Owner Occupied 2014	1.1041**	-0.4191**	1.2633**	-2.3675**

		(0.2609)	(0.1100)	(0.3685)	(0.4982)
Pct Public Assistance		1.6158+	-2.5065**	-0.5301	-1.0857
		(0.8897)	(0.4756)	(1.1909)	(1.5691)
Pct Public Assistance 2014		-0.3138	-3.1774**	-0.0671	0.3809
		(0.8046)	(0.3786)	(1.1206)	(1.5022)
Mean Predicted Daily $PM_{2.5}$ Level		0.5418**	-0.1389**	-0.0932	-0.4486*
		(0.1057)	(0.0533)	(0.1609)	(0.2057)
SD Predicted Daily $PM_{2.5}$ Level		-0.1474+	0.0884	0.2482*	-0.1007
		(0.0861)	(0.0726)	(0.1255)	(0.1627)
Mean Predicted Daily $PM_{2.5}$ Level 2014		0.5151**	0.2448**	0.6620**	-1.1771**
		(0.1012)	(0.0457)	(0.1491)	(0.1923)
SD Predicted Daily $PM_{2.5}$ Level 2014		-0.2030*	-0.0686	-0.3561**	0.5592**
		(0.0832)	(0.0574)	(0.1324)	(0.1678)
Pct Constructed Pre 1970		-3.1870**	-0.3555**	-1.3563**	4.5433**
		(0.0750)	(0.0382)	(0.1026)	(0.1335)
Number of Completed Appraisals		0.0001*	-0.0000	-0.0000	-0.0001
		(0.0001)	(0.0000)	(0.0001)	(0.0001)
Number of Completed Appraisals in Neighborhood		-0.0012	-0.0032**	-0.0315**	0.0327**
		(0.0011)	(0.0006)	(0.0032)	(0.0037)
%ΔZHI		0.4560**	-0.1150**	0.0232	-0.4793**
		(0.0486)	(0.0306)	(0.0737)	(0.0788)
$\%\Delta ZHI_{t-1}$		0.4359**	-0.0042	0.0989	-0.5348**
		(0.0468)	(0.0306)	(0.0730)	(0.0780)
Prev. 3 Months # Appraisals in Tract		-0.0100**	-0.0011**	-0.0220**	0.0320**
		(0.0009)	(0.0003)	(0.0023)	(0.0030)
County-Qtr-Yr FE	✓	✓	✓	✓	✓
Observations	10,440,118	10,440,118	812,386	10,440,118	10,440,118
Mean of Dependent Variable	7.8356	7.8356	-4.9288	27.1653	64.9991

B.3 Factors and Race

Table B3 is an extended version of Table 3. It reports the relationship between individual input factors and neighborhood race for each individual factor controlled for in Table 2. Like in the main table, we see that properties in neighborhoods with a higher share of African American residents have less desirable characteristics. They are farther from water, are older, and sit on smaller lots.

These neighborhoods are lower income with less educated residents who are less likely to own their homes. Notably, neighborhoods with a higher share of African American residents show less growth in these characteristics. Income, owner occupancy, and the education of residents grow slower or decline altogether. Moreover, air quality is both lower and more variable, though it has improved at a slightly higher rate in the previous five years.

Table B3: Complete Table of Factors and Race

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	% African American (A_g) in range =					
	0 / Cons.	(0,10]	(10,20]	(20,30]	(30,50]	(50,100]
Subject Property						
Has Water View	7.78	-3.78	-5.55	-5.70	-6.19	-7.26
	(0.25)	(0.25)	(0.27)	(0.29)	(0.30)	(0.27)
Located Near Water	3.81	-2.33	-3.30	-3.40	-3.46	-3.88
	(0.17)	(0.17)	(0.18)	(0.18)	(0.19)	(0.18)
Total # of Rooms	6.7901	0.1592	0.0076	-0.1426	-0.3130	-0.4168
	(0.0166)	(0.0175)	(0.0232)	(0.0345)	(0.0304)	(0.0250)
# of Bathrooms	2.4223	0.0474	-0.0881	-0.1636	-0.2658	-0.3831
	(0.0108)	(0.0114)	(0.0144)	(0.0188)	(0.0179)	(0.0159)
# of Bedrooms	3.1834	0.0971	0.0728	0.0117	-0.0434	-0.0501
	(0.0078)	(0.0082)	(0.0105)	(0.0141)	(0.0132)	(0.0117)
Site Area (Acres)	1.4427	-0.6529	-1.0143	-1.0270	-1.0729	-1.2180
	(0.0291)	(0.0298)	(0.0304)	(0.0319)	(0.0323)	(0.0312)
Gross Living Area (1k Sqft)	2.0252	0.0180	-0.1442	-0.2291	-0.3332	-0.4335
	(0.0100)	(0.0105)	(0.0135)	(0.0183)	(0.0168)	(0.0147)
Quality Score (1-5)	3.5126	0.0244	0.1327	0.1654	0.2084	0.2483
	(0.0054)	(0.0057)	(0.0065)	(0.0080)	(0.0075)	(0.0070)
Condition Score (1-5)	2.9186	-0.0820	-0.0539	-0.0099	0.0494	0.0466
	(0.0109)	(0.0117)	(0.0159)	(0.0207)	(0.0186)	(0.0161)
Effective Age	13.3941	-0.5729	-0.1043	0.5303	1.7193	2.8318
	(0.1136)	(0.1227)	(0.1656)	(0.2153)	(0.2070)	(0.1769)
Below Grade Total Sqft	473.0159	2.5611	-65.1442	-107.0316	-145.0338	-161.0471
	(6.3796)	(6.6644)	(7.4318)	(8.1823)	(8.4173)	(8.4611)
Below Grade Finished Sqft	225.1218	-3.8168	-41.4221	-63.9338	-84.8061	-77.9203
	(3.7529)	(3.9631)	(4.3601)	(4.7971)	(4.9478)	(5.0796)
Has Central A/C	81.92	4.34	3.74	2.56	1.00	-1.87
	(0.44)	(0.46)	(0.47)	(0.48)	(0.50)	(0.51)
Has a Pool	10.78	-0.56	-3.99	-5.26	-6.05	-7.33
	(0.21)	(0.22)	(0.27)	(0.29)	(0.28)	(0.26)
Has a Fireplace	57.74	2.98	-2.40	-4.69	-8.80	-16.04
	(0.50)	(0.52)	(0.63)	(0.74)	(0.77)	(0.77)
Has a Basement	40.32	1.69	0.01	-1.72	-3.38	-2.61
	(0.45)	(0.47)	(0.51)	(0.59)	(0.62)	(0.61)
Has a Garage	82.45	3.60	1.38	-2.86	-7.75	-17.26
	(0.32)	(0.32)	(0.43)	(0.60)	(0.69)	(0.76)
Has a Half Bathroom	37.54	4.59	3.52	2.37	0.54	-1.47
	(0.41)	(0.43)	(0.52)	(0.65)	(0.68)	(0.63)
Has 2 or More Stories	45.82	4.49	5.85	4.12	2.10	1.44
	(0.47)	(0.49)	(0.62)	(0.76)	(0.79)	(0.74)
Financial Assistance	36.90	3.37	9.83	11.03	12.66	14.48
	(0.32)	(0.33)	(0.41)	(0.48)	(0.48)	(0.45)
Over Conforming Limit	13.82	-3.23	-10.42	-10.92	-11.74	-12.94
	(0.43)	(0.44)	(0.47)	(0.48)	(0.47)	(0.47)
Comparables						
Comparable Prop. for Sale ≤ 2	0.2390	-0.0101	-0.0112	-0.0082	-0.0098	-0.0405
	(0.0022)	(0.0023)	(0.0028)	(0.0037)	(0.0035)	(0.0031)
# of Comparable Properties Used	5.0607	0.0527	0.0803	0.0722	0.0926	0.1402
	(0.0065)	(0.0068)	(0.0079)	(0.0098)	(0.0094)	(0.0085)
Avg. Proximity of Comps (Miles)	2.1015	-0.8552	-1.2744	-1.2578	-1.2810	-1.4448

	(0.0294)	(0.0301)	(0.0312)	(0.0344)	(0.0356)	(0.0333)
Avg Gross Adjustment (%)	12.7805	-2.2058	-3.0832	-2.7697	-2.2457	-1.4651
	(0.0759)	(0.0793)	(0.0887)	(0.1085)	(0.1169)	(0.1076)
Was for Sale Last 3 Years	23.04	1.18	2.91	3.88	5.96	16.11
	(0.18)	(0.19)	(0.25)	(0.31)	(0.31)	(0.40)
Appraiser						
Appraiser Type (z-Score FE)	-0.1328	0.0428	0.0917	0.1075	0.1298	0.2231
	(0.0045)	(0.0047)	(0.0062)	(0.0086)	(0.0085)	(0.0083)
# of Completed Appraisals	273.5206	33.5394	55.5844	48.8280	44.1097	38.1115
	(1.6585)	(1.7258)	(2.2276)	(2.8252)	(2.8223)	(2.3605)
# of Completed Appraisals	5.7679	0.3220	-1.1042	-1.6225	-2.8764	-4.6969
in Neighborhood	(0.1962)	(0.2185)	(0.2902)	(0.5442)	(0.3820)	(0.2468)
Neighborhood						
Pop. Density (1k/mi^2)	2.5768	1.4478	3.2494	3.8994	4.1694	5.3149
	(0.0724)	(0.0761)	(0.1056)	(0.1432)	(0.1616)	(0.1591)
% Bachelors or Higher	39.35	3.56	-1.75	-4.92	-8.63	-13.08
	(0.26)	(0.27)	(0.33)	(0.37)	(0.36)	(0.33)
Δ % Bachelor or Higher	3.17	0.12	-0.18	-0.32	-0.32	-0.55
	(0.09)	(0.09)	(0.11)	(0.13)	(0.14)	(0.13)
Median Income	75,140	63	-13,636	-19,800	-26,400	-32,706
	(500)	(519)	(576)	(617)	(607)	(587)
Δ Median Income	11,191	-141	-2,493	-3,313	-4,127	-5,176
	(187)	(194)	(220)	(245)	(246)	(234)
% Owner Occupied	78.59	-8.75	-21.84	-26.00	-30.04	-33.00
	(0.20)	(0.22)	(0.30)	(0.38)	(0.39)	(0.36)
Δ % Owner Occupied	0.59	-0.58	-1.24	-1.30	-1.67	-2.33
	(0.09)	(0.10)	(0.12)	(0.15)	(0.16)	(0.15)
% Public Assistance	1.73	0.24	1.27	1.75	2.28	2.88
	(0.03)	(0.03)	(0.04)	(0.06)	(0.07)	(0.06)
Δ % Public Assistance	-0.33	0	-0.28	-0.41	-0.52	-0.98
	(0.03)	(0.04)	(0.05)	(0.06)	(0.07)	(0.07)
Mean Daily $PM_{2.5}$	8.1776	0.2889	0.5769	0.6040	0.6327	0.7994
	(0.0165)	(0.0174)	(0.0191)	(0.0202)	(0.0199)	(0.0186)
Δ Mean Daily $PM_{2.5}$	-0.7609	-0.1179	-0.1622	-0.1717	-0.1895	-0.1668
	(0.0086)	(0.0090)	(0.0097)	(0.0103)	(0.0101)	(0.0096)
S.D. Daily $PM_{2.5}$	4.1393	0.1017	0.2185	0.2218	0.2094	0.2736
	(0.0142)	(0.0151)	(0.0164)	(0.0165)	(0.0158)	(0.0150)
Δ S.D. Daily $PM_{2.5}$	-0.0871	-0.1068	-0.1712	-0.1823	-0.2080	-0.2215
	(0.0113)	(0.0119)	(0.0120)	(0.0124)	(0.0123)	(0.0117)
Pct Constructed Pre 1970	37.51	2.51	5.86	8.48	13.02	22.56
	(0.31)	(0.33)	(0.42)	(0.49)	(0.50)	(0.46)
Market						
Δ ZHI	0.5056	0.0214	0.0499	0.0553	0.0684	0.1414
	(0.0010)	(0.0010)	(0.0012)	(0.0014)	(0.0015)	(0.0015)
Δ_{t-1} ZHI	0.4997	0.0228	0.0516	0.0564	0.0703	0.1436
	(0.0010)	(0.0010)	(0.0012)	(0.0014)	(0.0015)	(0.0015)
3 Month Avg. # of	8.8050	2.7479	2.1756	0.3570	-1.8099	-3.8771
Purchase Appraisals	(0.0196)	(0.0217)	(0.0306)	(0.0405)	(0.0348)	(0.0282)

B.4 Heterogeneity in Appraiser Experience

Table B4 reports estimates of the regressions incorporating heterogeneity in appraiser experience. See Figure 1 in Section 4.3 for plots of these estimates and associated 95% confidence intervals. The specifications in these regressions are otherwise identical to those reported

Table B4: Low Appraisals and Appraiser Experience

Dependent Variable	(1) Low Appraisal (Neighborhood Experience)	(2) Low Appraisal (Overall Experience)
% African American (A_g)	0.0507**	0.0477**
	(0.0015)	(0.0019)
$A_g\times$ ($50^{th}-75^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0085**	-0.0005
	(0.0017)	(0.0018)
$A_g\times$ ($75^{th}-90^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0151**	0.0014
	(0.0021)	(0.0020)
$A_g\times$ ($90^{th}-95^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0253**	0.0014
	(0.0030)	(0.0024)
$A_g\times$ ($95^{th}-99^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0330**	-0.0036
	(0.0040)	(0.0025)
$A_g\times$ ($>99^{th}$ Pctile # of Prev. Completed Appraisals)	-0.0418**	-0.0113**
	(0.0080)	(0.0034)
County-Qtr-Yr FE	✓	✓
Controls for Input Categories		
Property (R)	✓	✓
Comparables (S)	✓	✓
Appraiser (E)	✓	✓
Tract (G)	✓	✓
Market (M)	✓	✓
Mean of Dependent Variable	7.8356	7.8356
$50^{th} Pctile.$ # of Prev. Completed Appraisals	1	102
$75^{th} Pctile.$ # of Prev. Completed Appraisals	3	227
$90^{th} Pctile.$ # of Prev. Completed Appraisals	8	415
$95^{th} Pctile.$ # of Prev. Completed Appraisals	15	576
$99^{th} Pctile.$ # of Prev. Completed Appraisals	40	1004
Observations	10,440,118	10,440,118

Notes: *Data are from the UAD and include appraisals completed between 2015 and 2019, inclusive. Standard errors in parentheses are clustered at the Census tract level.* $+\ p<0.10$, $*\ p<0.05$, $**\ p<0.01$

in Table 2. Column 1 shows interactions between the proportion of African American residents in a tract (A_g) and the distribution of specific neighborhood experience. Column 2 of the table shows results from interactions with overall experience. Overall experience is measured as the total number of appraisals completed in the months during our period of analysis leading up to, but not including, the current appraisal.

Neighborhood experience is defined as the number of appraisals completed in the specific tract, or neighborhood, during months leading up to, but not including, the current appraisal. These measures of experience are included both as controls in the regressions (also in Table 2) and as interactions. Because the regressions include appraiser fixed effects, we can only account for gained experience during our period of analysis. Any previous experience, even if calculated, will be absorbed by the fixed effect.

As shown in the table, interacting A_g with overall appraiser experience does not seem to materially reduce the low appraisal gap. With the exception of the most experienced appraisers, i.e. the top 1%, no interaction is statistically different from the baseline (experience below the median). Even for these most experienced appraisers, the gap only declines by an additional 24% relative to the baseline. Moreover, what remains is significantly different from zero and economically large.

In contrast, interacting A_g with specific neighborhood experience consistently, and monotonically, attenuates the gap. Moreover, these differences are statistically distinguishable from the baseline. A typical appraiser working in neighborhoods where they are most experience ($> 99\%$) no longer shows a varying propensity to report low by neighborhood race. This is shown in Figure 1 in the main paper.

Table B5 reports interaction results for high and equal appraisals. It serves to complete the interaction analysis and provide a broader picture of how experience moderates the entire distribution of home valuations for purchase transactions. Consistent with the evidence in Table B4, heterogeneity in specific neighborhood experience, rather than overall, matters more for moderating the relationship between neighborhood race and the entire distribution of appraisal outcomes. As shown in Table 2, neighborhood race is positively associated with equal appraisals and negatively associated with high appraisals. In other words, neighborhood race is associated with a leftward shift in the distribution overall and an increase in excess mass of reporting at the contract price.

Much of this is undone when appraisers have specific neighborhood experience. For a typical appraiser working in a familiar neighborhood, a higher share of African Americans is associated with fewer equal appraisals and more high appraisals. Notably, at the top quantile of experience we see a reversal in pattern – an increase in both equal and high appraisals – though both are somewhat imprecisely estimated. This indicates perhaps more complex dynamics underlying appraisers' incentives to appraise at or above the contract price.

Unlike for specific experience in a neighborhood, we find that heterogeneity in general experience does not materially alter the relationship between neighborhood race and appraisal outcomes. Overall experience does not seem to change the association between high appraisals and neighborhood race in any statistically significant or economically meaningful way. The relationship between neighborhood race and equal appraisals does not change with

Table B5: Equal and High Appraisals by Appraiser Experience

Dependent Variable	(1) Equal Appraisal	(2) High Appraisal	(3) Equal Appraisal	(4) High Appraisal
	(Neighborhood Experience)		(Overall Experience)	
% African	0.0162**	-0.0669**	0.0109**	-0.0586**
American (A_g)	(0.0017)	(0.0023)	(0.0023)	(0.0028)
$A_g\times$ ($50^{th} - 75^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0054*	0.0139**	0.0006	-0.0001
	(0.0023)	(0.0027)	(0.0024)	(0.0027)
$A_g\times$ ($75^{th} - 90^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0131**	0.0282**	-0.0009	-0.0005
	(0.0029)	(0.0034)	(0.0027)	(0.0030)
$A_g\times$ ($90^{th} - 95^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0245**	0.0498**	0.0021	-0.0034
	(0.0048)	(0.0059)	(0.0034)	(0.0037)
$A_g\times$ ($95^{th} - 99^{th}$ Pctile. # of Prev. Completed Appraisals)	-0.0352**	0.0682**	0.0097**	-0.0060
	(0.0071)	(0.0086)	(0.0034)	(0.0039)
$A_g\times$ ($> 99^{th}$ Pctile # of Prev. Completed Appraisals)	0.0190	0.0228	0.0188**	-0.0075
	(0.0173)	(0.0208)	(0.0050)	(0.0057)
County-Qtr-Yr FE	✓	✓	✓	✓
Controls for Input Categories				
Property (R)	✓	✓	✓	✓
Comparables (S)	✓	✓	✓	✓
Appraiser (E)	✓	✓	✓	✓
Tract (G)	✓	✓	✓	✓
Market (M)	✓	✓	✓	✓
Mean of Dependent Variable	27.1653	64.9991	27.1653	64.9991
$50^{th} Pctile.$ # of Prev. Completed Appraisals	1	1	1	102
$75^{th} Pctile.$ # of Prev. Completed Appraisals	3	3	3	227
$90^{th} Pctile.$ # of Prev. Completed Appraisals	8	8	8	415
$95^{th} Pctile.$ # of Prev. Completed Appraisals	15	15	15	576
$99^{th} Pctile.$ # of Prev. Completed Appraisals	40	40	40	1004
Observations	10,440,118	10,440,118	10,440,118	10,440,118

Notes: *Data are from the UAD and include appraisals completed between 2015 and 2019, inclusive. Standard errors in parentheses are clustered at the Census tract level.* $+ p < 0.10$, $^* p < 0.05$, $^{**} p < 0.01$.

(general) experience either except at the top quantiles. Specifically, appraisers at these top quantiles are more likely to report values at the contract price when the share of African Americans in a neighborhood rises.

This is consistent with the results of Table B4, which shows a slight decline in the association between low appraisals and neighborhood race among the most (generally) experienced appraisers. Taken together, these results indicate that the most (generally) experienced appraisers may be more willing to raise their assessment up to the contract price, perhaps to avoid the loss of a transaction. However, they are not more willing to report above the contract price in minority neighborhoods, perhaps because they are highly sensitive to potential scrutiny from the GSEs and the lender (Eriksen et al., 2020; Calem et al., 2021).

C The Low Appraisal Gap and Neighborhood Change

At times, neighborhoods' demographic composition is more persistent than their relative socioeconomic standing. As discussed in Bayer et al. (2021), this can be the result of sorting by demographics not altogether related to economic factors. Rather, it can stem from individuals' preference for neighborhoods where they feel that their demographic is represented. Communities across the United States can exhibit persistent demographic character for reasons that are complex, long-lasting, and not entirely tied to economic factors underlying property values. This historical perspective provides additional information to explain the low appraisal gap.

Here, we detail neighborhood change in the post FHAct/ECOA era and connect it to the low appraisal gap.[41] For this analysis, we create a new sample that includes neighborhood characteristics as of the 1970 Decennial Census. The 1970 Census is closest in time to the passing of FHAct and ECOA. Moreover, it took place at the end of the Great Migration of African Americans during the 20^{th} Century. After 1970, the geographic movement of African Americans largely settled. The 1970 Census thereby marks a snapshot of neighborhood characteristics and race shares at the close of an historic migratory period and at the start of a new era of housing policy.

Complicating the exercise is that in 1970 many areas of the United States were not assigned a tract. Moreover, tracts change after each Decennial Census. To account for these changes and standardize to 2010 geographic boundaries, we obtain data from the Longitudinal Tract Data Base (LTDB) described in Logan et al. (2014). The LTDB uses area and population weighted information to standardize tract boundaries over time. The new sample has a little over 7,576,286 appraisal records completed in 45,608 tracts.[42]

C.1 Indexing Neighborhood Change

We begin by constructing a neighborhood change index based on economic factors to assess neighborhood change between 1970 and our period of analysis. There is a considerable literature assessing neighborhood change and gentrification using economic indices (UIC-Voorhees, 2014; Cohen and Pettit, 2019; Swanstrom et al., 2015). Our index closely follows

[41] The FHAct of 1968 prohibited sellers from any sales, rental, or lending decisions on the basis of a protected class. The ECOA of 1974 further restricted creditors from making decisions on these bases. As argued in Yinger (1991), the FHAct and ECOA did not immediately change such actions. However, they provided a template for their undoing.

[42] This new sample contains 2.5 million fewer appraisals and encompasses 21,761 fewer tracts than the main main sample (10,440,118 / 67,369). Census tract designations were entirely implemented until the 2,000 Decennial Census. In 1970, the area belonging to these 21,761 tracts were not designated in 1970. As a result, the LTDB is not able to provide standardized demographic values for them. These areas are still today more rural with smaller populations.

those prevalent in this literature. More precisely, we use:

$$index_t = z_{i,t} + z_{h,t} - z_{p,t} + z_{e,t} - z_{u,t} + z_{o,t} - z_{v,t}.$$

Three features of the tract level index are highlighted here. First, it is additive in characteristics. Second, absent any prior weighting scheme, all factors are weighted equally in the sum. Third, factors are standardized to z-scores prior to summing. An interpretation of this index is the relative standing of a tract based on the equal weighted sum of individual economic factors.[43] Since it eliminates level differences, this method is especially useful when comparing neighborhood change over long time horizons, as we are doing here.

Our index is constructed from seven factors listed in Table C1. These include tract aver-

Table C1: Neighborhood Index

Variables	Improve (+) / Decline (-)
Log Adj. Average Family Income	(+)
Log Adj. Average Housing Value	(+)
% Families in Poverty	(-)
Percent Bachelors or Over	(+)
Percent Unemployed	(-)
% Dwellings Owner Occupied	(+)
% Dwellings Vacant	(-)

ages in income, education, unemployment, and housing. Notably, some variables represent an improvement over time, while some represent a decline. Specifically, increases in poverty, unemployment, and vacant housing are associated with a negative outcome. As is standard practice, these factors receive a weight of minus one in the index.[44]

The index reveals substantial neighborhood change between 1970 and our period of analysis. This is plotted in the top right panel of Figure C1.[45] Moreover, as shown in the top middle and right panels of the figure, neighborhood change has been broad, and the distribution of changes among neighborhoods that are majority African American in 1970 is similarly centered that of neighborhoods which are not.[46] The distribution is centered around zero for majority historically African American (in 1970) neighborhoods.

Consistent with Bayer et al. (2021), the index also reveals that neighborhood race is more persistent than the index. The raw correlation between the neighborhood race in 1970

[43]Formally, absent any correlation among the factors, the index should be (close to) normally distributed with zero mean and variance equal to the number of factors in the index.

[44]Not all economic variables were available for all tracts used in the main analysis.

[45]By design the distribution is centered at about zero (0.57)

[46]In part because majority African American neighborhoods in 1970 are few, changes among these are more varied.

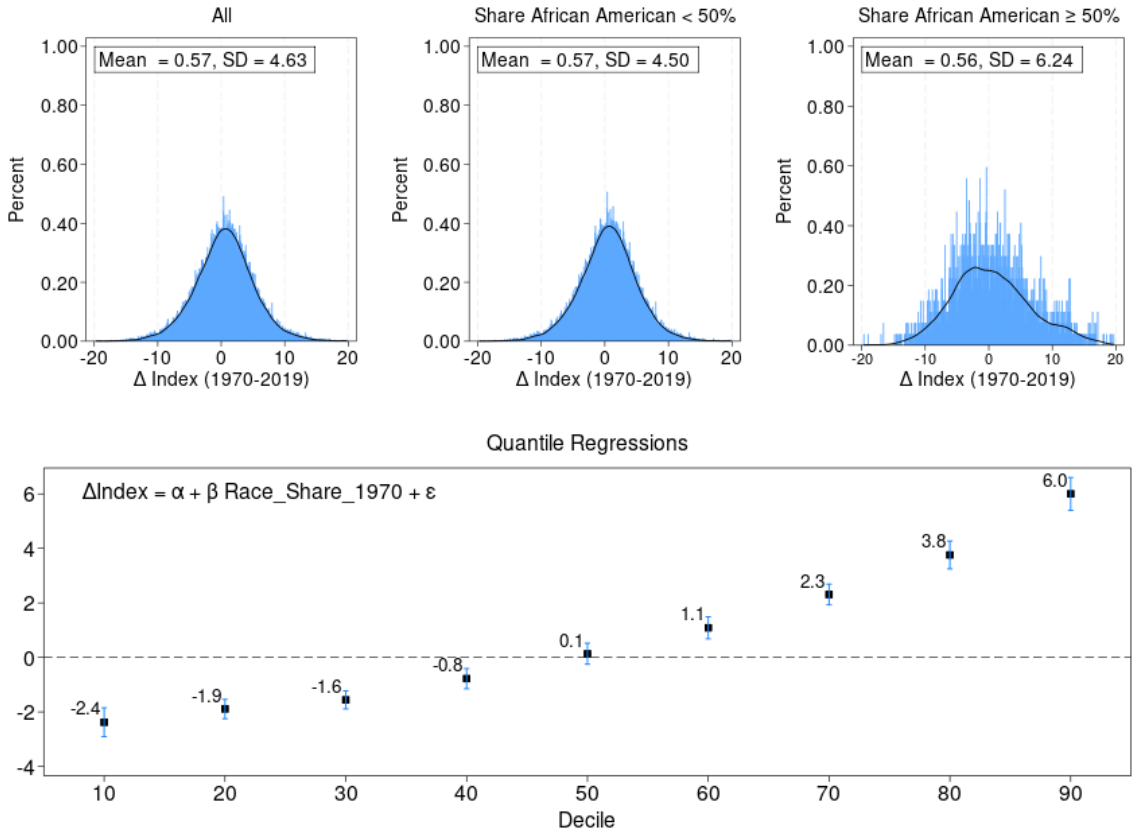


Figure C1: Differences in Index Score and Shares

Notes: *The figure plots distribution of neighborhood change by base (1970) shares. The top panels show, from left to right, these distributions for all, tracts with fewer than 50% African American residents, and majority African American tracts in 1970. The bottom panel plots coefficients and robust confidence intervals from a quantile regression of the index change between 1970 and 2019 on the tract share of African American residents in 1970. See Section 3 for details on data construction, and 1970 shares specifically.*

and in 2015-2019 is 61%. In contrast, the correlation between our quality index over the same period is 53%. Among tracts in which more than five percent of residents were African American in 1970, the top quartile in shares, this difference is still greater: correlation in the index is about 43% versus 60% in the rank order of share.[47]

The bottom panel of Figure C1 takes a more formal approach to the relationship between shares in 1970 and the distribution of the index change. It plots coefficients and confidence intervals from a series of quantile regressions relating the index change to the neighborhood race in 1970. This confirms more generally the earlier conclusion that the distribution of the

[47]Recall that all elements are standardized. As a result, this is measuring the change in relative neighborhood gains over this period. All secular growth or improvement in neighborhoods is normalized out.

change in the index did not experience a level shift by historical shares. Rather, it shows an increase in dispersion. This suggests a thicker tale of improvement among historically black neighborhoods. In other words, more instability in relative change than a systematic level shift.[48]

C.2 Neighborhood Change and the Low Appraisal Gap

The argument in Bayer et al. (2021) that neighborhood race can persist for non-economic reasons finds agreement with our analysis of low appraisals that incorporates heterogeneity in neighborhoods' historical race shares. Table C2 reports estimates from these regressions,

Table C2: Historical Neighborhood Race and Appraisal Outcomes

	(1) Low Appraisal	(2) Low Appraisal	(3) %Difference	(4) Equal Appraisal	(5) High Appraisal
% African American (A_g)	0.1174**	0.0512**	-0.0244**	0.0145**	-0.0658**
	(0.0025)	(0.0018)	(0.0009)	(0.0020)	(0.0028)
$A_g \times (30 < A_g^{1970} \leq 50)$	-0.0031	-0.0116+	-0.0004	-0.0075	0.0191+
	(0.0102)	(0.0063)	(0.0029)	(0.0082)	(0.0113)
$A_g \times (50 < A_g^{1970})$	-0.0350**	-0.0134**	-0.0188**	-0.0166**	0.0300**
	(0.0069)	(0.0050)	(0.0025)	(0.0052)	(0.0076)
County-Qtr-Yr FE	✓	✓	✓	✓	✓
Controls for Input Categories					
Property (R)		✓	✓	✓	✓
Comparables (S)		✓	✓	✓	✓
Appraiser (E)		✓	✓	✓	✓
Tract (G)		✓	✓	✓	✓
Market (M)		✓	✓	✓	✓
Observations	8.2826	8.2827	-4.8054	28.6616	63.0557
Mean of Dependent Variable	7,576,286	7,575,320	622,530	7,575,320	7,575,320

Notes: *Data are from the UAD based on the sample including neighborhoods with data in 1970. The term A_g^{1970} denotes the proportion of African American residents in the tract as of the 1970 Census. Controls in these specifications are the same as those used in Table 2. See Table B2 for details. Standard errors in parentheses are clustered at the Census tract level.* $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$

which are similar to those in Table 2 and include interactions of (and baseline controls for) the proportion of African American residents in 1970 (A_g^{1970}).

[48] We also note that conditioning on base year shares does not influence the neighborhood change distribution symmetrically. There is more a fattening of the right tail relative to the left. This is consistent the facts above in which the correlations become more distinct for tracts with some share of African American residents.

The relationship between low appraisals and neighborhood race is significantly attenuated for historically African American neighborhoods. Column 1 of Table C2 shows that, unconditionally, in tracts which were majority African American in 1970, the association between low appraisals and race shares during our period of analysis is about 30% smaller. This attenuation remains significant after controlling for factors used to assess value – shown in Column 2.

As discussed in Section 4.1, more low appraisals in minority neighborhoods supplant both equal and high appraisals, increasing the former and reducing the likelihood of the latter. This perhaps reflects appraisers' lowered desire to report distorted equal appraisals and greater worry of triggering overvaluation flags with high appraisals. Columns 4 and 5 of Table C2 shows that this is reversed for historically African American neighborhoods. In tracts that were majority African American in 1970, higher A_g see is no longer associated with more equal appraisals. Further, the relationship between A_g and high appraisals in those neighborhoods is significantly attenuated.

Nevertheless the relationship between assessed value and neighborhood race is more prominent in neighborhoods that are historically majority African American. As shown in Column 3 of the table, in historically non-minority neighborhoods, a one percent increase in A_g is associated with a -0.024% lower assessed value among low appraisals. For neighborhoods that were majority African American in 1970, a one percent increase in A_g is associated with a -0.043% lower assessed value. This finding suggests a more nuanced picture of how historical race plays into the low appraisal gap. In particular, it may signify an uneven-ness in neighborhood change for historically African American neighborhoods that is reflected in appraisers opinion of value.

C.3 Appraisal Inputs and Neighborhood Change

Here we repeat the analysis in Section 4.2 Table 3 separating out historically black neighborhoods ($A_g^{1970} > 30\%$). This allows us to compare the relationship between inputs and neighborhood race across these two types of neighborhoods to better understand differences in the low appraisal gap across them. We estimate this by augmenting Equation 1 as follows;

$$F = \eta_1 \cdot \mathbb{1}(A_g^{1970} > 30) + \sum_{b=1}^{3} \mathbb{1}(A_g \in P_b^1) \cdot (\eta_b^1 + \eta_b^2 \cdot \mathbb{1}(A_g^{1970} > 30)) + \tau_c + \epsilon\,, \tag{C1}$$

where we group Census tracts into five groups ($P_1 - P_3$):

$$A_g \in \{(0, 30], (30, 50], (50, 100]\}.$$

As before, the term τ_c are state by quarter fixed effects.

Table C3 reports the estimates from these regressions. This analysis largely confirms the intuition behind the results in Table C2. Properties in historically African American neighborhoods are larger and in better condition. The neighborhoods themselves also show more desirable characteristics, especially a generally newer housing stock. They are also in areas that show more stable home price growth.

Table C3: Inputs, Race, and Historical Race (1970)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$<30\%$ *African American in 1970*				$\geq 30\%$ *African American in 1970*			
Dependent Variable	% African American (A_g) in range =				% African American (A_g) in range =			
	0	(0,30]	(30,50]	(50,100]	0	(0,30]	(30,50]	(50,100]
Subject Property								
Has Water View	3.7500	-1.4700	-2.2100	-2.9600	4.0800	-0.4200	-2.9600	-3.3300
	(0.17)	(0.17)	(0.24)	(0.20)	(0.68)	(0.88)	(0.77)	(0.69)
Located Near Water	1.3400	-0.7800	-1.0900	-1.1700	0.9300	-0.3600	-0.8100	-0.8100
	(0.10)	(0.10)	(0.11)	(0.11)	(0.14)	(0.18)	(0.16)	(0.15)
Total # of Rooms	7.0234	-0.0288	-0.5353	-0.5974	6.6616	0.4505	-0.1592	-0.3863
	(0.0243)	(0.0249)	(0.0411)	(0.0342)	(0.1947)	(0.2141)	(0.2042)	(0.1971)
# of Bathrooms	2.5268	-0.0530	-0.3593	-0.4853	2.4118	0.1863	-0.1993	-0.3644
	(0.0157)	(0.0161)	(0.0238)	(0.0218)	(0.2125)	(0.2171)	(0.2154)	(0.2134)
# of Bedrooms	3.2979	0.0189	-0.1494	-0.1416	2.9843	0.3903	0.1905	0.1409
	(0.0107)	(0.0110)	(0.0170)	(0.0154)	(0.1688)	(0.1719)	(0.1714)	(0.1693)
Site Area (Acres)	0.9958	-0.4997	-0.7595	-0.7779	0.6058	-0.1120	-0.1985	-0.4414
	(0.0312)	(0.0316)	(0.0326)	(0.0330)	(0.1103)	(0.1132)	(0.1158)	(0.1108)
Gross Living Area (1k Sqft)	2.1259	-0.0960	-0.4417	-0.5256	2.0320	0.0872	-0.2737	-0.4579
	(0.0154)	(0.0158)	(0.0232)	(0.0210)	(0.1446)	(0.1517)	(0.1487)	(0.1458)
Quality Score (1-5)	3.4929	0.0690	0.2327	0.2847	3.4581	0.0388	0.1564	0.2316
	(0.0073)	(0.0075)	(0.0095)	(0.0088)	(0.0395)	(0.0414)	(0.0415)	(0.0403)
Condition Score (1-5)	2.8644	-0.0190	0.1132	0.1399	3.0860	-0.3982	-0.3008	-0.2929
	(0.0171)	(0.0177)	(0.0252)	(0.0220)	(0.1093)	(0.1142)	(0.1158)	(0.1112)
Effective Age	13.4858	-0.1274	1.9418	3.1577	3.7748	-2.0307	0.4074	1.5962
	(0.1776)	(0.1851)	(0.2800)	(0.2487)	(0.6329)	(0.7058)	(0.7737)	(0.6702)
Below Grade Total Sqft	20.3130	49.1817	178.1381	208.8434	5.7565	57.6450	-37.6534	41.9437
	(8.7530)	(8.9253)	(11.0793)	(11.6767)	(6.8725)	(107.1284)	(107.6343)	(07.1427)
Below Grade Finished Sqft	49.7549	28.2290	104.2487	106.3830	6.8889	47.8940	-11.7166	3.8701
	(5.2665)	(5.4159)	(6.6407)	(7.0647)	(4.9058)	(75.0070)	(75.2436)	(75.0945)
Has Central A/C	86.8100	1.1000	-2.6500	-4.9100	88.2400	-4.5600	-9.5100	-11.5500
	(0.51)	(0.53)	(0.58)	(0.59)	(0.67)	(0.80)	(1.13)	(0.87)
Has a Pool	11.7600	-1.9200	-6.2600	-6.8900	2.0800	10.7700	5.7300	4.7000
	(0.29)	(0.29)	(0.35)	(0.34)	(1.82)	(1.91)	(1.90)	(1.84)
Has a Fireplace	63.6200	-1.1200	-12.6600	-18.3500	75.7000	-17.3900	-28.5600	-40.0500
	(0.71)	(0.73)	(1.02)	(1.03)	(4.05)	(4.24)	(4.36)	(4.18)
Has a Basement	42.9300	-0.2300	-4.4400	-5.9500	32.4500	6.5800	2.7800	6.4200
	(0.54)	(0.55)	(0.74)	(0.76)	(9.87)	(9.88)	(9.92)	(9.88)
Has a Garage	86.2700	0.4000	-8.8100	-14.7800	93.6900	-6.7800	-21.4800	-37.3500
	(0.38)	(0.39)	(0.79)	(0.88)	(2.11)	(2.32)	(2.95)	(2.53)
Has a Half Bathroom	43.0000	1.6400	-3.5300	-6.7700	40.7400	5.9700	-4.1500	-5.7100
	(0.56)	(0.58)	(0.86)	(0.84)	(7.48)	(7.59)	(7.59)	(7.52)

Has 2 or More Stories	48.9900	3.9700	0.4900	-2.7100	39.0100	20.9400	10.7600	11.4200
	(0.61)	(0.63)	(0.95)	(0.95)	(9.06)	(9.16)	(9.20)	(9.10)
Financial Assistance	38.1900	2.8500	10.3000	13.1300	26.1100	16.2700	19.7100	21.2000
	(0.45)	(0.46)	(0.61)	(0.60)	(3.97)	(4.02)	(4.12)	(4.00)
Over Conforming Limit	15.8800	-5.9900	-13.1200	-14.0500	4.7900	6.3000	0.0800	-3.2900
	(0.66)	(0.67)	(0.70)	(0.71)	(3.27)	(3.39)	(3.33)	(3.29)
Comparables								
Comp. Prop. for Sale ≤ 2	22.8900	-0.4300	-0.9200	-3.2500	25.7900	-6.2000	-4.2100	-7.7500
	(0.32)	(0.33)	(0.46)	(0.41)	(3.09)	(3.15)	(3.13)	(3.11)
# of Comp. Prop. Used	5.1334	0.0385	0.0558	0.1066	5.0154	0.2259	0.1956	0.2182
	(0.0083)	(0.0085)	(0.0117)	(0.0105)	(0.0440)	(0.0456)	(0.0469)	(0.0450)
Avg. Proximity of Comps	1.3649	-0.5362	-0.7909	-0.7792	0.8644	-0.0218	-0.0582	-0.2649
(Miles)	(0.0262)	(0.0265)	(0.0280)	(0.0284)	(0.0941)	(0.0980)	(0.1029)	(0.0954)
Avg Gross Adj. (%)	11.1417	-1.5253	-1.1355	-0.1281	2.2949	-3.2587	-2.2551	-1.1173
	(0.0830)	(0.0846)	(0.1233)	(0.1172)	(0.8245)	(0.8338)	(0.8514)	(0.8354)
Was for Sale Last 3 Years	23.8100	0.6500	4.8200	13.6600	25.9700	0.4400	7.5300	20.1000
	(0.27)	(0.28)	(0.41)	(0.49)	(3.10)	(3.18)	(3.19)	(3.19)
Appraiser								
Appraiser Type	-0.0971	0.0396	0.0991	0.1869	0.5277	0.4483	0.4783	0.5756
(z-Score FE)	(0.0051)	(0.0052)	(0.0094)	(0.0098)	(0.0920)	(0.0930)	(0.0940)	(0.0926)
# of Completed Appraisals	100.5801	25.5890	26.8832	13.3322	2.4309	78.7928	65.7605	59.6358
	(2.0276)	(2.0606)	(3.0537)	(2.7501)	(7.3341)	(9.3873)	(10.5741)	(7.8048)
# of Completed Appraisals	4.1583	0.4417	-1.5526	-2.9242	4.2086	2.2171	-1.3442	-3.0938
in Neighborhood	(0.2046)	(0.2123)	(0.4528)	(0.2514)	(0.8664)	(1.3774)	(0.9671)	(0.8728)
Neighborhood								
Pop. Density (1k/mi^2)	3.9308	1.9359	3.5911	4.4918	0.9255	8.6426	9.0380	8.1324
	(0.1347)	(0.1388)	(0.2247)	(0.2352)	(4.2441)	(4.2532)	(4.2717)	(4.2506)
% Bachelors or Higher	43.7800	0.6600	-11.6700	-16.1900	39.3600	1.4400	-7.5000	-14.8200
	(0.43)	(0.44)	(0.53)	(0.51)	(12.12)	(12.14)	(12.14)	(12.12)
Δ % Bachelor or Higher	3.2700	0.0200	-0.5100	-0.9500	3.1100	6.8500	7.05	6.2100
	(0.13)	(0.13)	(0.19)	(0.19)	(2.68)	(2.69)	(2.69)	(2.68)
Median Income	84,914	-8,281	-33,077	-36,754	68,762	-1,850	-19,153	-28,741
	(872)	(888)	(978)	(970)	(10),230	10,277	10,267	10,239
Δ Median Income	12,731	-1,376	-5,363	-6,410	6,566	4,388	2,578	124
	(307)	(313)	(365)	(360)	(7),191	7,202	7,206	7,195
% Owner Occupied	76.3700	-12.0700	-29.2600	-28.5900	75.1800	-19.6200	-28.3900	-31.0200
	(0.34)	(0.36)	(0.56)	(0.55)	(8.72)	(8.75)	(8.76)	(8.74)
Δ % Owner Occupied	0.3100	-0.5400	-1.4400	-2.5000	8.0800	-8.2700	-8.8800	-9.1600
	(0.14)	(0.14)	(0.21)	(0.22)	(3.49)	(3.50)	(3.51)	(3.50)
% Public Assistance	1.7200	0.5200	2.3300	2.4600	2.8400	0.7900	1.8700	2.5000
	(0.05)	(0.05)	(0.09)	(0.09)	(1.13)	(1.13)	(1.14)	(1.13)
Δ % Public Asst.	-0.4100	-0.0100	-0.4000	-0.6100	0.8600	-1.9500	-2.1000	-2.6100
	(0.05)	(0.05)	(0.10)	(0.10)	(1.14)	(1.15)	(1.16)	(1.15)
Mean Daily $PM_{2.5}$	8.6619	0.1863	0.3558	0.4589	8.7185	0.3948	0.3400	0.4255
	(0.0256)	(0.0263)	(0.0286)	(0.0275)	(0.2791)	(0.2811)	(0.2807)	(0.2794)
Δ Mean Daily $PM_{2.5}$	-0.7622	-0.1394	-0.1934	-0.1467	1.0542	0.0527	0.0665	0.0890
	(0.0128)	(0.0131)	(0.0144)	(0.0140)	(0.0561)	(0.0576)	(0.0572)	(0.0564)
S.D. Daily $PM_{2.5}$	4.3858	0.0557	0.0932	0.1128	4.4174	0.1375	0.0694	0.1093
	(0.0204)	(0.0211)	(0.0220)	(0.0213)	(0.1877)	(0.1894)	(0.1885)	(0.1879)
Δ S.D. Daily $PM_{2.5}$	-0.1596	-0.0977	-0.1533	-0.1608	0.3905	0.1281	0.0865	0.0496
	(0.0141)	(0.0144)	(0.0154)	(0.0147)	(0.1826)	(0.1830)	(0.1829)	(0.1827)
% Constructed	40.6900	2.4600	10.3300	18.3000	36.6100	12.3200	19.0300	27.2400
Pre 1970	(0.53)	(0.55)	(0.76)	(0.74)	(5.86)	(5.91)	(5.93)	(5.88)
Market								

Δ ZHI	0.5162	0.0293	0.0725	0.1351	0.6783	-0.1445	-0.0895	-0.0102
	(0.0013)	(0.0014)	(0.0018)	(0.0019)	(0.0236)	(0.0236)	(0.0237)	(0.0236)
Δ_{t-1} ZHI	0.5126	0.0301	0.0730	0.1359	0.6707	-0.1401	-0.0836	-0.0057
	(0.0014)	(0.0014)	(0.0018)	(0.0019)	(0.0264)	(0.0265)	(0.0265)	(0.0264)
3 Month Avg. # of	9.6393	2.0563	-1.8458	-4.1277	8.8642	3.2766	-2.4668	-4.6057
Purch. Appraisals	(0.0289)	(0.0305)	(0.0471)	(0.0395)	(0.8186)	(0.8254)	(0.8214)	(0.8191)