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Daniel Grodzicki
Sean Cannon
Christopher W. Davis
Ken Lam

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FEDERAL HOUSING FINANCE AGENCY
Division of Research and Statistics
400 7th Street SW
Washington, DC 20219, USA

Please address correspondence to Daniel Grodzicki (daniel.grodzicki@fhfa.gov). Helpful feedback was provided by Will Doerner, Julie Giesbrecht, Saty Patrabansh, Hanna Pitz, Jonathan Spader, Scott Susin, and numerous other FHFA seminar participants.

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Abstract

We study how the share of African American residents in a neighborhood impacts appraisers' valuation decisions for home purchases. Controlling for many appraisal inputs, including the appraiser themselves, we find that appraisals below the contract price are at least 23 percent more likely in majority African American neighborhoods relative to similar neighborhoods with no African American residents. Instrumental variable estimates, based on historical shares, indicate an impact of at least 13 percent. However, this effect dissipates when an appraiser works in neighborhoods in which they have appraised before or in which many appraisals were recently completed, facts consistent with an information based mechanism.

Keywords: Appraisals · Mortgages

JEL Classification: R30 · J15 · G21

Daniel Grodzicki
Federal Housing Finance Agency
Division of Research and Statistics
Office of Data and Statistics
400 7th Street SW
Washington, DC 20219, USA
daniel.grodzicki@fhfa.gov

Sean Cannon
Federal Housing Finance Agency
Division of Research and Statistics
Office of Data and Statistics
400 7th Street SW
Washington, DC 20219, USA
sean.cannon@fhfa.gov

Christopher W. Davis
Federal Housing Finance Agency
Division of Research and Statistics
Office of Data and Statistics
400 7th Street SW
Washington, DC 20219, USA
christopher.w.davis@fhfa.gov

Ken Lam
Federal Housing Finance Agency
Division of Research and Statistics
Office of Data and statistics
400 7th Street SW
Washington, DC 20219, USA
ken.lam@fhfa.gov

1 Introduction

The Fair Housing Act (FHAct) of 1968 and the Equal Credit Opportunity Act (ECOA) of 1974 prohibit decisions in home sales or financing on the basis of a protected class. However, differences in outcomes have been shown to persist. Most documented in this debate are differences in home prices and pricing of home loans (Bayer et al., 2017; Bayer, Ferreira, and Ross, 2018; Hanson et al., 2016; Bartlett et al., 2022; Bowen III et al., 2024). Understanding potential reasons underlying this has long been of interest in the academic literature. However, a home purchase is complex, whereby a key step in this process, the appraisal, has until recently received less attention.

An appraisal is required by lenders and regulators to independently determine a property's collateral value. It directly enters the loan-to-value (LTV) calculation in the underwriting of a mortgage. As a result, the appraisal can dictate the viability and price of the loan. Unfavorable appraisals can prompt delays of sale, a re-negotiation of the contract price, or void transactions altogether (Fout and Yao, 2016). Given the weight of housing in private wealth, knowing and understanding differences in appraisal outcomes may help explain an important facet of enduring heterogeneity in economic circumstance across demographic groups in the United States (Bayer, Charles, and Park, 2021).

This paper studies the impact of a neighborhood's share of African American residents on an appraiser's valuation decision for a home purchase appraisal. It then explores the potential mechanisms underlying any effect. Unlike other aspects of mortgage underwriting, which are primarily based on borrowers' characteristics, the value of a home is intimately connected to the neighborhood in which it is located. Moreover, while most mortgage credit transactions related to a new home purchase require direct borrower-lender interaction, 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 backgrounds altogether. Any incorporation by the appraiser of demographic information in their valuation would most likely stem from that which they observe most directly: the neighborhood or the property.

Our analysis uses data from the Federal Housing Finance Agency's Uniform Appraisal Dataset (UAD), a large repository of millions of appraisals nationwide. We combine the UAD with data on neighborhood characteristics from the US Census Bureau and the Centers for Disease Control and Prevention (CDC). These data are combined at the Census tract level, our

definition of neighborhood. The period of analysis spans January 2015 to December 2019, inclusive. This coincides with the Census Bureau's 2015-2019 American Community Survey (ACS) five-year averages, the most recent release not encompassing the pandemic period.

Empirically, we focus on whether the share of African Americans in a neighborhood influences an appraiser's decision to return a low appraisal, or an appraisal below the a-priori agreed upon buyer-seller (contract) price. Though an appraiser reports an exact dollar value, low appraisals are consequential because lenders are bound to underwrite a loan based on the lower of appraised value and contract price. An amount at or above the contract price has little material impact on the transaction. A low appraisal places economic burdens on both buyer and seller. It can trigger higher upfront payment, worse loan terms, or denial of credit altogether. Moreover, focusing on low appraisals allows us to benchmark the appraiser's decision to a previously agreed upon price, which is known to them at the time of the appraisal.

We begin by documenting the association between the likelihood of a low appraisal and a neighborhood's share of African American residents. Unconditionally, low appraisals are 0.11 percentage points (p.p.) more likely in a tract with a one p.p. greater proportion of African American residents. This corresponds to a 66 percent higher rate of low appraisals for a majority (50 percent) African American tract compared to one with no African American residents. Next, we incorporate the many other factors an appraiser considers in their valuation decision. These are categorized as follows: (1) characteristics of the subject property, (2) the comparable properties used and their reconciliation to the subject property, (3) the appraiser themselves, (4) the neighborhood and its history, and (5) local housing market trends.

Information on the subject property, comparable properties, and reconciliation come from the UAD. These are captured in great detail in the data. The UAD also includes information on the appraiser themselves. This allows us to construct a unique and anonymous appraiser identifier, a feature novel to this literature. We use this to account for time invariant appraiser fixed effects and to track their experience across neighborhoods and over time. Neighborhood information comes from the Census and the CDC. The latter captures neighborhood air quality, a crucial amenity determining property values (Chay and Greenstone, 2005). Local housing market trends come from the Zillow Home Value Index (ZHVI).

Our assessment of how these factors moderate differences in the likelihood of a low appraisal proceeds in two steps. First, we measure their combined contribution and find it reduces the gap by 64 percent. Second, following a long standing tradition of studies dating back to Oaxaca (1973) and Blinder (1973), we evaluate each category's distinct contribution. To sidestep the "order" problem, we approach the accounting question using the method in Gelbach (2016). About 53 percent of the reduction is due to heterogeneity in observable neighborhood characteristics. Another 28 percent arises from differences in individual appraiser characteristics, almost exclusively from the inclusion of the appraiser fixed effect. This indicates that neighborhoods and the appraisers themselves matter most in accounting for this difference.

Next, we analyze any potential causal effects. As evident in the correlation results, factors in the appraiser's decision that are jointly determined with the share of African American residents in a neighborhood include differences in the subject and comparable properties assessed, the neighborhood's long standing socioeconomic characteristics, the appraiser themselves, and market dynamics. Our specification contains extraordinarily rich information on these elements. Notably, inclusion of appraiser fixed effects and gained experience, new to the literature, captures both appraiser sorting and their evolving experiences. Moreover, the analysis of appraisers' valuation relative to a previously agreed upon contract price nets out long term secular differences in market values across neighborhoods.

Captured less well in the data are the shorter term evolving facets of the neighborhood and more geographically granular changes in the market, both of which form part of an appraiser's choice and can be associated with a neighborhood's share of African American residents. We control for medium term levels and changes in neighborhoods' socioeconomic characteristics and amenities. Yet, appraisers may also use more immediate and short term information - including expectations they might hold. Further, we measure market dynamics at the county by month level. Appraisers likely know and also incorporate more geographically precise information on what is happening in the housing market.

To isolate the impact, we apply an instrumental variable design based on neighborhoods' historical demographic composition. Specifically, we use the share of African American residents as of the 1970 Decennial Census. This Census is noteworthy for three reasons. First, it was recorded nearly half a century prior to the start of our analysis period. Second, it

marked the end of the Great Migration of African Americans in the United States. Third, it took place at the start of a post FHAct and ECOA housing market. The 1970 Census thereby provides a snapshot of the geographic distribution of the U.S. population at the close of an historic migratory period and at the dawn of a new era of laws governing housing and housing finance.

Formally, identification relies on differential persistence in the unobserved processes driving a neighborhood's demographic shares and omitted factors in the appraiser's decision rule. The maintained assumption is that historical shares are long lasting for reasons that often go beyond more recent economic factors (Bayer, Fang, and McMillan, 2014). While they can be persistent over time, these omitted factors ultimately contain information about shorter lived aspects of the neighborhood and the market. Notably, the long historical perspective means that nearly all properties ($> 99\%$) in our data were not in existence or were substantially altered since that time, indicating neighborhoods and the housing market changed substantially.

Our instrumental variable estimates indicate that a one p.p. increase in the proportion of African American residents in a tract leads to a 0.022 p.p. increase in the likelihood of a low appraisal. In other words, the impact is about 43 percent smaller than that implied by the association. Nevertheless, it is still economically meaningful and precisely estimated. All else equal, increasing the proportion of African American residents in a tract by 50 percent generates a 1.10 p.p., or 13.3 percent, increase in the likelihood of a low appraisal.

The share of African Americans in a neighborhood also reduces the relative appraised value among low appraisals: a one p.p. increase in the proportion of African Americans in a tract reduces the difference between contract price and appraisal report by 0.034 p.p. A similar (50 p.p.) increase in the proportion of African Americans in a tract reduces low appraised home values by an additional 1.7 p.p. relative to the prior agreed upon contract price. On a typical property in our data, this translates to about $6,100 or 8.5 percent of the modal 20 percent down payment on the new purchase of a home.

To understand the underlying mechanisms, we relate our findings to long standing economic theories by allowing heterogeneity in the effect through a series of interactions. The economics literature has settled on two main theories to explain this effect. The first is preference, or

taste, based. This theory postulates an innate cost of trade with individuals of a different background or group (Becker, 1957). The second is information based, or statistical (Stiglitz, 1973; Arrow, 1998). It is premised on incomplete information between groups, whereby a known characteristic may be used to form prior expectations about those unobserved traits with which it may be associated.

We find that the effect of a neighborhood's share of African American residents on the likelihood of appraising low is largely eliminated when an (average) appraiser works in a neighborhood where they have appraised before. The effect also dissipates when the appraiser works in a neighborhood in which many appraisals took place over the previous quarter. These are presumably "thicker" markets in which they likely have more up to date information on a property's expected resale value. This suggests the share of African American residents in a neighborhood does not seem to factor into the valuation decision when an appraiser is better informed, a fact more consistent with an information based mechanism. In contrast, the effect does not vary with an appraiser's overall experience. Rather, it is specific neighborhood experience that matters. Though cursory evidence, this is somewhat inconsistent with a preference based mechanism in which inexperienced appraisers trying to establish a reputation may find it more costly not to be accurate.

This paper relates to previous work on this topic that has garnered some interest in the popular press (Kamin, 2020; Mock, 2020; Edwards, 2021; Choe, 2022) and prompted discussion in policy circles (Perry, Rothwell, and Harshbarger, 2018; Pinto and Peter, 2022; Rothwell and Perry, 2022; Peter and Pinto, 2023; Howell, 2023*b*). Following the trend, a few academic studies have emerged as well (Howell, 2023*a*; Jackson, 2024). Our work contributes to this literature in several ways. From a measurement perspective, we analyze appraisal level data for loans that were originated and for loans that were not. Previous work has relied on aggregated appraisal outcomes or on appraisals only from originated mortgages. Our approach overcomes the missing data problem, controls for appraisal specific attributes, and give broader coverage of both appraisals and appraisers - for whom we construct unique identifiers.

Conceptually, we focus on the neighborhood as the relevant source of demographic information used by the appraiser. As discussed above, this is more in line with the institutional reality of the home purchase appraisal process. It also sidesteps the need to decipher the mix of buyer

and seller backgrounds and whether that is even observed by the appraiser in a purchase transaction. The focus on the neighborhood also forms a basis for our instrumental variable design. With this, we provide an estimate of the impact of a neighborhood's share of African American residents on an appraiser's decision, which we tie to long standing economic theories postulating potential mechanisms that explain our findings.

2 The Role of Appraisals in Home Purchases

A home purchase appraisal is meant to provide a lender with the fair market value of a property that is to be the collateral for a new mortgage. Appraisal standards were codified as part of the Financial Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA) in response to losses from the Savings and Loan crisis of the late 1980s (Getter, 2023).[1] The rule calls 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. In other words, lenders are the clients. They select, review, and pay for appraisal services.[2]

For most arm's length home purchases, appraisers rarely interact with either the buyer or the seller. The appraiser receives a contract from the lender that only includes financial information about the purchase, often only a contract price and the name of the buyer. The vast majority of residential purchase mortgage appraisals require a site visit. 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.[3] The appraiser is nearly always informed by the neighborhood in forming their opinion of value.

An appraisal is included in mortgage underwriting through the loan-to-value (LTV) calculation. For this, the lender is required to follow the minimum value rule, whereby the property's value is the minimum of the contract price and the appraised value. The LTV measures the amount of equity held by the borrower. High LTV has been shown to predict poor mortgage

[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.

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

[3]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.

performance (Elul et al., 2010; Mayer, Pence, and Sherlund, 2009). As a result, GSE rules for purchase eligibility include LTV standards. Moreover, LTV ratios are watched by investors of privately securitized mortgage pools. Higher LTV mortgages require mortgage insurance and higher interest rates. When the reported appraisal is below the contract price, the LTV at origination rises relative to that determined by the contract price. Usually this occurs in the middle of the mortgage application process, after the buyer and seller have agreed on a price. As a result, it adversely affects the buyer's financial position, the viability of the mortgage, and purchase transaction.[4]

The appraisal regulatory system is substantial. It is comprised of the Appraisal Foundation, 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).[5] 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).[6]

The USPAP identifies three principal approaches to valuation: the sales comparison approach, the cost approach, and the income approach. The sales comparison approach is required for mortgages eligible to be purchased by Fannie Mae and Freddie Mac.[7] It unfolds in five parts. First, the appraiser may conduct an on-site inspection to collect information about the

[4]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.

[5]The USPAP is the generally recognized ethical and performance standards for the appraisal profession.

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

[7]The sales comparison approach is the most common practice, in part due to guidance from Fannie Mae, Freddie Mac, and government insuring or guaranteeing agencies such as the U.S. Department of Housing and Urban Development (HUD), VA, and USDA. 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.

subject property. This includes the legal, sale (contract), site, neighborhood, and detailed physical characteristics of the property. It does not necessarily require an onsite inspection of the property. Second, the appraiser identifies comparable properties that are most similar to the subject property.[8]

Third, the appraiser analyzes each comparable property and assigns an adjustment amount to each attribute that is different from the subject property. Fourth, the appraiser calculates the attribute-adjusted sale price for each comparable property. Fifth, the appraiser reconciles the attribute-adjusted sale price of the comparable properties to arrive at an appraised market 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.

As a result, under the USPAP, the sales comparison approach still affords appraisers substantial discretion in how they value homes. Notably, the academic 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 climbed again in the years since (Ben-David, 2011; Calem et al., 2021). This suggests both parties retain sufficient flexibility in selection and reporting to allow for accommodation to a new regulatory regime.

A number of descriptive studies have highlighted differences in the likelihood of low appraisals for neighborhoods with a high share of African American residents (Perry, Rothwell, and Harshbarger, 2018; Howell and Korver-Glenn, 2018, 2021; Narragon et al., 2021; Williamson and Palim, 2022; Narragon et al., 2022). These studies cite a large number of reasons for these differences. Policymakers have taken note of these studies (Perry, Rothwell, and Harshbarger, 2018; Howell, 2023*b*). There have been a number of court cases in which defendants alleged malfeasance by appraisers, see for example Edwards (2021); Choe (2022). In relation to our study, it is important to note that all these cases involved refinance transactions. Our study is on purchases.

[8]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. Recent analysis conducted by FHFA indicates that majority of the appraisal reports include five or more comparable properties (Cannon and Fischler, 2024).

Unlike purchases, there is only one party and no contract price in a refinance transaction. This presents a different problem for the appraiser than is considered in our analysis. The case of refinances is treated very nicely in Ambrose et al. (2021). Our analysis of purchases may have implications for home ownership opportunities. In contrast, analysis of refinances relates more to how existing homeowners take advantage of market fluctuations and their ability to turn their housing equity into liquid assets for consumption or investment.

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.[9]

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.[10] The appraiser is also required to provide standardized ratings on the property condition and 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 on the appraiser, we construct a unique anonymous identifier to track them across space and over time.

[9]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). 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`.

[10]See Appendix A for more information.

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 mortgage is not originated. It follows that analyses of appraisal outcomes based on appraisals from originated mortgages suffer a severe selection problem. The full UAD is not prone to this limitation.

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.[11] 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.[12]

As aforementioned, air quality is an important neighborhood amenity and, more importantly, a determinant of property values (Chay and Greenstone, 2005). It is not explicitly captured in the appraiser's report, though it more than likely forms 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_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.

The instrumental variable design is based on the share of African American residents in a tract from the 1970 Decennial Census. In 1970, many areas of the United States were not

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

[12]In our main analysis, we use the tract as our definition of a neighborhood in large part because it is a reasonably sized geographic unit and the most granular level of geography available in the historical context (see below our discussion of the IV). However, in Table B2 of Appendix B we provide robustness analysis showing our OLS results are almost completely unchanged when conducting the analysis re-defining the neighborhood to be a Census block-group.

[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`

assigned a Census 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, Xu, and Stults (2014). The LTDB uses area and population weighted information to standardize tract boundaries over time. Finally, we use the monthly Zillow Home Value Index (ZHVI) at the County level for tracking 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 7.5 million appraisal records completed in 45,608 tracts.[16]

As shown in the table, about 8.3 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. Given the average contract price is about $357,000, this amounts to $\$357,000 \times 4.95\% \approx \$17,680$ lower, or 25 percent of the modal down payment. For more than 75 percent of low appraisals in our sample, the appraised value is more than 1.8 p.p. lower than the contract price.[17] Of the remaining 91.7 percent of appraisals in our sample, 28.6 percent are exactly equal to the contract price and 63.1 percent are above.

The large mass of appraisals exactly equal to the contract price has long been a source of

[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]There are about 70 thousand Census tracts in the United States. This means our analysis sample does not include about 25 thousand tracts, which account for about 3.5 million appraisals in the UAD. In 1970, the area belonging to these 25 thousand tracts were areas where census tracts were not created by the Census in 1970 and are likely to have smaller populations. As a result, the LTDB is not able to provide standardized demographic values for them. While we cannot carry out a full analysis on these remaining tracts, in the Appendix sections A and B we provide information on how the full sample, including all tracts comprising the UAD, compares to our analysis sample. We show both updated summary statistics and OLS regression results from our main specifications. Overall, we find that including these tracts does not materially alter our estimates. See the Appendix A and B for more details.

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

Table 1: Selected Summary Statistics

	Mean	SD	P25	P50	P75
Appraisal Outcomes					
% Low Appraisals	8.26				
Difference | Low (%)	-4.76	4.95	-6.06	-3.36	-1.82
% Equal Appraisals	28.6				
% High Appraisals	63.1				
Subject Property					
Contract Price ($)	357,143	296,098	190,000	285,000	425,000
Over Conforming Limit (%)	9.52				
Financial Assistance (%)	41.62				
Quality Score (1-5)	3.57	0.57	3	4	4
Condition Score (1-5)	2.85	0.89	3	3	3
Was for Sale Last 3 Years (%)	25.30				
Effective Age (Years)	13.46	10.59	5	12	20
Actual Age (Years)	35.74	29.92	12	30	56
Comparables					
Comparable Prop. for Sale ≤ 2 (%)	22.24				
# of Comparable Prop. Used	5.18	1.32	4	5	6
Calc Avg Proximity of Comps (Miles)	0.83	1.28	0.28	0.48	0.85
Avg Gross Adjustment (%)	9.71	6.00	5.58	8.48	12.43
Market					
%ΔZHVI	56.98	46.33	30.00	54.98	81.04
%ΔZHVI_{t-1}	57.39	46.81	30.21	55.22	81.57
Appraiser					
Appraiser Saw Contract Price (%)	99.99				
Gained Experience (#)	325.49	356.99	89	215	436
Gained Exp. in Neighborhood (#)	4.44	12.01	0	1	4
Tract/Neighborhood					
% African American	15.17	22.46	1.57	5.55	17.32
% African American in 1970	7.70	18.83	0.00	0.45	3.96
Pop. Density (1k/mi^2)	5.73	8.19	1.44	3.49	6.60
% Bachelors or Higher	41.94	19.55	26.60	39.81	55.82
Median Annual Household Income ($)	72,649	35,716	47,500	65,219	89,963
% Owner Occupied	62.67	22.44	46.55	65.74	81.29
% Public Assistance	2.56	2.98	0.67	1.67	3.38
% Constructed Pre 1970	44.98	30.51	15.80	44.69	72.78
Mean Predicted Daily $PM_{2.5}$ Level	8.88	1.46	7.94	8.87	9.66
SD Predicted Daily $PM_{2.5}$ Level	4.45	1.22	3.76	4.29	4.81
Number of Observations	7,508,826				
Number of Tracts	45,608				

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, whereby nearly all ($> 99\%$) of appraisals, the appraiser reports having previous knowledge of the contract price.

The average contract price in our sample is $357,143, with an inter-quartile range of $140,000. In just over nine in ten properties of our sample, 80 percent of the contract price 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 few.

Condition and quality scores are important variables in our analysis because they provide a standardized scale of assessment for the property. Property Condition and 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.[18]

As reflected in the actual age variable, the typical subject property in our sample was built 36 years prior to its appraisal, and 75 percent were built fewer than 56 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.[19] These measures factor into our analysis in two ways. First, they directly enter the appraiser's decision rule. Second, they provide evidence in favor of our identification strategy based on historical shares. Nearly all properties under consideration in our data were not constructed or were substantially changed from the historical point we consider for our instrument.

[18]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`.

[19]As discussed further below in Section 4, about 99 percent of homes in our sample are "effectively" less than 45 years old. In other words, nearly all properties in our sample were either built more recently or substantially renovated after 1970.

On average, five comparable properties are used in an appraisal and at least 4 are used in 75 percent of appraisals. This is in line with estimates from Cannon and Fischler (2024) showing that the modal appraisal is based on 5 comparable properties. 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 nearly 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.[20]

The average share of African Americans in a tract is 15 percent. However, this distribution is highly skewed. At the 25^{th} percentiles, only 1.6 percent of tract residents are African American. Only 5 percent of tracts are majority African American (not shown). Also shown in the table, as compared to today, the distribution of African Americans was more concentrated in 1970. In an average tract, about 42 percent have a college degree and annual income is just over $72 thousand. About 62 percent of homes are owner occupied and just over 55 percent were constructed prior to 1970.[21]

High levels of particulate matter in the air are hazardous to health and are correlated 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 8.8 and 8.9 $\mu g/m^3$, similar to the overall average of 8.87 $\mu g/m^3$.

[20]For example, see (Doerner and Susin, 2024)

[21]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.

Moreover, a (mean) standard deviation of 4.45 µg/m^3 suggests the average census tract often rises above the annual standard, but does not often go over the daily standard.

4 Differences in Appraisal Outcomes

4.1 The Frequency of Low Appraisals

We begin the analysis by documenting the basic relationship between the likelihood of low appraisals and the proportion of African American residents in a Census tract. This is reported in Column 1 of Table 2. The association is quantitatively large and precisely

Table 2: The Likelihood of a Low Appraisal

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS		1^{st} *Stage*	*Instrumental Variable*			
	Low Appraisal	Low Appraisal	% African American	Low Appraisal	Equal Appraisal	High Appraisal	%Difference
% African American (A_g)	0.107**	0.038**		0.022**	0.008	-0.030	-0.034**
	(0.002)	(0.002)		(0.006)	(0.007)	(0.0096)	(0.002)
% African American in 1970 (A_g^{1970})			0.523**				
			(0.006)				
County-QtrYr FE	✓	✓		✓	✓	✓	✓
Controls							
Property (R)		✓		✓	✓	✓	✓
Comparables (S)		✓		✓	✓	✓	✓
Appraiser (E)		✓		✓	✓	✓	✓
Tract (G)		✓	✓	✓	✓	✓	✓
Market (M)		✓		✓	✓	✓	✓
Mean Dep. Var	8.257	8.257	15.170	8.257	28.618	63.125	-4.756
N	7,508,826	7,508,826	45,608	7,508,826	7,508,826	7,508,826	615,307

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 for complete regression results including the full set of estimates for controls. Standard errors in parentheses are clustered at the Census tract level.* $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$

estimated. A one p.p. higher proportion of African American residents in a tract is associated with a 0.107 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 $0.107 \times 50 \approx 5.35$ p.p., or $5.35/8.26 \approx 65$ percent, higher in a tract that is majority ($\geq 50\%$) African American.

Recall that 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, which may themselves be associated with a neighborhood's share of African American residents, and which we would like incorporate in the analysis. 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 (G) 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.[22]

Information about Comparable properties (S) is also well represented in the UAD. We control for the number of comparable properties used by the appraiser, their average distance from the subject property, and gross price adjustment (as a share of the sale price) made by the appraiser. We also control for other properties currently offered for sale in the neighborhood and the volume of appraisals in the neighborhood over the past three months. The latter captures overall thickness of sales in the neighborhood.

The appraisers themselves (E) often vary in the decisions they make given similar circumstances. These differences can be informed by their time invariant type or their evolving experience. Moreover, appraisers may be differently assigned to properties in neighborhoods with more or fewer African American residents. We account for this heterogeneity, and sorting, using a 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. As a result, the interpretation of the variable of interest is the average within appraiser. Second,

[22]See Section 3 and Appendix A details.

we track appraisers' experience overall and in each neighborhood to account for their evolving traits throughout the period of analysis. Note that an appraiser's baseline experience is also absorbed by the fixed effect. As a result, we can only measure how the experience they acquire throughout the study period changes their decisions.

Qualities of a neighborhood (G) other than its share of African American residents likely also play an important role. For example, similar 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 contrast, medium term changes to the tract's character, such as increases in median income or education, can also signal its new desirability and a potential rise expected property values.

Our analysis accounts for tract-level population density, education level of residents, median household income, home ownership rates, shares of residents receiving public assistance, and neighborhood air quality. We also include controls for the proportion of homeowners residing in a tract since 1970 and the share of homes built prior to 1970. These measures absorb any long-term stability and longevity of home ownership in the neighborhood. To account for medium term neighborhood change, we further include controls for each of these characteristics recorded in the previous 5-year period.[23]

Finally, an appraiser is 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. For secular time trends, we include County by Quarter fixed effects. We also include the previous 3-month moving average of contract prices (in log scale) of the appraisals in the neighborhood (tract).

Column 2 of Table 2 reports OLS results of a linear regression controlling for the above discussed factors. As might be expected, the association between the share of African American residents in a tract and likelihood of low appraisals is attenuated by 64 percent. Nevertheless, it remains both quantitatively meaningful and precisely estimated. All else equal, an appraisal in a tract that is majority ($\geq 50\%$) African American is at least $0.038 \times 50 \approx 1.90$

[23]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 for details.

p.p. ($1.90\%/8.26\% \approx 23\%$) more likely to be below the contract price relative to an appraisal in an otherwise similar tract with no African American residents.

Following a long standing tradition of decomposition studies dating to Oaxaca (1973) and Blinder (1973), we evaluate the distinct role for each category of observable factors. This provides insight by highlighting how much the addition of each category of observed characteristics accounts for the difference in the likelihood of low appraisals. Specifically, we apply the conditional decomposition proposed in Gelbach (2016). This method derives a linear component structure characterizing the distinct role each observable factor plays in moderating a coefficient of interest. Importantly, it resolves the "order" problem.[24]

Equation 1 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.

$$\begin{aligned} \beta_1^{base} - \quad \beta_1^{full} = \quad & \delta^{Property} + \delta^{Comps.} + \delta^{Market} + \delta^{Tract} + \delta^{Appraiser} \\ 0.107 - 0.038 = \quad & 0.004 \quad + 0.007 \quad + 0.002 \quad + 0.036 \quad + 0.020 \end{aligned} \tag{1}$$

Two categories emerge as especially prominent moderators: the neighborhood (tract) characteristics and the appraiser characteristics. All else equal, $0.036/0.068 \approx 53$ 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 $0.020/0.069 \approx 29$ percent. Heterogeneity in the remaining factors accounts for $0.013/0.069 \approx 19$, with a larger weight on the comparable properties used and their reconciliation than on variation in the subject property characteristics. County level differences of trends in property values account for about 3 percent of the observed difference.

[24]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. The method 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.

Broadly, the above findings indicate a quantitatively meaningful and precisely estimated association between a the share of African Americans in a neighborhood and the likelihood of a low appraisal. Though attenuated, this relationship remains substantial after controlling for observable factors comprising inputs into the appraisers' decision. Two sets of these are especially important: (1) observable neighborhood (tract) characteristics, and (2) appraisers' "type" and experience.

4.2 The Impact: An Instrumental Variable Design

Next we assess the impact of a neighborhood's share of African American residents on the likelihood of a low appraisal. To fix ideas, consider the following linear approximation of an appraiser's decision rule:

$$V_{rgt} = F(A_g, R_{rgt}, S_{rgt}, E_{gt}, G_{gt}, M_{gt}, \nu_{rgt}, \epsilon_{rgt})$$

$$\approx \beta A_g + \gamma^r R_{rgt} + \gamma^s S_{rgt} + \gamma^e E_{gt} + \gamma^g G_{gt} + +\gamma^m M_{gt} + \nu_{rgt} + \epsilon_{rgt}. \quad (2)$$

V_{rgt} is the appraisal outcome for property r in neighborhood g at time t, and A_g is the share of African Americans in neighborhood g. Characteristics $[R, S, E, G, M]$ are defined above. ϵ_{rgt} is an independently distributed idiosyncratic state observed only by the appraiser. Let ν_{rgt} denote the omitted component observed only by the appraiser and associated with A_g.

Factors in the appraiser's decision that are jointly determined with A_g include differences in the subject and comparable properties assessed, the neighborhood's socioeconomic characteristics, the appraiser themselves, and market dynamics. As discussed above, our data contain extraordinarily rich information on these elements.[25] Notably, inclusion of appraiser fixed effects and gained experience, new to the literature, captures both appraiser sorting and their evolving experiences. Moreover, the analysis of appraisers' valuation relative to a previously agreed upon contract price nets out long term secular differences in market values across neighborhoods.[26]

The data captures less well the shorter term evolving facets of the neighborhood and more

[25] See Column 2 of Table 2. See also Table B1 in Appendix B for complete regression estimates.

[26] For example, equation 1 with $v = 1[Appraisal < ContractPrice]$ can be interpreted as characterizing how an appraiser uses this information to decide whether or not to report a value lower than that agreed upon between buyer and seller.

geographically granular changes in the market, both of which are likely incorporated into an appraiser's decision, and which can be associated the share of African American residents in a neighborhood. In particular, recall that we incorporate medium term levels and changes in neighborhood quality and amenities, whereby appraisers may also use more immediate and short term information - including expectations they might have. Also, we measure market dynamics at the county by month level. Appraisers likely know and also use more geographically precise information on what is happening in the housing market.[27]

To isolate the role of A_g as distinct from ν we apply an instrumental variable design. Our instrument is the historical shares of African American residents in a tract. Specifically, we use the 1970 census. We use shares in 1970 for several reasons. First, the 1970 Census takes place nearly half a century prior to the start of our analysis period. Neighborhoods changed a great deal throughout this time.[28] About 66 percent of the homes in our sample were not in existence before 1970, and over 99 percent are deemed "effectively" less than 45 years old.[29] In other words, of the few properties built before 1970, nearly all were substantially modified and updated.[30]

Second, this decennial census marked the end of the Great Migration of African Americans during the 20^{th} Century. After 1970, the geographic movement of African Americans largely settled. Our instrument captures demographic patterns at the close of this migratory period. Third, the 1970 Census took place at the start of a post FHAct and ECOA housing market. The FHAct prohibited sellers from any sales, rental, or lending decisions on the basis of a protected class. The ECOA, passed just six years later, further restricted creditors from

[27]Some unreported information about the subject property and the comparable properties may be picked up in the omitted term ν. Given the long horizon of our IV (see below) and the neighborhood change, this possibility would not affect validity of our identification argument.

[28]In Appendix C we provide a detailed analysis of neighborhood change between 1970 and our sample period via a neighborhood change index. Our analysis reveals that tract characteristics changed substantially over this half century. Some tracts experienced relative gains based on popular economic measures of well being, and some experienced relative decline. Notably, the index is less persistent than the share of African Americans in a tract. Moreover, the distribution of relative change does not shift, but rather becomes more disperse, when conditioning on the share of African Americans in a tract.

[29]Effective age is determined and reported by the appraiser. It captures what the appraiser deems the effective age of the property after accounting for renovations and improvements. As a point of comparison from Table 1, in over 75 percent of tracts the actual age of typical property being appraised is less than 56 years. Moreover, in a typical tract, over 55 percent of housing units, whether up for sale or not, were constructed after 1970.

[30]In addition, the 1970 Census precedes the FIRREA by nearly two decades. It is unlikely any significant contingent of appraisers working as of 2015 were appraising homes in 1970.

making decisions on these bases. The FHAct and ECOA did not immediately change such actions Yinger (1991). However, they provided a template for their undoing. The 1970 census represents a snapshot of housing and the demographic shares at the start of this new era of housing policy.

Our identification relies on differential persistence in the unobserved processes driving A_g and ν_{rgt}. The covariance, $cov(A_g, A_{g,1970})$ represents a long-term, or enduring, demographic path dependence. In contrast, ν_{rgt} contains information about potentially persistent yet ultimately shifting aspects of the neighborhood.[31] We should note that, while popular, there has been criticism of the application of "lagged" variables as instruments, i.e. Reed (2015). However, nearly all studies cited use recent past values as instruments. In contrast, we look nearly a half century into the past. In addition to the long perspective, our choice is informed by the specifics of our underlying problem. It is also informed by the historical context. That is, we pick a point in history pivotal to the evolution of neighborhood shares and home-ownership of African Americans in the United States.

Column 3 of Table 2 reports the first stage regression. As shown in the table, the share of African American residents in a tract displays considerable path dependence, with a

[31] Consider the following formal argument for identification. As a simple example, let the processes generating A_g and ν be given by:

$$\textbf{(i)}\ \ A_{g,t} = \rho A_{g,t-1} + \psi_{i,t} = \rho^k A_{g,t-k} + \sum_{j=0}^{k} \psi_{i,t-j}, \quad \textbf{(ii)}\ \nu_{rg,t} = \sum_{s=0}^{S} \alpha_s \nu_{rg,t-s}.$$

The evolution of a tract's share of African American residents follows a stationary AR(1) process with $\rho \in (0,1)$ shown in Equation **(i)**. This highlights the path dependence of tracts' demographic evolution. In contrast, systematic factors known only to the appraiser (ν_{rgt}) follow an MA(S) process with $\alpha \in (0,1)$. This is a persistent but ultimately finite process driving unobserved factors of neighborhood change. The maintained assumption is that $cov(A_{g,t}, \nu_{rge,t}) \neq 0$, or that $A_{g,t}$ is endogenous. Let k be the number of lags corresponding to the instrument. In this application, measured in five year intervals based on ACS releases, $k = 9$. Differential persistence in A and ν can be more precisely expressed as $S < k$. It follows that,

$$\textbf{FS}\text{: } Cov(A_{g,t}, A_{g,t-k}) = \mathbb{E}\big[(\sum_{j=0}^{k} \rho^j \psi_{g,t-j}) \cdot \psi_{g,t-j}\big] = \sum_{j=0}^{k} \rho^j \mathbb{E}\big[\psi_{g,t-j} \cdot \psi_{g,t-k}\big] = \rho^k \sigma_\psi^2 \neq 0,$$

and

$$\textbf{EXCL}\text{: } Cov(A_{g,t-k}, \nu_{rg,t}) = \mathbb{E}\big[\psi_{i,t-k} \sum_{s=0}^{S} \alpha_s \nu_{rg,t-s}\big] = \sum_{s=0}^{S} \alpha_s \mathbb{E}\big[\psi_{g,t-k} \cdot \nu_{rg,t-s}\big] = 0.$$

As shown, both requirements for the validity of the instrument, a non-zero first stage **(FS)** covariance and the exclusion **(EXCL)** assumption, are satisfied.

correlation coefficient of just over 0.52. It is also precisely estimated, with a first stage F-statistic $> 10^3$. This is in line with our claim that the share of African Americans in a tract is long lived. Column 4 reports the impact of the share of African Americans in a tract on the likelihood of a low appraisal. A one p.p. increase in the proportion African Americans in a tract raises the likelihood of a low appraisal by 0.022 p.p. In other words, increasing the share of African American residents in a tract by 50 percent generates a $0.022 \times 50 \approx 1.10$ p.p., or $1.10\%/8.26\% \approx 13.3$ percent increase in the rate of low appraisals.

The amount by which a low appraisal lies below the contract price also materially impacts the outcome of, and related surplus from, a transaction Fout and Yao (2016). Column 7 of Table 2 reports the impact of the share of African Americans in a neighborhood on this difference. For low appraisals, a one p.p. increase in the proportion of African Americans in the tract reduces the relative appraisal value by 0.034 p.p. Increasing the proportion of a tract's African American residents by 50 p.p. leads a low appraised property to be valued $50 \times 0.034 \approx 1.7$ p.p. lower. Given the contract price for a typical property receiving a low appraisal is $391,000$, this amounts to $\approx \$6,650$, or 8.5 percent of the modal 20 percent down payment.

Though the appraiser reports an exact dollar value, much of the policy and academic discussions highlight three important reporting regions (Ben-David, 2011; Calem et al., 2021). 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 fact in this market is that about 30 percent of properties are appraised at *exactly* the contract price.[32] The third is an appraisal above the contract price, or a "high" appraisal. High appraisals have little material impact on the transaction. They do provide some comfort to the buyer, though they may also trigger an overvaluation flag from the GSEs.

Columns 5 and 6 of Table 2 report the impact of the share of African Americans in a neighborhood on appraisals equal to and above the contract price, respectively. As shown in the table, the share of African Americans in a neighborhood does not have a significant impact on equal appraisals. Rather, the share of African Americans in a neighborhood reduces the

[32]As aforementioned, this excessive bunching at the contract price has motivated an intense debate about both the accuracy and independence of appraisals.

likelihood of high appraisals. This indicates a secular shift down of the distribution as a whole, rather than just a lower likelihood of equal appraisals. This is likely the results of appraisers' overall reticence to generate high valuation risk scores, or over-valuation flags, that can lead to overturned appraisals in post acquisition audits, even exposing the lender to risk from default.

4.3 Relation to Existing Theories

We now turn to understanding the potential mechanisms underlying these effects. The literature has for the most part converged on two mechanisms (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 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 the share of African American residents in a neighborhood into their decision rule because, all else equal, they intrinsically values homes in those neighborhoods less. Alternatively, a lack of knowledge about actual home values in that neighborhood can lead them to use one characteristic of the neighborhood to establish beliefs that substitute for specific knowledge about the property value in that neighborhood. Were they to have more experience in a neighborhood, or were more information about expected property values available to them, we would expect the share of African Americans in the neighborhood to matter less for the outcome.

We test these predictions by estimating heterogeneous effects through a series of interactions of the share of African Americans in a tract with appraisers' experience and the information available on recently appraised homes in the neighborhood.[33] Our results are shown in Table 3. Column 1 reports this heterogeneous effect across tracts in which many purchase appraisals occurred over the past quarter compared to those with few. When an (average) appraiser works in a tract in which there were many appraisals, there is more up to date information about expected resale prices. An information based mechanism predicts that the effect is

[33]These interactions require a second instrument. We use the product of a tract's historical share of African American residents and the interaction variable. See Wooldridge (2010) for a further discussion of this approach.

Table 3: Heterogeneous Effects

(Depvar = Low Appraisal)	(1)	(2)	(3)
Interaction Var (I^k_{rget}) =	Previous Qtr. Num. Appraisals in Tract (> Median)	Appraiser's Previous Experience in Tract (> Median)	Appraiser's Previous Experience Overall (> Median)
(i) % African American (A_g)	0.025**	0.025**	0.024**
	(0.005)	(0.005)	(0.006)
(ii) $A_g \times I^k_{rget}$	-0.017**	-0.015**	-0.003
	(0.006)	(0.004)	(0.004)
(i) + (ii)	0.008	0.010	0.021**
	(0.009)	(0.007)	(0.006)
County-Qtr-Yr. FE	✓	✓	✓
Controls (R, S, E, G, M)	✓	✓	✓
Mean Dep. Var	8.257	8.257	8.257
Mean I^k_{rget}	24.518	4.442	325.487
Median I^k_{rget}	14	1	215
N	7,508,826	7,508,826	7,508,826

Notes: *Data are from the UAD and contain appraisals completed between 2015 and 2019, inclusive. See Section 3 for full description on data construction. Standard errors in parentheses are clustered at the Census tract level.* $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$

attenuated in these tracts. As shown in Column 2 of the table, when a typical appraiser works in a neighborhood with many previous appraisals, the share of African Americans in that neighborhoods does not enter their decision. The parameter estimate is strongly attenuated and no longer statistically different from zero.

In Columns 2 and 3 of Table 3, we interact the share of African Americans in a tract with an appraiser's past experience in the tract and their experience generally. As shown in the table, when an appraiser works in a neighborhood they have worked in previously, the magnitude of the parameter is substantially reduced and it is no longer statistically different from zero. This is also consistent with information based mechanisms. In contrast, overall appraisal experience does not seem to significantly change the estimated value of the effect (Column 3).[34]

[34]Recall our specifications include appraiser fixed effects. As a result, our estimates are based on within appraiser (over time) variation. That means all of an appraiser's experience prior to the start of the analysis period is time invariant and incorporated in their fixed effect. The results in Columns 2 and 3 are therefore based on experience acquired during the analysis period. In other words, once an (average) appraiser is observed gaining additional experience in a tract, the share of African American residents in that tract no longer factors into their appraisal decision.

This last finding on overall experience suggests two things. First, it is specific experience in a neighborhood that matters for assessing resale values. Second, 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 inconsistent with a preference based mechanism: inexperienced appraisers trying to establish a reputation may find it more costly to be inaccurate or report a low appraisal (Ben-David, 2011; Calem et al., 2021; Conklin et al., 2020).

5 Conclusion

In this paper, we estimate the impact of the share of African American residents in a neighborhood on the likelihood of a low appraisal in that neighborhood. A higher share of African Americans in a tract, or neighborhood, significantly increases the likelihood of low appraisals. All else equal, raising this share from zero to 50 percent (just a majority) generates a 13.3 percent increase in the likelihood of receiving a low appraisal. We further show that when the (typical) appraiser works in a neighborhood they have worked in before or in a neighborhood where many recent appraisals took place this share does not seem to enter their decision rule . These new results are more consistent with information based mechanisms underlying our estimated effects.

The findings in this paper arise from our analysis of a large database of appraisals, the UAD. The UAD is especially well suited to this study for a number of reasons. Principal among these is that it includes both appraisals that led to a mortgage origination and those that did not. This feature assuages concerns over missing data that have been a limiting factor in previous work on this topic. Further, the UAD records extraordinarily detailed information about the appraiser's decision process. This allows us to include a rich set of controls for factors that may confound the coefficient of interest, limiting pathways for unobserved confounding elements and informing our instrumental variable design.

Lastly, it is important to note that our results are just one step in our overall understanding of why neighborhoods may experience differences in housing and housing finance outcomes. Much is left to future work. In particular, two questions naturally arise from our analysis. First, what are the welfare and distributional impacts resulting from these differences? Second, to the extent information drives the mechanism underlying these differences, what does this imply for optimal policy designs meant to address the issue?

References

Appendix

A Summary Statistics

Table A1 reports complete summary statistics for the analysis sample and the full UAD. The estimation sample encompasses 7,508,826 appraisals in 45,608 tracts while the full data includes 11,010,358 appraisals in 69,382 tracts. Summary statistics of the estimation sample compare closely to the full data with reasonable variation. The main outcome, percent of appraisals that are low, shows a minimal difference between the full and estimation samples, though it is slightly higher in the estimation sample. The vast majority of the other demographic, market, and property specific dimensions had similar means between the full and estimation samples, with less than a 10 % difference as a percentage of the full sample mean for most variables. [35]

A few variables did have noticeably larger percent differences. These include whether the property is located near water (57%), whether there is a water view (38%), the site area in acres (32%), the average proximity of comps (31%), population density (23%), and appraiser experience in African American-majority tracts (20%). This is not unexpected given the additional tracts in the full sample are those not well populated in 1970. Moreover, most of these have a low baseline and therefore show low nominal differences. For example, for average proximity the estimation sample had a mean of 0.81 miles while the full sample was greater by less than half a mile at 1.21 miles on average.

B Full Regression Results

Table B1 reports the complete set of estimates of regressions shown in Table 2. We find that the signs of parameter estimates typically align with intuition. For example, the positive direction on the estimate of the number of comparable properties used might indicate that appraisers may incorporate more comparable properties, or information, to justify a low appraisal. Additionally, the positive sign on the gross adjustments made to comparable

[35]Property condition and quality of construction scores are determined by the appraiser and recorded as part of a home appraisal, representing a holistic view of the property and any improvements. The property condition scale ranges from C1 to C6, with C1 representing very recently constructed properties with no physical depreciation and C6 representing properties with substantial damage, deferred maintenance, or deficiencies. Similarly, Quality of Construction is scored on a scale ranging from Q1 to Q6, with Q1 representing exceptionally high-quality refinements, workmanship and materials. Conversely, Q6 properties represent lower cost, basic properties with unprofessional build quality that may lack electrical, plumbing, or mechanical systems.

Table A1: Complete Summary Statistics for Full and Estimated Sample

	Estimation Sample					Full Data				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Mean	SD	P25	P50	P75	Mean	SD	P25	P50	P75
Appraisal Outcomes										
Low Appraisals	8.26					7.78				
Difference | Low	-4.76	4.95	-6.06	-3.36	-1.82	-4.94	5.24	-6.25	-3.45	-1.84
Equal Appraisals	28.62					26.83				
High Appraisals	63.13					65.39				
Subject Property										
Contract Price	357,143	296,099	190,000	285,000	425,000	338,900	291,307	178,398	269,900	404,980
View Type: Water	2.29					3.70				
Location: Water	0.57					1.35				
Total Rooms	6.96	1.68	6	7	8	6.86	1.66	6	7	8
Bathrooms	2.45	0.96	2	2	3	2.41	0.95	2	2	3
Bedrooms	3.31	0.81	3	3	4	3.26	0.82	3	3	4
Site Area (Acres)	0.50	1.82	0.14	0.20	0.33	0.74	2.89	0.15	0.22	0.40
Gross Living Area (1k Sqft)	2.01	0.86	1.38	1.81	2.44	1.98	0.84	1.37	1.79	2.40
Quality Score (1-5)	3.57	0.57	3	4	4	3.57	0.58	3	4	4
Condition Score (1-5)	2.85	0.89	3	3	3	2.84	0.91	3	3	3
Effective Age	13.46	10.59	5	12	20	13.04	10.49	5	10	20
Actual Age	35.74	29.92	12	30	56	34.76	30.65	11	28	54
Below Grade Total Sqft	459.47	634.09	0	0	920	447.70	632.08	0	0	912.00
Below Grade Finished Sqft	215.60	425.59	0	0	277	206.58	422.86	0	0	72
Central A/C	87.44					85.60				
Pool	9.50					8.95				
Fireplace	61.31					58.16				
Basement	42.14					40.95				
Garage	85.63					84.05				
Has a Half Bathroom	44.11					41.20				
2 or More Stories	52.60					49.92				
Transaction										
Financial Assistance	41.62					42.36				
Over Conforming Limit	9.52					8.63				
Comparables										
Comparable Prop. for Sale ≤ 2	22.24					22.90				
Number of Comparable Properties Used	5.18	1.32	4	5	6	5.16	1.34	4	5	6
Calc Avg Proximity of Comps (Miles)	0.83	1.28	0.28	0.48	0.85	1.21	2.21	0.31	0.54	1.09
Avg Gross Adjustment Percent	9.71	6.00	5.58	8.48	12.43	10.64	6.96	5.88	9.10	13.64
Was for Sale Last 3 Years	25.30					25.26				
Market										
$\%\Delta$ZHI	0.57	0.46	0.30	0.55	0.81	0.56	0.46	0.29	0.54	0.81
$\%\Delta\text{ZHI}_{t-1}$	0.57	0.47	0.30	0.55	0.82	0.56	0.47	0.29	0.54	0.81
Appraiser										
Appraiser Experience	325.49	356.99	89	215	436	304.41	344.35	77	197	409
Experience in AA Neighborhoods	4.44	12.01	0	1	4	5.53	14.12	0	1	5
Appraiser Saw Contract Price	99.99					99.99				
Tract/Neighborhood										
% African American	15.17	22.46	1.57	5.55	17.32	13.60	21.48	0.99	4.26	15.24
% African American in 1970	7.70	18.83	0.00	0.45	3.96					
Pop. Density (1k/mi^2)	5.73	8.19	1.44	3.49	6.60	4.67	8.79	0.33	2.23	5.26
Pct Bachelors or Higher	41.94	19.55	26.60	39.81	55.82	39.04	18.71	24.61	35.61	51.33
Pct Bachelor or Higher 2014	38.72	19.24	23.54	36.23	52.04	35.91	18.36	21.73	32.25	47.55
Median Annual Household Income ($)	72,649	35,716	47,500	65,219	89,963	67,380	33,241	44,783	49,875	81,866
Median Annual Household Income 2014 ($)	61,893	30,540	40,362	55,704	76,752	57,579	28,284	38,388	51,285	70,035
Log Income	11.08	0.48	10.77	11.09	11.41	11.01	0.47	10.71	11	11.31
Log Income 2014	10.92	0.48	10.61	10.93	11.25	10.85	0.46	10.56	10.85	11.16
Pct Owner Occupied	62.67	22.44	46.55	65.74	81.29	64.63	21.72	50.44	69.25	81.93
Pct Owner Occupied 2014	63.08	22.23	47.43	66.26	81.54	64.92	21.49	51.11	69.60	81.95
Pct Public Assistance	2.56	2.98	0.67	1.67	3.38	2.51	2.85	0.71	1.68	3.31
Pct Public Assistance 2014	3.10	3.47	0.85	2.04	4.10	3.00	3.29	0.90	2.05	3.95
Mean Predicted Daily $PM_{2.5}$ Level	8.88	1.46	7.94	8.87	9.66	8.54	1.49	7.59	8.64	9.37
SD Predicted Daily $PM_{2.5}$ Level	4.45	1.22	3.76	4.29	4.81	4.26	1.22	3.52	4.11	4.69
Mean Predicted Daily $PM_{2.5}$ Level 2014	9.77	1.56	8.74	9.89	10.75	9.43	1.62	8.42	9.59	10.45
SD Predicted Daily $PM_{2.5}$ Level 2014	4.70	1.23	3.99	4.69	5.40	4.46	1.17	3.77	4.31	5.20
Pct Constructed Pre 1970	44.98	30.51	15.80	44.69	72.78	42.91	28.41	18.05	40.66	66.80
Number of Observations	7,508,826					11,010,358				
Number of Tracts	45,608					69,382				

properties indicates that, on average, more adjustments are made to the sale price on low appraisals.

The results suggest that, when looking at general experience, more seasoned appraisers may have more confidence delivering a low appraisal. Additionally, when an appraiser has specific experience in a neighborhood or greater information about the market, they are less likely to deliver a low appraisal. Some results, like the estimates on the quality and condition scores, are less predictable. Though these scores are likely positively correlated, they measure different attributes of the property and the parameter estimates on the scores have opposite signs. Overall, regression results are robust and a majority of the parameter estimates are precisely estimated.

Table B1: Complete Regression Results (Analysis Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS		1^{st} *Stage*	*Instrumental Variable*			
	Low Appraisal	Low Appraisal	% African American	Low Appraisal	Equal Appraisal	High Appraisal	%Difference
Pct. African American (%AA)	0.1073**	0.0379**		0.0221**	0.0078	-0.0300**	-0.0341**
	(0.0022)	(0.0017)		(0.0055)	(0.0070)	(0.0096)	(0.0024)
%AA in 1970			0.5225**				
			(0.0062)				
View Type: Water		0.0100		0.0021	0.2213^{+}	-0.2234	-0.0016
		(0.0978)		(0.0980)	(0.1263)	(0.1520)	(0.0444)
Location: Water		-0.9154**		-0.9220**	-0.9402**	1.8622**	-0.1764
		(0.1666)		(0.1667)	(0.2300)	(0.2654)	(0.1089)
Total Rooms		-0.1311**		-0.1303**	-0.0879**	0.2183**	0.1007**
		(0.0151)		(0.0151)	(0.0238)	(0.0268)	(0.0095)
Bathrooms		0.0352		0.0329	-0.7465**	0.7135**	-0.0054
		(0.0271)		(0.0271)	(0.0430)	(0.0492)	(0.0176)
Bedrooms		-0.0297		-0.0246	0.3028**	-0.2782**	0.1508**
		(0.0239)		(0.0239)	(0.0370)	(0.0431)	(0.0143)
Site Area (Acres)		-0.0914**		-0.0917**	-0.0571**	0.1488**	0.0086
		(0.0061)		(0.0061)	(0.0099)	(0.0112)	(0.0082)
Gross Living Area (1k Sqft)		-2.5716**		-2.5640**	-2.9591**	5.5231**	0.0015
		(0.0389)		(0.0389)	(0.0605)	(0.0725)	(0.0256)
Quality Score (1-5)		-0.3301**		-0.3269**	-1.5337**	1.8606**	-0.0883**
		(0.0283)		(0.0283)	(0.0453)	(0.0512)	(0.0197)
Condition Score (1-5)		0.4792**		0.4771**	6.0788**	-6.5559**	-0.2973**
		(0.0272)		(0.0272)	(0.0636)	(0.0785)	(0.0124)
Effective Age		-0.0800**		-0.0811**	-0.1369**	0.2181**	-0.0358**
		(0.0021)		(0.0021)	(0.0033)	(0.0039)	(0.0013)
Below Grade Total Sqft		0.0006**		0.0006**	-0.0011**	0.0005**	-0.0002**

Notes: Footnotes. $+ p < 0.10$, $* p < 0.05$, $** p < 0.01$ Continued on next page

Table B1: Complete Regression Results (Analysis Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS		1^{st} *Stage*	*Instrumental Variable*			
	Low Appraisal	Low Appraisal	% African American	Low Appraisal	Equal Appraisal	High Appraisal	%Difference
		(0.0000)		(0.0000)	(0.0001)	(0.0001)	(0.0000)
Below Grade Finished Sqft		0.0005**		0.0005**	0.0007**	-0.0013**	0.0001**
		(0.0000)		(0.0000)	(0.0001)	(0.0001)	(0.0000)
Central A/C		0.7257**		0.7196**	1.3415**	-2.0610**	0.3868**
		(0.0429)		(0.0429)	(0.0694)	(0.0775)	(0.0325)
Pool		0.3782**		0.3703**	0.9196**	-1.2900**	0.1211**
		(0.0518)		(0.0519)	(0.0694)	(0.0859)	(0.0207)
Fireplace		0.6307**		0.6358**	0.8157**	-1.4515**	0.1419**
		(0.0310)		(0.0311)	(0.0509)	(0.0606)	(0.0169)
Basement		-1.7768**		-1.7728**	-0.5720**	2.3448**	0.4380**
		(0.0578)		(0.0578)	(0.0901)	(0.1036)	(0.0414)
Garage		0.2014**		0.1886**	-0.7724**	0.5839**	0.5283**
		(0.0431)		(0.0433)	(0.0587)	(0.0699)	(0.0251)
Has a Half Bathroom		0.3613**		0.3698**	0.7838**	-1.1536**	0.0696**
		(0.0304)		(0.0306)	(0.0474)	(0.0545)	(0.0190)
2 or More Stories		0.2899**		0.2899**	0.1768**	-0.4667**	-0.1195**
		(0.0367)		(0.0367)	(0.0527)	(0.0647)	(0.0196)
Appraiser Saw Contract Price		-2.2480^{+}		-2.2478^{+}	5.1146**	-2.8668	0.5112
		(1.2277)		(1.2278)	(1.6435)	(1.7632)	(0.5016)
Financial Assistance		-0.8562**		-0.8487**	-1.2352**	2.0839**	0.2725**
		(0.0249)		(0.0250)	(0.0433)	(0.0496)	(0.0148)
Over Conforming Limit		3.7926**		3.8054**	3.4764**	-7.2818**	-2.0904**
		(0.0676)		(0.0676)	(0.1008)	(0.1280)	(0.0455)
Comparable Prop. for Sale ≤ 2		2.0640**		2.0568**	0.8602**	-2.9170**	-0.0884**
		(0.0333)		(0.0333)	(0.0489)	(0.0540)	(0.0171)
Number of Comparable Properties Used		2.1371**		2.1370**	0.2683**	-2.4054**	-0.0919**
		(0.0151)		(0.0151)	(0.0192)	(0.0214)	(0.0065)
Calc Avg Proximity of Comps (Miles)		-0.0659**		-0.0697**	0.2616**	-0.1919**	-0.0799**
		(0.0106)		(0.0107)	(0.0167)	(0.0192)	(0.0108)
Avg Gross Adjustment Percent		0.1759**		0.1767**	-0.1681**	-0.0086^{+}	-0.1625**
		(0.0029)		(0.0029)	(0.0039)	(0.0046)	(0.0019)
Was for Sale Last 3 Years		1.4455**		1.4614**	1.0155**	-2.4769**	-0.1003**
		(0.0290)		(0.0294)	(0.0501)	(0.0583)	(0.0140)
Pop. Density (1k/mi^2)		0.0410**	-0.0007	0.0407**	0.0881**	-0.1288**	0.0073*
		(0.0069)	(0.0144)	(0.0069)	(0.0098)	(0.0129)	(0.0031)
Pct Bachelors or Higher		-3.8443**	-12.0427**	-3.8607**	-2.6619**	6.5227**	0.1721
		(0.3281)	(1.3256)	(0.3280)	(0.4490)	(0.5916)	(0.1399)
Pct Bachelors or Higher 2014		0.3350	5.1745**	0.4832	0.7753^{+}	-1.2584*	0.1073
		(0.3137)	(1.3010)	(0.3170)	(0.4589)	(0.5975)	(0.1379)
Log Income		0.0523	-7.9806**	-0.0629	0.3116	-0.2488	0.2324**
		(0.1520)	(0.5606)	(0.1580)	(0.2065)	(0.2804)	(0.0687)
Log Income 2014		-0.0390	2.6452**	-0.0804	0.7452**	-0.6647*	0.3190**

Notes: Footnotes. $+ p < 0.10$, * $p < 0.05$, ** $p < 0.01$

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Table B1: Complete Regression Results (Analysis Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS		1^{st} *Stage*	*Instrumental Variable*			
	Low Appraisal	Low Appraisal	% African American	Low Appraisal	Equal Appraisal	High Appraisal	%Difference
		(0.1516)	(0.5631)	(0.1532)	(0.2068)	(0.2797)	(0.0632)
Pct Owner Occupied		-0.7952**	-18.7208**	-0.9271**	-0.5646	1.4918**	-0.0207
		(0.3057)	(1.3080)	(0.3077)	(0.4189)	(0.5604)	(0.1256)
Pct Owner Occupied 2014		0.9485**	8.4471**	1.0213**	0.9113*	-1.9326**	-0.2782*
		(0.3130)	(1.3121)	(0.3144)	(0.4395)	(0.5917)	(0.1225)
Pct Public Assistance		1.6106	18.5957**	2.3688*	-0.9681	-1.4007	-1.3710**
		(1.0766)	(4.0135)	(1.1032)	(1.4729)	(1.9238)	(0.5268)
Pct Public Assistance 2014		-0.8853	38.7836**	-0.0927	-0.1647	0.2573	-2.4139**
		(0.9429)	(3.6728)	(0.9682)	(1.3712)	(1.8147)	(0.4077)
Mean Predicted Daily $PM_{2.5}$ Level		0.1664	3.9685**	0.1944	-0.1032	-0.0912	-0.1378*
		(0.1359)	(0.2590)	(0.1367)	(0.2125)	(0.2717)	(0.0594)
SD Predicted Daily $PM_{2.5}$ Level		0.1023	-5.0677**	0.0496	0.4148*	-0.4644*	0.0644
		(0.1119)	(0.2389)	(0.1145)	(0.1818)	(0.2328)	(0.0937)
Mean Predicted Daily $PM_{2.5}$ Level 2014		0.9053**	-1.8261**	0.9594**	0.7314**	-1.6908**	0.2290**
		(0.1254)	(0.2162)	(0.1263)	(0.1893)	(0.2422)	(0.0508)
SD Predicted Daily $PM_{2.5}$ Level 2014		-0.4566**	2.6424**	-0.4819**	-0.5422**	1.0241**	-0.0378
		(0.1017)	(0.1829)	(0.1022)	(0.1731)	(0.2154)	(0.0743)
Pct Constructed Pre 1970		-3.4513**	3.9007**	-3.4964**	-1.6598**	5.1561**	-0.3988**
		(0.0845)	(0.2984)	(0.0864)	(0.1179)	(0.1531)	(0.0413)
Appraiser Experience		0.0001^{+}		0.0001^{+}	0.0001	-0.0003^{+}	-0.0000
		(0.0001)		(0.0001)	(0.0001)	(0.0001)	(0.0000)
Experience in AA Neighborhoods		-0.0023		-0.0024	-0.0462**	0.0486**	-0.0042**
		(0.0016)		(0.0016)	(0.0037)	(0.0045)	(0.0008)
%ΔZHI		0.4449**		0.4535**	-0.0082	-0.4453**	-0.1216**
		(0.0654)		(0.0654)	(0.0973)	(0.1029)	(0.0336)
$\%\Delta ZHI_{t-1}$		0.5108**		0.5196**	0.1722^{+}	-0.6918**	0.0132
		(0.0627)		(0.0628)	(0.0960)	(0.1019)	(0.0338)
3 Month Average Purchase Appraisals		-0.0113**		-0.0109**	-0.0190**	0.0300**	-0.0006^{+}
		(0.0012)		(0.0011)	(0.0025)	(0.0034)	(0.0003)
Log 3 Month Average Contract Price		-2.0242**		-2.1589**	-1.4638**	3.6227**	0.1601**
		(0.0650)		(0.0792)	(0.1076)	(0.1393)	(0.0537)
N	7,508,826	7,508,826	45,608	7,508,826	7,508,826	7,508,826	615,307
Mean Dep. Var	8.2565	8.2565	15.1697	8.2565	28.6184	63.1251	-4.7562

Table B2 reports OLS regressions. This table compares results using the estimation sample to the full UAD. We find that coefficient estimates are stable between specifications run using the sample and full data. This is true for both the independent variable of interest and the

vast majority of regressors in the specification with controls. Some parameter estimates have minor differences in magnitude or statistical significance. For example, the estimate on the Mean Predicted Daily $PM_{2.5}$ Level is statistically significant when using the full UAD, as compared to not statistically significant using the estimation sample. Other variables, like the presence of a pool or garage, have minor differences in magnitude when using the full UAD. In general, results are largely consistent between the sample and full data.2.

Table B2: OLS Regression Results: Analysis Sample vs. Full UAD

	Estimation Sample (ES)		Full UAD		*Block Group (ES)*	
	(1)	(2)	(3)	(4)	(5)	(6)
	No Controls	Controls	No Controls	Controls	Controls	No Controls
Pct. African American (%AA)	0.1073**	0.0379**	0.1044**	0.0408**	0.1022**	0.0405**
	(0.0022)	(0.0017)	(0.0019)	(0.0015)	(0.0018)	(0.0014)
View Type: Water		0.0100		0.0408		0.0326
		(0.0978)		(0.0657)		(0.0970)
Location: Water		-0.9154**		-1.0520**		-0.8500**
		(0.1666)		(0.0951)		(0.1664)
Total Rooms		-0.1311**		-0.1173**		-0.1316**
		(0.0151)		(0.0125)		(0.0152)
Bathrooms		0.0352		0.0112		0.0154
		(0.0271)		(0.0223)		(0.0272)
Bedrooms		-0.0297		-0.0180		-0.0096
		(0.0239)		(0.0197)		(0.0240)
Site Area (Acres)		-0.0914**		-0.0583**		-0.0959**
		(0.0061)		(0.0033)		(0.0065)
Gross Living Area (1k Sqft)		-2.5716**		-2.5327**		-2.5488**
		(0.0389)		(0.0320)		(0.0381)
Quality Score (1-5)		-0.3301**		-0.4202**		-0.3206**
		(0.0283)		(0.0239)		(0.0286)
Condition Score (1-5)		0.4792**		0.3934**		0.4947**
		(0.0272)		(0.0224)		(0.0272)
Effective Age		-0.0800**		-0.0739**		-0.0829**
		(0.0021)		(0.0018)		(0.0021)
Below Grade Total Sqft		0.0006**		0.0004**		0.0006**
		(0.0000)		(0.0000)		(0.0000)
Below Grade Finished Sqft		0.0005**		0.0005**		0.0005**
		(0.0000)		(0.0000)		(0.0000)
Central A/C		0.7257**		0.6524**		0.7727**
		(0.0429)		(0.0346)		(0.0431)
Pool		0.3782**		0.4846**		0.4025**
		(0.0518)		(0.0444)		(0.0501)
Fireplace		0.6307**		0.5901**		0.6113**
		(0.0310)		(0.0251)		(0.0317)
Basement		-1.7768**		-1.5128**		-1.8357

Notes: Footnotes. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

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Table B2: OLS Regression Results: Analysis Sample vs. Full UAD

	Estimation Sample (ES)		Full UAD		*Block Group (ES)*	
	(1)	(2)	(3)	(4)	(5)	(6)
	No Controls	Controls	No Controls	Controls	Controls	No Controls
		(0.0578)		(0.0462)		(0.0569)
Garage		0.2014**		0.1234**		0.2578**
		(0.0431)		(0.0336)		(0.0434)
Has a Half Bathroom		0.3613**		0.3392**		0.3621**
		(0.0304)		(0.0252)		(0.0309)
2 or More Stories		0.2899**		0.3694**		0.2565**
		(0.0367)		(0.0298)		(0.0358)
Appraiser Saw Contract Price		-2.2480+		-3.4294**		-2.3943
		(1.2277)		(0.9834)		(1.2415)
Financial Assistance		-0.8562**		-0.6846**		-0.8516**
		(0.0249)		(0.0208)		(0.0245)
Over Conforming Limit		3.7926**		3.7072**		3.6510**
		(0.0676)		(0.0581)		(0.0639)
Comparable Prop. for Sale ≤ 2		2.0640**		1.9144**		2.0475**
		(0.0333)		(0.0276)		(0.0335)
Number of Comparable Properties Used		2.1371**		2.0323**		2.1458**
		(0.0151)		(0.0124)		(0.0150)
Calc Avg Proximity of Comps (Miles)		-0.0659**		-0.0391**		-0.0678**
		(0.0106)		(0.0055)		(0.0110)
Avg Gross Adjustment Percent		0.1759**		0.1446**		0.1847**
		(0.0029)		(0.0022)		(0.0029)
Was for Sale Last 3 Years		1.4455**		1.2653**		1.4428
		(0.0290)		(0.0244)		(0.0289)
Pop. Density (1k/mi^2)		0.0410**		0.0496**		0.1304**
		(0.0069)		(0.0066)		(0.0143)
Pct Bachelors or Higher		-3.8443**		-3.2965**		-2.4909**
		(0.3281)		(0.2721)		(0.1769)
Pct Bachelors or Higher 2014		0.3350		-0.3691		-0.4652**
		(0.3137)		(0.2608)		(0.1734)
Log Income		0.0523		0.1149		-0.2299**
		(0.1520)		(0.1232)		(0.0843)
Log Income 2014		-0.0390		0.1647		0.0212
		(0.1516)		(0.1232)		(0.0848)
Pct Owner Occupied		-0.7952**		-1.0416**		0.1203
		(0.3057)		(0.2530)		(0.1680)
Pct Owner Occupied 2014		0.9485**		0.6471*		0.4887**
		(0.3130)		(0.2599)		(0.1712)
Pct Public Assistance		1.6106		1.4598		1.0067
		(1.0766)		(0.8914)		(0.5999)
Pct Public Assistance 2014		-0.8853		-0.6844		-1.3563*
		(0.9429)		(0.8009)		(0.5460)
Mean Predicted Daily $PM_{2.5}$ Level		0.1664		0.4201**		0.2587*
		(0.1359)		(0.1058)		(0.1299)
SD Predicted Daily $PM_{2.5}$ Level		0.1023		-0.0922		0.1065

Notes: Footnotes. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

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Table B2: OLS Regression Results: Analysis Sample vs. Full UAD

	Estimation Sample (ES)		Full UAD		*Block Group (ES)*	
	(1)	(2)	(3)	(4)	(5)	(6)
	No Controls	Controls	No Controls	Controls	Controls	No Controls
		(0.1119)		(0.0863)		(0.1082)
Mean Predicted Daily $PM_{2.5}$ Level 2014		0.9053**		0.6333**		0.7947**
		(0.1254)		(0.1013)		(0.1167)
SD Predicted Daily $PM_{2.5}$ Level 2014		-0.4566**		-0.2559**		-0.4410**
		(0.1017)		(0.0830)		(0.1001)
Pct Constructed Pre 1970		-3.4513**		-3.2487**		-2.8968**
		(0.0845)		(0.0748)		(0.0647)
Appraiser Experience		0.0001+		0.0001*		0.0001
		(0.0001)		(0.0001)		(0.0001)
Experience in AA Neighborhoods		-0.0023		-0.0012		-0.0062**
		(0.0016)		(0.0011)		(0.0023)
%ΔZHI		0.4449**		0.4462**		0.4906**
		(0.0654)		(0.0492)		(0.0674)
$\%\Delta ZHI_{t-1}$		0.5108**		0.4501**		0.5109**
		(0.0627)		(0.0473)		(0.0650)
3 Month Average Purchase Appraisals		-0.0113**		-0.0105**		-0.0141**
		(0.0012)		(0.0010)		(0.0023)
Log 3 Month Average Contract Price		-2.0242**		-1.5870**		-1.6700**
		(0.0650)		(0.0500)		(0.0489)
N	7,508,826	7,508,826	11,010,358	10,339,253	7,080,329	7,080,329
Adj. R^2	0.0189	0.0898	0.0162	0.0858	0.0186	0.0895
Mean Dep. Var	8.2565	8.2565	7.7813	7.8163	8.234	8.234

C Neighborhood Change Index

Since 1970, neighborhoods have changed considerably along a number of demographic and economic measures. However, it is often the case that the demographic composition of these neighborhoods is more persistent than their relative socioeconomic standing. As shown in Bayer, Charles, and Park (2021), this can be the result of sorting by demographics not altogether related to economic factors. This stems from individuals' preference for neighborhoods where they feel that their demographic characteristic 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.

To better understand this difference, we construct a neighborhood change index based on economic factors to assess neighborhood change along economic dimensions between 1970

and 2019. We then relate it to changes the share of African American residents in the neighborhood. In the construction of our index, we follow existing work on neighborhood change. We start with historical Census data (see Section 3) for 43,544 normalized tracts.[36] The base (1970) data is from the Decennial Census. The contemporaneous data is from the 2015-2019 ACS five-year averages.

As noted above, there is a considerable amount of work assessing neighborhood change and gentrification using economic indices (UIC-Voorhees, 2014; Cohen and Pettit, 2019; Swanstrom, Webber, and Metzger, 2015) Our index closely follows those prevalent in this literature. More precisely,

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

Three features of the tract level index are highlighted here. First, it is additive in economic factors. 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.[37] 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 economic factors listed in Table C1. These include

Table C1: Neighborhood Index Factors

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	(-)

tract averages in income, education, unemployment, and housing. Notably, some variables

[36]Not all economic variables were available for all tracts used in the main analysis. These 43,544 tracts comprise the majority ($> 95\%$) of tracts in our analysis sample.

[37]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.

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.

First, we compare persistence in shares and the index. A raw correlation supports our assertion that shares are more persistent than neighborhood quality along a large set of economic factors. The raw correlation between the share of African Americans in 1970 and in 2015-2019 is 61 percent. In contrast, the correlation between our quality index over the same period is 53 percent. 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 percent versus 60 percent correlation in the rank order of share. In all, though still persistent, neighborhood change is substantially less persistent than the share of African Americans in the tract. 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.

Next, we explore the association between neighborhood change and relative shares in 1970. If unobserved components of housing values are associated with the shares in 1970, we might expect that the conditional distribution of neighborhood change shifts to the left, or right, with the share of African Americans in 1970.[38] This would support the notion that majority African American neighborhoods saw less or more relative gains, on average, over this time.

The top panel of Figure C1 plots the distribution of the change in the index for all tracts (left), Tracts with a less than 50 percent share of African American residents (middle), and majority African American tracts (right). By visual inspection, the (relative) neighborhood change is substantial and, by design, centered at about zero (0.57). The distribution of the change among majority African American neighborhoods in 1970 is change distribution for neighborhoods that were majority African American in 1970 (0.56) is not materially different than for minority neighborhoods (0.57). This suggests the modal neighborhood with high shares of African Americans in 1970 did not fair relatively better or worse than overall. However, the distribution of the change is much more dispersed among these neighborhoods.

The bottom panel of Figure C1 takes a more formal approach to the relationship between

[38]Note that z-scores are normalized unconditionally.

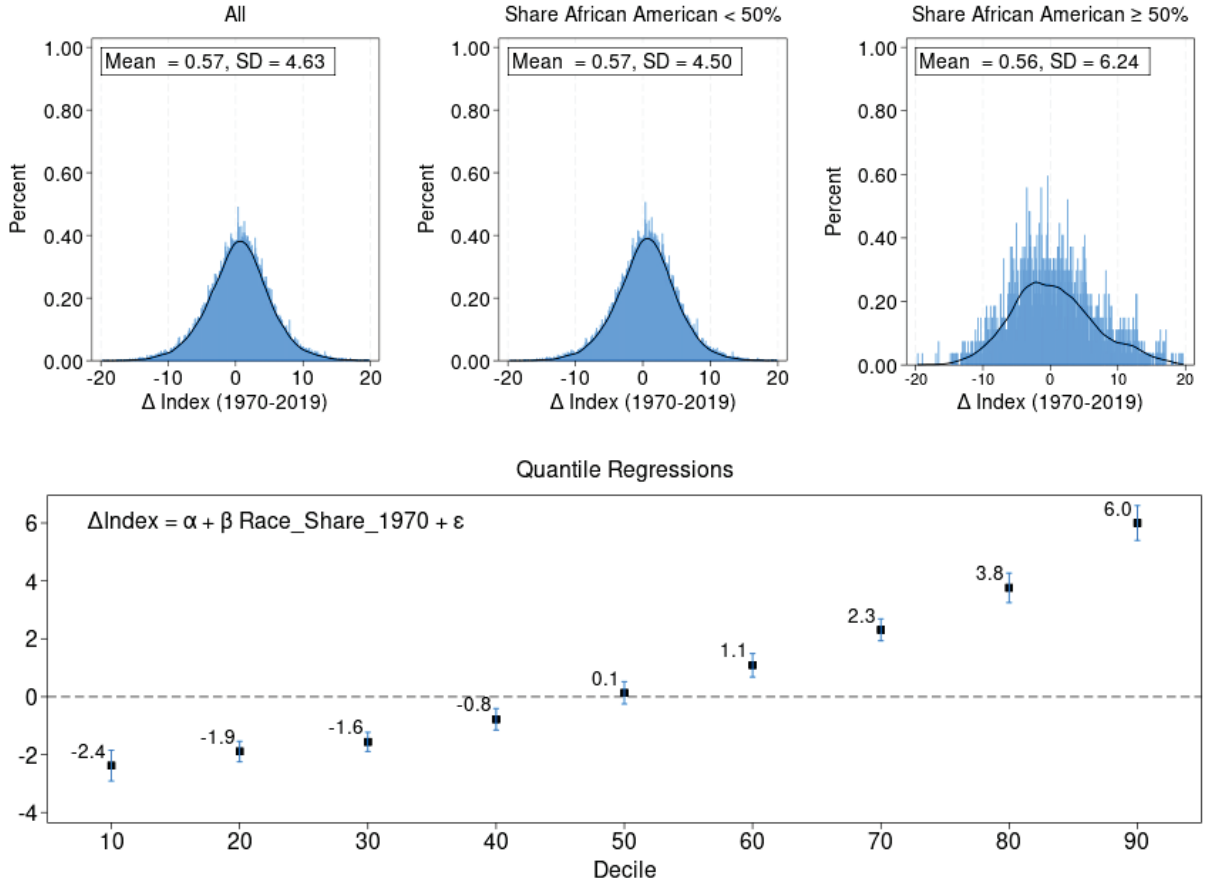

Figure C1: Differences in Index Score and Share of African Americans in a Tract

Notes: *The figure plots distribution of neighborhood change by base (1970) shares. The top panels show, from left to right, these distributions for all, minority African American, 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's share of African American residents in 1970. See Section 3 for details on data construction, and 1970 shares specifically.*

shares in 1970 and the distribution of the index change. The figure plots coefficients and confidence intervals from a series of quantile regressions relating the index change to the shares in 1970. This confirms more generally the earlier conclusion that the distribution of the 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 these neighborhoods. In other words, more instability in relative change among originally minority neighborhoods than a systematic level shift in their relative development.

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. Moreover, given that property values in majority African American neighborhoods are lower both in 1970 and today, this fact is consistent with the assumptions underlying our instrument.