Did Minority Applicants Experience Worse Lending Outcomes in the Mortgage Market? A Study Using 2020 Expanded HMDA Data

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Before 2018, Home Mortgage Disclosure Act (HMDA) data did not include credit factors, such as credit score, debt-to-income ratio, or loan-to-value ratio, typically used by lenders to make loan decisions. HMDA data also did not include important pricing information, such as discount points and lender credits. Starting in 2018, qualifying lenders report these variables, which allow researchers to account for differences in credit risk when modeling mortgage underwriting and loan pricing. In addition, several new variables (final interest rate, total loan costs, discount points paid, and lender credits) allow researchers to study the simultaneous determinants of mortgage pricing. Using 2020 HMDA data, this paper finds that group-level differences persist between minority applicants and non-Hispanic White borrowers in both underwriting and pricing outcomes after accounting for credit risk factors available in HMDA data. Further, group-level differences are generally higher for borrowers in lower credit score ranges for conventional purchase and conventional refinance lending.

I.   Introduction

In response to the 2007–2008 U.S. financial crisis, Congress passed the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) on July 21, 2010. Among the Act's numerous provisions was an expansion of the Home Mortgage Disclosure Act (HMDA) dataset to include additional information about mortgage applications and loans that would aid understanding of the mortgage market. HMDA data serve multiple purposes, including "providing information to help determine whether financial institutions are serving their communities' housing needs."[2] On October 15, 2015, the Consumer Financial Protection Bureau (CFPB) issued a final rule governing the inclusion of new HMDA data fields and mandating reporting for qualifying reporters. Implementation and data collection under the new HMDA data framework began on January 1, 2018. Expanded HMDA data include detailed information on loan pricing, such as interest rates, discount points, lender credits, points and fees, and negative amortization; applicant creditworthiness factors including credit score, debt-to-income ratio, and loan-to-value (LTV) ratio; and information on the property being financed (e.g., manufactured housing with and without land).

Before the expansion of the dataset, HMDA data did not include credit factors commonly used by lenders to make loan decisions.[3] Thus, while researchers used pre-expansion HMDA data to understand mortgage lending patterns, they could not easily account for differences in credit risk affected by those patterns. Pre-2018 studies solely using HMDA data could show only raw, unadjusted differences between groups (such as race and ethnicity).[4] For example, a study by Glantz and Martinez (2018) that relied on 2015–2016 HMDA data found that Black applicants were turned away at rates significantly higher than Whites in 48 cities, Latinos in 25, Asians in nine, and Native Americans in three. In Washington, DC, the authors found that all four groups were significantly more likely to be denied a home loan than Whites. However, because pre-expansion HMDA data did not include credit score, LTV ratio, or debt-to-income ratio, the authors could not account for differences arising from these factors. To account for credit factor differences, researchers had to match HMDA data with third-party data, which often presented challenges.[5] The expanded HMDA data allow researchers to analyze how applicants and borrowers experience the mortgage market without having to match to third-party data.[6]

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[2] Consumer Financial Protection Bureau, "Home Mortgage Disclosure (Regulation C): Small Entity Compliance Guide," May 2020, p. 8, https://files.consumerfinance.gov/f/documents/cfpb_hmda_small-entity-compliance-guide.pdf.

[3] Pre-expansion HMDA data included property and loan characteristics, such as unit type and term. Income was also available pre-expansion, but income alone is not used for loan decisioning and thus its usefulness was limited.

[4] The age variable was added in the 2018 HMDA expansion. This paper does not analyze differences in lending outcomes based on age.

[5] For example, Bhutta et al. (2021) obtain credit factor information by matching 2014 and 2015 HMDA data with Optimal Blue, a secondary mortgage market company that provides loan performance data including credit factors of borrowers. Matching may be done based on property address, geographic area (e.g., census tract), loan amount, and other features. Due to differences in reporting of these fields, 100 percent matching is not typically possible and researchers often choose strict rules to reduce incorrect matching.

[6] HMDA data federal government regulators receive include interest rates, points, fees, other loan costs, debt-to-income ratio, credit score, LTV ratio, and many other newly added data fields. Public HMDA data omit or mask many of these expanded fields to protect borrower and applicant privacy.

Despite the expansion and improvements, many limitations remain in expanded HMDA data. Zhang and Willen (2021) report that expanded HMDA data do not provide information on mortgage applicants who shopped for a mortgage, mortgage products an applicant considered, product offerings potential lenders showed applicants, or applications from the same applicant(s). HMDA data also do not include all factors used in either pricing or underwriting by individual lenders. In addition, there is concern among some researchers and public policymakers that variables used to make loan decisions may be racially biased.[7]

Despite these challenges, researchers often use HMDA data in research studies and regulators use the data to identify potential fair lending risk.[8] In 2021, then Acting Director of the CFPB, David Uejio, stated that "HMDA data provide good insights on the racial and economic disparities in the mortgage market [and] can help us ask the right questions."[9] Differences that remain after controlling for debt-to-income ratio, credit score, LTV ratio, and other factors may reflect either the importance lenders place on non-HMDA reportable data fields, such as residency and employment stability requirements, bankruptcies, and previous foreclosures, or the impermissible influence of bias (intentional or unintentional) by lenders. Therefore, differences in loan underwriting or loan pricing decisions between population groups in this paper should not be interpreted as evidence of discrimination under fair lending (or other relevant) law, as such results may reflect unobserved factors (e.g., employment or resident stability) or unobserved lender-specific differences in permissible use of such factors for underwriting or pricing decisions that are correlated with race and ethnicity.

According to the CFPB, 63 percent of mortgage originations in 2020 were conventional conforming loans sold to Fannie and Freddie (conventional), and an additional 4 percent were conventional non-conforming jumbo loans (jumbo). Ten percent of mortgage originations were loans insured by the Federal Housing Administration (FHA). Using 2020 HMDA data, I analyze lending outcome differences between Black and non-Hispanic White (hereafter White) borrowers

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[7] In 2017, U.S. Senator Tim Scott wrote that "[t]he current credit scoring model at the center of our housing market overlooks a large swath of people that are paying their monthly bills on time and deserve an opportunity to pursue homeownership." Because credit scores do not account for utility, phone, or rental payments, there is a group of consumers that do not have credit histories because such payments are not factored into credit scoring models. Therefore, this omission biases credit scores for the population of applicants whose credit reports do not feature these payment histories. This in turn can lead to biased coefficient estimates in a model that includes both race and credit score as independent variables, as renters are more likely to be minorities. Notably, Fannie Mae recently introduced a policy incorporating rental payments into its automated underwriting system. See Fannie Mae, "Fannie Mae Introduces New Underwriting Innovation to Help More Renters Become Homeowners," press release, August 11, 2021, https://www.fanniemae.com/newsroom/fannie-mae-news/fannie-mae-introduces-new-underwriting-innovation-help-more-renters-become-homeowners. Some of the limitations of HMDA data may be less concerning than appear at first glance. For example, a 2013 CFPB survey found that 77 percent of mortgage applicants did not shop for a mortgage and instead applied to only one lender for one mortgage product. See CFPB, "Consumers' Mortgage Shopping Experience: A First Look at Results from the National Survey of Mortgage Borrowers," January 2015, https://files.consumerfinance.gov/f/201501_cfpb_consumers-mortgage-shopping-experience.pdf.
[8] Typically, regulator use of HMDA data combines statistical analysis of HMDA data to identify differences in how lenders make loan decisions to members of different groups and examination of a lender's loan program to identify potential fair lending risk. HMDA data alone cannot determine whether racial disparities exist in lending, nor can those data be used to determine whether individual lenders violated fair lending law.
[9] CFPB, "2020 HMDA Data on Mortgage Lending Now Available," press release, March 31, 2021, https://www.consumerfinance.gov/about-us/newsroom/2020-hmda-data-on-mortgage-lending-now-available/.

and between Hispanic and White borrowers.[10] I find that Black and Hispanic applicants are denied conventional purchase loans, FHA purchase loans, and conventional refinance (cash-out or no cash-out) loans at rates higher than White applicants, without controlling for borrower, lender, and loan characteristics.[11] After adding controls including applicant credit score, debt-to-income ratio, LTV ratio, state and month indicators, and lender characteristics, estimated denial differences for conventional purchase loans fall by 76 percent (from 7.8 percent to 1.9 percent) between Black and White borrowers and 68 percent (from 4.2 percent to 1.3 percent) between Hispanic and White borrowers. For FHA loans, denial differences fall by 34 percent (from 6.7 percent to 4.4 percent) between Black and White borrowers and 14 percent (from 3.5 percent to 3.0 percent) between Hispanic and White borrowers.[12] I surmise that differences decline less for FHA purchase loans than for conventional purchase loans because Black and White applicants for FHA purchase loans are more similar than Black and White applicants for conventional purchase loans in terms of credit score, debt-to-income ratio, and LTV ratio. For conventional refinance with no cash out, denial rate differences fall by 77 percent (from 12.5 percent to 2.8 percent) between Black and White borrowers and 75 percent (from 6.5 percent to 1.7 percent) between Hispanic and White borrowers when controlling for borrower, lender, and loan characteristics. For conventional refinance with cash out, denial rate differences fall by 77 percent (from 13.9 percent to 3.3 percent) between Black and White borrowers and 70 percent (from 5.9 percent to 1.8 percent) between Hispanic and White borrowers.

If denial rates for Black or Hispanic applicants were the same as those for White applicants in 2020, I estimate that total approvals for conventional purchase loans would have been 2.1 percentage points higher (or 2,042 additional approvals) for Black applicants and 1.5 percentage points higher (or 3,136 additional approvals) for Hispanic applicants. Approval rates for Black applicants would have been 3.5 percentage points higher for conventional no cash-out refinance (or 2,645 additional approvals) and 4.3 percentage points higher (or 1,304 additional approvals) for conventional cash-out refinance. Approval rates for Hispanic applicants would have been 1.9 percentage points higher for conventional no cash-out refinance (or 3,804 additional approvals) and 2.1 percentage points higher (or 1,670 additional approvals) for conventional cash-out refinance. Correspondingly, the model results suggest that if denial rates were the same as White applicants in FHA purchase lending, Black approvals would have been 5.2 percentage points higher (or 6,024 additional approvals) and Hispanic approvals would have been 3.4 percentage points higher (or 6,845 additional approvals).[13]

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[10] I identify a record as being Black if either the applicant or co-applicant selected Black as a racial group and did not select Hispanic as their ethnicity. Hispanic records are those in which the applicant or co-applicant selected Hispanic as their ethnicity. A record is considered to be White if both the applicant and co-applicant selected only White as their racial group and non-Hispanic as their ethnicity.

[11] I analyze first-lien, 1–4 unit, owner-occupied, site-built, fully amortizing, closed-end loan applications for conventional purchase, FHA purchase, conventional no cash-out refinance, and conventional cash-out refinance.

[12] It is somewhat surprising that the newly added credit factors do not explain much of the differences in FHA lending. However, the distribution of credit factor attributes (credit score, debt-to-income ratio, and LTV ratio) for Black and Hispanic applicants is more similar to White applicants for FHA purchase than conventional purchase loans. For example, for conventional loans, the median credit score is 734 for Black applicants, 746 for Hispanic applicants, and 766 for White applicants, but for FHA loans, the median credit score is 664 for Black applicants, 676 for Hispanic applicants, and 673 for White applicants.

[13] This assumes that a denied borrower did not get an approved loan post-denial through another application. HMDA data cannot identify application(s) to the same applicant. In addition, these numbers reflect only the

Without controls, interest rates on conventional purchase loans made to Black borrowers in 2020 were on average 13.1 basis points higher than interest rates for White borrowers. For Hispanic borrowers, conventional purchase interest rates were on average 2.7 basis points higher than rates for White borrowers. I also find that Black borrowers pay on average 11.8 basis points more than White borrowers for FHA purchase loans, while Hispanic borrowers pay 6.5 basis points more.[14]

Using the expanded HMDA data loan pricing variables, I estimate a simultaneous equations model with interest, discount points paid (percent of loan amount), lender credits (percent of loan amount), and loan costs (percent of loan amount) as the dependent variables. Explanatory variables include credit score, LTV ratio, income, lender and loan characteristics, and geography as well as indicators for race and ethnicity. Results from estimating this simultaneous equations model find that in conventional purchase lending, Black borrowers paid 6.1 basis points more in interest rate than White borrowers and Hispanic borrowers paid 6.4 basis points more. Interest rate differences between minority (Black or Hispanic) borrowers and White borrowers in FHA purchase lending are smaller.[15]

Using estimates for all four pricing components, I find that Black borrowers paid $1,583 more than White borrowers for a conventional purchase loan and $541 more for an FHA purchase loan.[16] Similarly, Hispanic borrowers paid $1,725 more than White borrowers for conventional purchase loans and $26 more for FHA purchase loans. In conventional no cash-out refinance, I identify a total pricing difference of $1,211 between Black and White borrowers and a $394 difference between Hispanic and White borrowers. Differences in conventional cash-out refinance are marginally higher compared to conventional no cash-out refinance, with Black borrowers paying $1,909 more than White borrowers and Hispanic borrowers paying $549 more than White borrowers.

This paper makes three valuable contributions to the literature on mortgage lending. First it evaluates the contribution that expanded HMDA data have on explaining mortgage underwriting and loan pricing differences between minority and White applicants. Second, it shows that for many loan types, differences in lending outcomes between minority and White applicants vary

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completed loan applications recorded in HMDA. "Informal" denials may occur before completion of the loan application.

[14] For conventional no cash-out refinance, Black borrowers paid 8.4 basis points more than White borrowers and Hispanic borrowers paid 4.6 basis points more than White borrowers. For conventional cash-out refinance, these differences are 29.0 and 16.9 basis points, respectively.

[15] Differences are statistically significant at the 1 percent level except for Hispanic borrowers in FHA purchase loans, which are statistically significant at the 5 percent level. After including controls, I estimate that for conventional no cash-out refinance, Black borrowers paid 1.9 basis points more than White borrowers. For conventional cash-out refinance, Black borrowers paid 4.4 basis points more than White borrowers and Hispanic borrowers paid 1.0 basis points more than White borrowers. Differences are statistically significant at the 1 percent level.

[16] I calculate this first by determining the cumulative interest paid (CumIntDiff) associated with protected class, and then discounting this total using a discount rate of 3% to find the present value (PV) with the formula of $PV\_CumIntDiff = CumIntDiff (1/(1+r)^n)$, where r is the discount rate, n is 360, and future value is the sum of the payment portion associated with the interest rate difference. For all calculations, $200,000 is used as a standard loan amount. Assumes no prepayment, and interest rate differences are calculated into present value differences.

predictably by credit score bands, with such differences being higher between minority and White borrowers in the same, but lower, credit score bands.[17] Third, this paper uses new HMDA data fields to analyze more components of loan pricing than interest rate alone, accounting for differences in discount points paid, lender credits, and loan fees and thus capturing more of the overall price for a mortgage loan than simple interest or annual percentage rate (APR) differences would. Indeed, this paper's methodology accounts for the fact that borrowers can make tradeoffs (to some extent) in deciding how much they pay in interest rate, discount points, and loan costs, while lenders can choose how much in lender credits to offer.[18]

The paper proceeds as follows: Section II reviews recent research related to mortgage lending outcomes, placing this paper in the broader context. Section III discusses the expanded HMDA data and defines important variables such as loan types and protected class indicators. Section IV formulates the empirical model including control variables. Section V summarizes results for conventional and FHA purchase lending and conventional non-jumbo loans. Section VI concludes.

II.   Related Research

This section reviews related works by researchers on how mortgage lending outcomes for minority borrowers and White borrowers may differ. Until 2018, researchers used third-party data or manually collected data from lenders' paper application files (which include more information than reported in HMDA) to obtain credit factor information, such as credit score.

        a.   Underwriting and Pricing Differences

Research into differences in denial rates by racial groups has roots in Munnell et al. (1996). Using HMDA data, the authors observed that Black and Hispanic applicant denial rates were two to three times those of White applicants. To account for credit factor differences, the authors reviewed applicant files from several Boston area banks and matched those records to their corresponding entries in the HMDA data. They found that after controlling for financial, employment, and neighborhood characteristics, Black and Hispanic mortgage applicants in the Boston metropolitan area were about 60 percent more likely to be turned down for a loan than White applicants.

Bocian et al. (2008) matched 2004 HMDA data to third-party data on subprime loans that contained additional applicant characteristics such as credit score and LTV ratio, finding that "African American and Latino borrowers are more likely to receive higher rate subprime home loans than [White] borrowers."[19] Woodward (2008) studied differences in closing costs among FHA purchase applicants by manually collecting 32 types of fees charged by lenders and found

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[17] Bhutta, Hizmo, and Ringo (2021) note that unexplained denial rate differences widen as credit scores fall. However, their empirical model differs from the model put forth in this paper in that they analyze conventional, FHA, VA, and U.S. Department of Agriculture (USDA) loan types together under a single model.

[18] Bhutta and Hizmo (2021) perform a similar analysis as this paper but only for FHA purchase loans. I am unaware of any similar application to conventional lending.

[19] Bocian et al. (2008) p. 110. Notably, the 2020 mortgage market studied in this paper is dominated by prime borrowers. Bocian et al. (2008) study APR differences and include state- level economic characteristics in their model. This paper does not study APR and instead uses state and metropolitan statistical area (MSA) dummy variables.

that "African-American borrowers pay an additional $415 for their loans after accounting for other borrower differences and Latino borrowers pay an additional $365, on average [compared to White borrowers]."[20]

Zhang (2010) relied on HMDA data augmented with credit score, LTV ratio, and debt-to-income ratio to study differences in lending outcomes between minority and non-minority applicants at two banks supervised by the Office of the Comptroller of the Currency (OCC) (rather than the whole market as this paper does). Zhang finds that statistically significant differences remained between minority and non-minority applicants in one of the two studied banks.

Bhutta and Hizmo (2021) matched 2014 and 2015 HMDA data on FHA loans with Optimal Blue, a financial data provider, to obtain information on interest rates, points, and fees, and credit factors such as credit score, debt-to-income ratio, and LTV ratio, since those variables were not reported in HMDA in those years. They report a 3 (2) basis point spread in mortgage interest rate between Black (Hispanic) applicants and White Applicants after accounting for credit differences. In addition, they report that minority applicants were less likely to pay discount points but do not find difference in fees paid. In contrast, Cheng et al. (2014) reported that, using data from the U.S. Survey of Consumer Finance, that Black borrowers paid 29 basis points more than similar White borrowers.

Finally, Martinez and Kirchner (2021) used publicly available 2019 HMDA data to analyze loan denial differences for conventional loans and found that Black (Hispanic) applicants are denied at rates 1.8 (1.4) times those of White applicants after controlling for factors such as LTV ratio and lender and property characteristics. Unlike this paper's model, the authors could not account for differences in credit score.

Previous research generally finds differences between minority and White applicants in loan approval rates and loan pricing after accounting for applicant characteristics (though this required complicated matching to third-party data or estimating such factors). The next section reports on recent work that may explain how these differences arise.

> b. Potential Explanations for Underwriting and Pricing Differences

Zhang and Willen (2021) find that while minority applicants typically pay interest rates higher than White applicants, this difference could result from a choice between paying discount points or accepting a higher rate absent discount points. To test this hypothesis, the authors use 2018–2019 HMDA data merged with Optimal Blue rate lock information and find that Black borrowers would pay an additional 2 basis points and Hispanic borrowers would pay an additional 1.5 basis points to receive same loan pricing options that White borrowers received. Further, they find the difference in loan pricing options is concentrated among applicants with higher credit scores, indicative of "less risky non-Hispanic White borrowers being more likely to be offered discounts during the search and negotiation process." In other words, minority borrowers will pay more to receive options similar to those offered to White borrowers, suggesting that the options minority

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[20] Expanded HMDA data include such fees summed as total loan costs. Another difference between this study and Woodward (2008) is that due to incomplete data, Woodward estimates credit scores for those records with no credit score identified. See Woodward (2008), p. 10.

borrowers receive are inferior. Related research from Woodward and Hall (2012) shows that borrowers who consider limited options for mortgage servicing (i.e. do not shop) pay at least $1,000 dollars more to complete the mortgage transaction compared to borrowers who did shop around which offers an explanation for the differences found by Zhang and Willen. Further, Hanson et al. (2016) find that during applicants' initial inquiries to mortgage originators, minority applicants are more likely to not receive a response, receive fewer loan details upon response, and less likely to receive follow up messages than similar White applicants.

Similarly, Turner et al. (2012) find that Black applicants were shown fewer homes than White applicants by realtors despite being otherwise similar to White applicants on common credit features. Giacoletti et al. (2021) find that monthly volume quotas reduce discretion in mortgage application decisions as these quotas become more salient to loan officers at the end of the month (due to impending deadline of fulfilling quotas pay incentives). Using this variation in discretion arising from the volume quota policy to analyze lending differences, the authors find that Black applicants face 3.5 to 5 percent lower approval rates compared with White applicants, a finding they state explains about half the difference in overall approval rates.

Finally, Bhutta, Hizmo, and Ringo (2021) study how the use of automated underwriting systems (AUS) affects denial decisions using 2018 and 2019 HMDA data.[21] Their analysis includes all 30-year, fixed-rate, owner-occupied, single-family homes in a single estimation. Using their model specification, the authors find denial rate differences between Black and White borrowers of one to two percentage points. Further, they find that among Black and White borrowers in the same credit score band, the denial rate difference rises as credit scores fall. The authors also find that denial rate differences are associated with application completeness and verification. I speculate that the inability of applicants to complete applications or lenders to verify income as shown by the authors could result from differences in borrower *or* lender effort.

Findings in these studies suggest that minority borrowers were shown fewer homes, were offered fewer mortgage options, were less likely to shop around, and suggest that minority borrowers may be more negatively affected by discretion when quotas are non-binding, which could be due to differences in effort by lenders and borrowers to complete and verify application information. Each of these findings pertains to aspects of the mortgage lending decision not observed in HMDA data and therefore may explain why research cited in Section II.a generally finds differences between minority and White applicants in loan approval rates and loan pricing.

The literature broadly agrees that differences exist in both underwriting and pricing for minority and non-minority applicants and that without credit factor controls, minority applicants are associated with worse outcomes (higher denial rates, higher interest rates, higher loan costs). To account for credit factors not included in HMDA data, researchers had to match HMDA data to third-party data, which often necessitated complex queries or limited the analysis to a segment of financial institutions. In those cases, the literature finds that credit factors explain a significant proportion of these differences. Differences in credit factors *and* differences in the use of discretion in loan-making decisions may explain why, according to Dey and Brown (2020), Black and

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[21] An AUS applies algorithmic decision rules using applicant characteristics to provide a decision to approve or deny a loan.

Hispanic renters were one-half to two-thirds as likely as Whites to transition to mortgage ownership between 2012 and 2018.

This paper contributes to the literature by using newly expanded HMDA data, which include credit factors such as credit score, debt-to-income ratio, and LTV ratio (and therefore does not require matching to third-party data to obtain these variables), to show that lending differences between minority and White borrowers persist. I also estimate lending differences by loan types rather than combining loans of different types into a single analysis as done in prior research such as Bhutta and Hizmo (2021). Further, this paper shows that lending differences are typically larger between minority and White borrowers in the same, but lower, credit score bands in several loan types. This paper also studies differences in discount points, lender credits, and total loan costs in addition to interest rates for both conventional and FHA loans.

III.   Data

The Dodd-Frank Act amended HMDA to require the reporting of 13 new data fields, including credit scores and total points and fees. The CFPB's 2015 final rule added 14 additional data fields, including origination charges, discount points, lender credits, debt-to-income ratio, interest rate, combined LTV ratio, and manufactured property type.[22] The 2015 final rule also replaced the pre-existing property type with two variables, construction type and total units; included additional occupancy categories such as second residence and investment property; and split refinance loans into cash-out refinance and no cash-out refinance.[23]

From the 2020 HMDA dataset, I retain only those records for applications (1) approved by the lender, (2) approved by the lender but rejected by the applicant, and (3) denied by the lender. I do not include records for applications withdrawn or not completed by the applicant, purchased loans from another lender, or preapproved applications that were denied. Records must also have reported credit factor fields such as credit score, debt-to-income ratio, and LTV ratio.[24] I retain only those applications in which the data allow for identification of applicant race and ethnicity. I define three race and ethnicity (hereafter race) groups: Black, Hispanic, and White.[25] However, for brevity and to help focus the reader on important findings, I report only the estimates of differences between Black and White records or Hispanic and White records.[26] Finally, I limit the analysis to the following types of loans and analyze each separately: (1) conventional conforming

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[22] CFPB, "Home Mortgage Disclosure Act (Regulation C)," *Federal Register* 80 (October 28, 2015): 66127, https://www.consumerfinance.gov/rules-policy/final-rules/regulation-c-home-mortgage-disclosure-act/.

[23] Not all of the newly mandated data fields in HMDA are public. As part of the 2015 final rule, the CFPB conducted a "balancing test" to determine which HMDA data fields would be made public in whole, with modifications (such as reporting a range rather than an exact value), or reported solely to financial regulators. Among data fields not included in public HMDA data is credit score; other data fields such as debt-to-income ratio and loan amount are modified to reduce the precision of the values to protect applicant or borrower privacy.

[24] Reporters may qualify for a partial exemption in reporting certain fields, such as credit score, debt-to-income ratio, and LTV ratio based on their loan origination volume in the prior two years if that volume was above 100 originations but below 500 originations in both years. Between 80 to 90 percent of records in a given year are not subject to the partial exemption as they come from lenders who meet the origination threshold necessary for full reporting.

[25] See note 10 for definitions of race and ethnicity groups.

[26] Results for all racial groups available upon request.

home purchase, (2) FHA purchase, (3) conforming no cash-out refinance, and (4) conforming cash-out refinance.[27]

Table 1 provides summary statistics related to coverage of the mortgage market after restrictions on loan type and race and ethnicity identification. Conventional conforming home purchase loans and FHA purchase loans together make up more than half (38 percent and 15 percent, respectively) of the total count of home purchase mortgages. Conforming no cash-out refinance loans make up 27 percent of the refinance market, and conforming cash-out refinance loans account for 11 percent. The final dataset has 5.5 million records across these four loan types where race and ethnicity are identified, covering 54 percent of conventional conforming home purchase loans, 80 percent of FHA purchase loans, 39 percent of conforming no cash-out refinance loans, and 41 percent of conforming cash-out refinance loans.

As shown in Figure 1, Black and Hispanic applicants are denied more often than White applicants across all loan types and years studied. On average, Black and Hispanic borrowers also pay higher interest rates compared with White borrowers, as shown in Figure 2. For conventional purchase loans in 2020, for example, interest rates paid by Black borrowers were 13.2 basis points higher than interest rates paid by White borrowers.

IV.   Empirical Model(s)

For the estimation strategy, I assume that loan choice is exogenous and that credit characteristics are predetermined before application.[28] The underwriting model using formal notation is given in (1) below as:

$$(1) \quad Denial_{ta} = \alpha_{ta} + \beta P_{ta} + \gamma C_{ta} + \delta AC_{ta} + \theta S_{ta} + \vartheta T_{ta} + \varepsilon_{ta}$$

Equation (1) is a logit model with denial outcome as the dependent variable, which I estimate separately for each loan type (t) among all applicants in that loan type (a) where P is an array of racial indicator variables; C is a vector of credit characteristics including credit score (CS), debt-

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[27] These loan types are first liens on single-family, owner-occupied, site-built homes with loan terms of 30 years and a fixed interest rate. I remove records with non-typical features, such as negative amortization and balloon payments, and records in which credit factors such as credit score were not reported; such records represent less than 1 percent of total records.

[28] Identification challenges in estimating effects of the variables in the vector of interest (P) include whether credit characteristics, such as credit score, are subject to racial bias, and thus potentially lead to underestimated effects of race. In addition, if applicants are strategic by either shopping among lenders or improving their credit factors before application, then selection bias raises the possibility of endogeneity of our credit factor variables. Previous work similar to the research in this paper, such as Bhutta and Hizmo (2021), do not discuss this possibility. Further, as research suggests over 75% of mortgage applicants did not shop for a mortgage, I do not consider selection bias to be a significant risk. To the extent that credit score has racial bias, this would work against any findings of a difference between Black or Hispanic borrowers and White borrowers. Bhutta and Hizmo (2021), among others, discuss the potential issue of omitted variables bias. If minority borrowers are more likely to be associated with riskier values of these variables, then omitted variables bias would lead to higher estimates of lending differences between minority and White borrowers than if these variables were observed and included in the model. As such, any findings of differences in lending outcomes between Black or Hispanic borrowers and White borrowers should motivate further research to determine if these unobserved factors can be obtained for future analysis.

to-income ratio (DTI), and loan-to-value ratio (LTV); *AC* is a vector of application characteristics;[29] *S* is a vector of state-MSA dummies; *T* is a vector of monthly time dummies; and ε is residual error.[30] Standard errors are clustered robust, with clustering by financial lender (LEI or Legal Entity Identifier). Credit score is the maximum of applicant and co-applicant credit score. Table 3 provides the cutoff values for the creation of indicator variables for credit score, debt-to-income ratio, LTV ratio, and income (used in estimating (2) below). Coefficients of interests are the β's for our protected class variables, which will indicate the effects associated with protected class on the denial decisions once additional and important explanatory variables are included in the model. The simultaneous linear equation model for loan pricing is given in (2) below where *IR*, *CS*, *LTV*, and *INC,* are interest rate spread, credit score, combined loan-to-value ratio, and income, respectively.[31] Discount points (*DP*), lender credits (*LC*), and total loan costs (*TC*) are expressed as a percentage of the total loan amount.

$$(2) \begin{cases} IR_{ta} = \alpha_{1ta} + \rho_1 PC_{1ta} + \beta_1 P_{ta} + \gamma_{11} CS_{ta} + \gamma_{12} LTV_{ta} + \delta_1 AC_{ta} + \theta_1 S_{ta} + \vartheta_1 T_{ta} + \varepsilon_{1ta} \\ DP_{ta} = \alpha_{2ta} + \rho_2 PC_{2ta} + \beta_2 P_{ta} + \gamma_{21} CS_{ta} + \gamma_{22} LTV_{ta} + \delta_2 AC_{ta} + \theta_2 S_{ta} + \vartheta_2 T_{ta} + \varepsilon_{2ta} \\ LC_{ta} = \alpha_{3ta} + \rho_3 PC_{3ta} + \beta_3 P_{ta} \qquad\qquad\quad + \gamma_{32} INC_{ta} + \delta_3 AC_{ta} + \theta_3 S_{ta} + \vartheta_3 T_{ta} + \varepsilon_{3ta} \\ TC_{ta} = \alpha_{4ta} + \rho_4 PC_{4ta} + \beta_4 P_{ta} \qquad\qquad\quad + \gamma_{42} LTV_{ta} + \delta_4 AC_{ta} + \theta_4 S_{ta} + \vartheta_4 T_{ta} + \varepsilon_{4ta} \end{cases}$$

Equation (2) is a simultaneous equations model estimating each equation among all applicants (a) with the same loan type (t).[32] This makes intuitive sense, as each of the dependent variables is related and equations share common explanatory variables. The decision to pay discount points depends in part on the interest rate offered; lender credits may offset total loan costs to the borrower or be part of the price negotiation for loan costs.[33] Thus, *PC* denotes other pricing components in this system of equations.[34] For interest rates, *CS* and *LTV* are explanatory variables and are often listed in rate sheets used by banks.[35] Because discount points directly affect the final interest rate, its equation also uses *CS* and *LTV*. *INC* is used as a control for *LC* as these credits can offset closing costs and thus their inclusion may reflect a borrower's liquid wealth or the lender accommodating a borrower for an unexpectedly high closing cost expense. *LTV* also is a control for total loan costs

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[29] AUS, broker loan, and the presence of other liens are indicator variables of whether the lender offers more than one of the following: conventional FHA, VA, and USDA loans. Lender origination count in bins of 0-500, 501-2000, 2001-5000, 5001-10000. Lenders whose total number of closed-end originations was 500 or greater in the preceding two calendar years are required to report expanded HMDA data; this reporting is optional for originations below 500. For more information, see CFPB, "Executive Summary of the 2020 Home Mortgage Disclosure Act (Regulation C) Final Rule," April 16, 2020, https://files.consumerfinance.gov/f/documents/cfpb_hmda_executive-summary_2020-04.pdf.

[30] Table 2 provides summary statistics for the credit characteristics by racial group.

[31] Interest rate spread is defined as interest rate less the applicable weekly Freddie Mac Primary Mortgage Market Survey (PMMS) rate.

[32] A high-cost lender indicator is included as a robustness check; however, there were no material differences in the results using that indicator.

[33] CFPB, "What Are (Discount) Points and Lender Credits and How Do They Work?" September 4, 2020, https://www.consumerfinance.gov/ask-cfpb/what-are-discount-points-and-lender-credits-and-how-do-they-work-en-136/. Inclusion of income in this analysis is motivated as an imperfect proxy for borrower liquid wealth.

[34] For example PC_1 contains DP, LC, and TC.

[35] DTI is generally an underwriting factor, whereas rate sheets typically assign rates based on credit score and LTV ratio, among other adjustments. See Fannie Mae, Loan-Level Price Adjustment (LLPA) Matrix, https://singlefamily.fanniemae.com/media/9391/display.

as its value may affect certain closing cost items, such as appraisal or initial payments for mortgage insurance premiums.[36] The coefficients of interest again are the β's for our protected class variables, which will indicate the associated effect protected class has on pricing outcomes once additional and important explanatory variables are included in the model. All other variables in equation (2) follow definitions set forth for equation (1). Error terms are assumed correlated across equations.[37] Lender fixed effects estimating (1) and (2) are not included, though each estimation includes lender characteristics as explanatory variables. Including specific lender-based controls (i.e., lender fixed effects) may also control for differences in the discretionary component of loan pricing, which could reduce estimates of lending outcome differences between groups.[38] A robustness check will consider whether differences in likelihood of minority borrowers to use higher-cost lenders may explain lending differences.[39] Results from estimating (1) and (2) are available in the Tables 4, 5, 6, 7, 8, 9, A, and B in the Appendix, with full model estimation results available in the Appendix.

V.   Results

A. Denials

Table 4 shows denial rate differences by estimating (1) between Black or Hispanic applicants and White applicants for each loan type and reporting estimated odds ratios and marginal effects estimates.[40] After adding controls, these denial rate differences are noticeably lower than the differences without controls reported in Figure 2, with Black applicants being denied 1.9 percentage points more than White applicants in conventional purchase, 4.4 percentage points more than White applicants in FHA purchase, 2.8 percentage points more than White applicants in conventional no cash-out refinance, and 3.3 percentage points more than White applicants in conventional cash-out refinance.[41] For Hispanic applicants, these differences are 1.3, 3.0, 1.7, and 1.8, respectively.

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[36] Typically, loan amount is used to determine many closing costs, such as origination charges, as these are calculated as a percentage of loan amount. However, loan amount is accounted for, as total loan costs are expressed as a percentage of loan amount.

[37] Because model errors are likely correlated within a lender, I would prefer to use clustered standard errors. Standard errors are clustered when estimating (1). However, due to software limitations, I am unable to utilize standard errors clustered at the lender level for estimating (2). While this does not affect parameter estimation, the inability to cluster likely results in standard errors that overestimate the precision of the estimates. Thus, I evaluate statistical significance in both estimating (1) and (2) at the 1 percent level rather than the 5 percent level. Future versions of this paper will incorporate clustered standard errors. State MSA dummies are constructed such that for a given state, the dummy equals 1 if the property address is in an MSA and 0 otherwise.

[38] Regulators have the statutory authority to request full and complete information on the loan approval (or loan price) decision-making process for lender-specific analyses.

[39] High-cost lender is defined as a lender that has more than 10 percent of its originations with a rate spread of 150 basis points or higher, as a robustness check.

[40] Marginal effects are calculated if the p-value associated with the odds ratio is less than 0.01 (**).

[41] These findings are roughly similar to those reported in a working paper by Bhutta, Hizmo, and Ringo (2021), who report a 1 to 2 percentage point difference in denial rates using 2018 HMDA data and control for impact of credit factors, AUS, and other variables.

Table 5 combines data from Figure 2 and Table 4 to show the impact of adding credit factor, loan, and lender controls. Adding controls explains approximately 70 percent of the observed raw lending differences between Black or Hispanic applicants and White applicants in conventional lending.[42] Notably, the contribution of controls to denial rate differences is substantially less for FHA purchase than for conventional purchase, perhaps because the distribution of credit factors (CS, DTI, LTV) is more similar between Black or Hispanic and White applicants in FHA purchase applications than in conventional purchase applications, as shown in Table 6. The percentage difference between Black or Hispanic applicants and White applicants in the 10th, 25th, and 50th percentiles for CS, DTI, and LTV is lower in FHA purchase than in conventional purchase.[43]

Estimation results are reported in Table A in the Appendix. In conventional purchase, the probability of denial falls with credit score and noticeably increases for applicants with DTI above 45 percent. In addition, applicants with LTV greater than 95 percent are more likely to be denied a loan than those with LTV of less than 95 percent. For FHA purchase, there are large increases in denial probability for applicants with DTI above 50 percent or whose credit scores are at or below 580, consistent with the higher allowable DTI and lower allowable credit scores for FHA purchase loans. In refinance lending, conventional no cash-out denial rates fall as credit score improves and denial likelihood rises as LTV or DTI increase, with noticeable jumps in denial probability for applicants with credit scores at or below 620, LTV of more than 95 percent, and DTI above 45 percent. For conventional cash-out refinance, jumps in denial probability occur when credit score falls to 620 or below, DTI exceeds 45 percent, and LTV is above 80 percent. The estimation results suggest that for purchase loans (but not refinance loans), brokered loans are more likely to be denied than non-brokered loans, and that denial probability for FHA purchase loans increases in the presence of other liens on the financed property. In contrast, purchase lending applicants who submitted an application to a lender that uses an AUS are less likely to be denied as are conventional purchase and conventional refinance applicants who submitted applications to a small lender (fewer than 5,000 originations).

a. Denial Rate Differences Within Credit Score Bands

I explore the possibility that denial rate differences between minority and White applicants might vary by borrower creditworthiness.[44] Table 7 contains estimation results of the impact of applicant race for each of the loan types discussed below.

Conventional purchase lending. The results show no difference in denial probability between Black and White applicants whose credit scores are below 620, the minimum required credit score for a conventional loan. However, the estimation results show a 4.8 percentage point difference in conventional purchase denial rates among Black and White applicants with the lowest qualifying

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[42] Bhutta, Hizmo, and Ringo (2021) report a raw denial rate difference of 7 percentage points between Black and White applicants, which falls to 1.9 percentage points with controls including credit factors, though their model combines conventional conforming, jumbo conventional, FHA, and VA mortgages.

[43] For example, in conventional purchase, the 10th percentile credit score is 663 for Black applicants and 695 for White applicants, a difference of 4.6 percent.

[44] For this analysis, I exclude credit scores as an explanatory factor. Specifically I estimate (1) by loan type and credit score bins (see Table 3 for bin values) but do not include credit score since it now defines separate estimation runs. Specifically, (1) is estimated where (t) indexes the unique combination loan type and credit score bin, and credit score is no longer included in C, the vector of credit characteristics.

credit scores (620 to 659). In contrast, the denial rate difference is 1.3 percentage points for Black and White applicants with credit scores greater than 740. Denial rate differences between Hispanic and White applicants in conventional purchase whose credit scores are above 620 show a similar pattern, albeit smaller in magnitude. Interestingly, for applicants with credit scores between 580 and 619 in conventional purchase, Hispanic applicants are denied less often than White applicants.

FHA purchase lending. Black applicants have higher denial probability than White applicants in each credit score bin. Denial rate differences between Black and White applicants fall as credit score rises for applicants with credit scores at or above 580. Denial rate differences between Hispanic and White applicants do not monotonically decrease with credit score but instead remain roughly stable at 3 percentage points for credit scores of 620 or higher.[45] Given that applicants with higher credit scores are more likely to pursue conventional lending opportunities, or have superior credit quality attributes outside of credit score, it is perhaps not surprising that differences in denial rates in FHA purchase lending are smaller among borrowers with higher credit scores.[46]

Conventional refinance lending. For both conventional no cash-out and conventional cash-out refinancing loans, denial rate differences between Black (or Hispanic) and White applicants with credit scores lower than 620 are not statistically significant. For applicants with credit scores above 620, both Black and Hispanic applicants are denied more often than White applicants in the same credit score bin. These denial rate differences generally decline as credit score rises. Denial rate differences are larger between Black and White applicants than those between Hispanic and White applicants in both conventional refinance loan types.

B. Loan Pricing

Table 8 provides results of the simultaneous equations model for each of the four components of loan pricing: interest rate spread, discount points, lender credits, and loan costs. Discount points, lender credits, and total loan costs are estimated as a percentage of loan amount.

Conventional purchase lending. Pricing differences experienced by Black and Hispanic borrowers are similar except that Hispanic borrowers received fewer lender credits. Both Black and Hispanic borrowers paid approximately 6 basis points more in interest rate than White borrowers for conventional purchase loans. As a percentage of loan amount, Black and Hispanic borrowers also paid more in more in discount points, received more in lender credits, and paid more in total loan costs compared with White borrowers.

FHA purchase lending. Black borrowers paid 2 basis points more in interest rates compared with similar White borrowers, while no such statistically significant difference is found between Hispanic and White borrowers. Neither Black nor Hispanic borrowers paid more in total loan costs

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[45] Bhutta, Hizmo, and Ringo (2021) find that denial rate differences are smaller between Hispanic and White applicants than between Black and White applicants, and that denial rate differences between Hispanic and White applicants do not decline as credit scores rises, contrasting with findings for Black and White applicants. They acknowledge the literature on racial bias in appraisals in their findings, and they run additional analyses which show that their findings could be explained by racial bias in appraisal explanation. However, the authors clearly state that their results do not rule out other alternative benign explanations.

[46] Perhaps these borrowers have similar lack of access to saved wealth and thus would not have sufficient reserves for a conventional loan down payment.

relative to White borrowers. However, both Black and Hispanic borrowers paid more in total discount points but received more in lender credits than comparable White borrowers.

Conventional refinance lending. For conventional refinance lending, Black borrowers paid more in interest rates, spent more on paying for discount points, and had higher loan costs than White borrowers. However, in contrast with conventional purchase lending, Black borrowers received less in lender credits than otherwise similar White borrowers. In addition, the lending outcomes of Hispanic borrowers relative to White borrowers show a similar pattern to those between Black and White borrowers, with the exception that in conventional cash-out refinance Hispanic borrowers did not receive less in lender credits than similar White borrowers.

Overall, I find roughly similar basis point differences in interest rates paid by Black and White borrowers (6.1 bps compared to 4.8 bps) in conventional purchase lending as Zhang and Willen (2021) and find that Black borrowers were more likely to pay discount points.[47] Similarly, I find that interest rate differences between Black and White borrowers are lower in FHA purchase lending than in conventional purchase lending.[48]

Full model results, including the impact of credit factor controls, for pricing are available in Table B in the Appendix. In conventional purchase, interest rates fall with credit score with noticeable jumps in interest rates for applicants with credit scores below 660. In addition, interest rates rise for loans with greater than 95 percent LTV. Discount points and lender credits generally fall with income. Loan costs tend to decline as lender origination volume rises, perhaps reflecting economies of scale or greater negotiating power with third parties. Unsurprisingly, interest rates for FHA purchase fall with credit score, and discount points paid generally rise with income and fall with credit score.[49] Unlike with conventional purchase, there is no obvious pattern between loan costs and a lender's origination volume.

Interest rates for conventional refinance fall with credit score, but discount points paid fall with credit score only for conventional cash-out refinance.[50] For conventional no cash-out refinancing, loan costs tend to rise with LTV, potentially accounting for higher appraisal and underwriting costs for such loans.

a. Interest Rate Differences Within Credit Score Bands

Finally, I estimate (2) by loan type and credit score bins (see Table 3 for bin values), removing credit score as an explanatory factor since it now defines separate estimation runs. Table 9 contains estimation results of the associated impact of applicant race on interest rates for each of the loan types discussed below.[51]

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[47] See Table 3 of Zhang and Willen (2021).

[48] Zhang and Willen (2021) highlight that estimates of FHA interest rates differences are inconsistent in recent literature, though all estimates are small in magnitude.

[49] Lender credits also fall with income.

[50] It stands to reason that lower credit score borrowers are receiving higher interest rate offers and therefore would be more likely to purchase discount points to lower the interest rate and monthly payment, while higher-income borrowers may have more liquid reserves and thus greater ability to pay discount points out of pocket.

[51] For brevity, I discuss only interest rate differences. Differences for other pricing components by credit score bins are available upon request.

Conventional purchase lending. The results show no statistically significant differences in interest rates between Black and White borrowers with credit scores below 660. However, for borrowers with credit scores above 660, interest rate differences fall with credit score, from 8.9 basis points between Black and White borrowers with credit scores between 661 and 700 to 4.8 basis points for Black and White borrowers with credit scores above 740. For Hispanic borrowers, interest rate differences fall with credit scores above 620. For borrowers with credit scores between 620 and 659, the Black-White interest rate difference is 12.8 basis points. The difference declines to 4.4 basis points for borrowers with credit scores at or above 740.

FHA purchase lending. The estimates do not follow a clear monotonic pattern between interest rate differences and credit score bins. The Black-White interest rate difference ranges from 2.9 to 3.2 basis points for borrowers with credit scores above 660, and the Hispanic-White interest rate difference is not statistically significant within any credit score bin.

Conventional refinance lending. The clear pattern observed for conventional purchase does not emerge for either conventional no cash-out or conventional cash-out refinance. In conventional no cash-out refinance, the Black-White interest rate difference ranges from 1.9 to 2.1 basis points among borrowers with credit scores above 660. In conventional cash-out refinance, the Black-White interest rate gap ranges non-monotonically from 3.2 to 6.0 basis points among borrowers with credit scores of 620 or higher. The estimates do not show statistically significant differences in interest rates between Hispanic and White borrowers in conventional no cash-out refinance and show a very small magnitude (1 basis point) difference among borrowers with credit scores of 700 or higher.

VI. Conclusion

The availability of additional HMDA data that do not require complicated matching to third-party datasets is beneficial to researchers. The expanded HMDA data allow researchers to study facets of loan pricing other than interest rates, such as discount points, lender credits, and total loan costs. Expanded HMDA data also include credit factors (such as credit score) not previously collected.

I use the expanded HMDA data to test whether differences in loan denial rates and loan pricing exist between minority and White borrowers, accounting for differences in credit factors and lender characteristics (such as total origination volume) and controlling for the timing and location of loan origination.

Including controls explains approximately 70 percent of the raw no-controls denial rate differences for conventional loans, indicating the value to researchers of having credit score, debt-to-income ratio, and LTV ratio readily available through HMDA. The impact of these controls on denial rate differences in FHA lending is noticeably lower, though it likely reflects that minority and White borrowers are more similar in FHA purchase lending than in conventional lending and that underwriting requirements are quite different between these two loan types.

Denial rate differences of approximately 2 to 3 percentage points persist between minority and White applicants after controls. Minority borrowers also pay approximately 6 basis points more in

interest rates than similar White borrowers in conventional purchase lending. However, interest rate differences for other studied loan types are smaller.

The expanded HMDA data also allow researchers to consider the impact of discount points, lender credits, and loans costs. My estimates of the aggregate pricing difference using all four pricing components show that for a 30-year, $200,000 loan, Black borrowers pay approximately $1,583 more than similar White borrowers for conventional purchase, $542 more for FHA purchase, $1,211 more for conventional no cash-out refinance, and $1,909 more for conventional cash-out refinance. Hispanic borrowers also pay more relative to similar White borrowers, but total pricing differences for Hispanic borrowers are substantially smaller than those for Black borrowers. The one exception is conventional purchase, in which estimates suggest an overall pricing difference of $1,725. I also find that for conventional purchase lending among borrowers with credit scores above 660, interest rate differences between minority and White borrowers in the same credit score bin fall as credit scores rise, consistent with findings from Zhang and Willen (2021).

I analyze conventional refinance lending, introducing new evidence that interest rate differences between Black and White borrowers persist even at higher credit scores. But unlike purchase lending, such differences are stable and do not fall with credit score.[52] This finding presents an opportunity for future research, as one might expect that credit factors not observed in HMDA data would correlate with credit score, leading to findings similar to those for conventional purchase lending. Because the estimation models group borrowers by credit factors regardless of loan type, the model results might capture subtle differences in how these variables are used to underwrite and price loans based on loan type.

The analyses in this paper do not have guidelines on how individual lenders use credit factors to underwrite or price loans, nor are they conducted at the lender level.[53] Therefore, one cannot interpret differences identified in this paper as evidence of racial discrimination by individual lenders, as these differences could be due to unobserved credit quality factors or unobserved differences in the non-discretionary standards lenders use for loan decisions. Rather, the results should help researchers identify where racial lending differences remain and where future research may prove fruitful in identifying underlying causes.

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[52] HMDA data are not exhaustive of all credit factors used in the loan pricing models. For instance, employment and income documentation and verification are not required data fields for HMDA reporting, yet these variables are typically used by lenders to make loan decisions and are likely correlated with credit score.
[53] While lenders may generally underwrite or price according to government guidelines, they may also apply their own "overlays" or additional adjustments to criteria. This is generally not observable to the econometrician outside of a targeted fair lending review of a specific bank.

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Figure 1: Denial Rates for Selected Loan Types

Denial Rates - 30 yr Conventional Purchase

- Black: 12.4%
- HISP: 8.8%
- WHITE: 4.6%
- 2020

Denial Rates - 30 yr Conv. Refi No Cash Out

- Black: 21.0%
- HISP: 14.9%
- WHITE: 8.4%
- 2020

Denial Rates - 30 yr FHA Purchase

- Black: 15.4%
- HISP: 12.1%
- WHITE: 8.6%
- 2020

Denial Rates - 30 yr Conv. Refi Cash Out

- Black: 25.4%
- HISP: 17.3%
- WHITE: 11.4%
- 2020
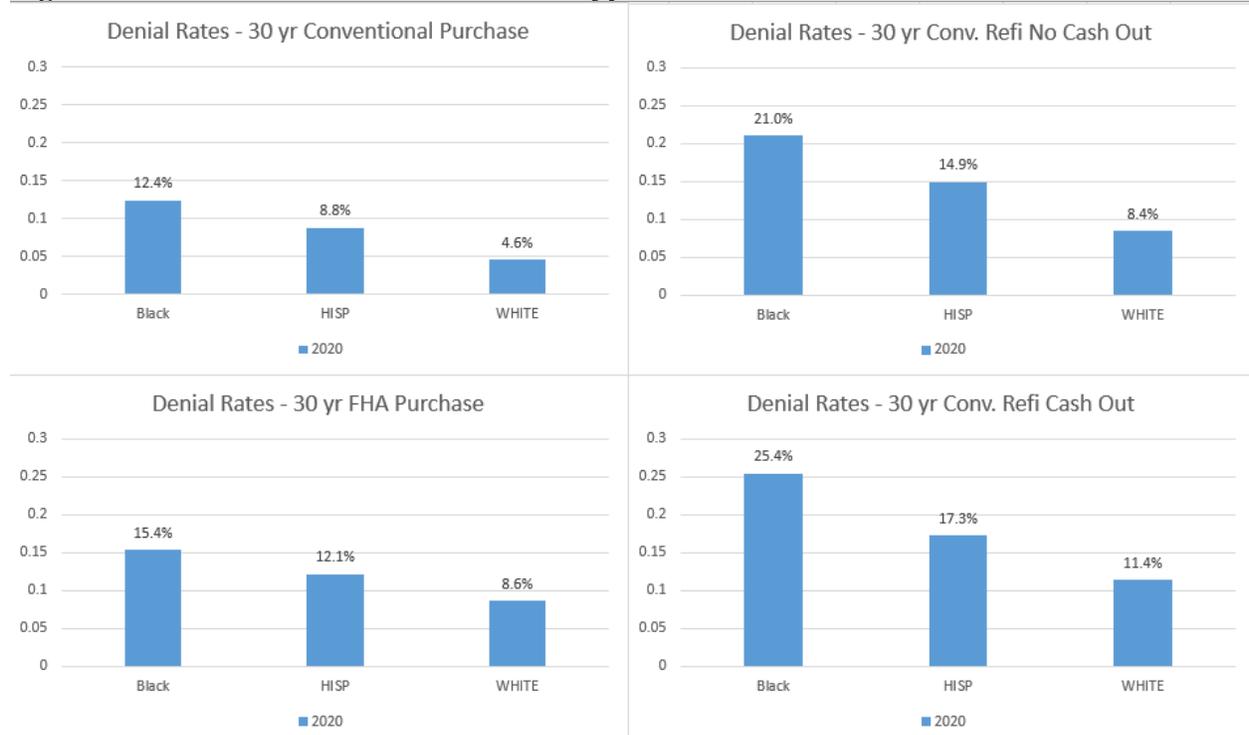
Figure 2: Interest Rate Spreads
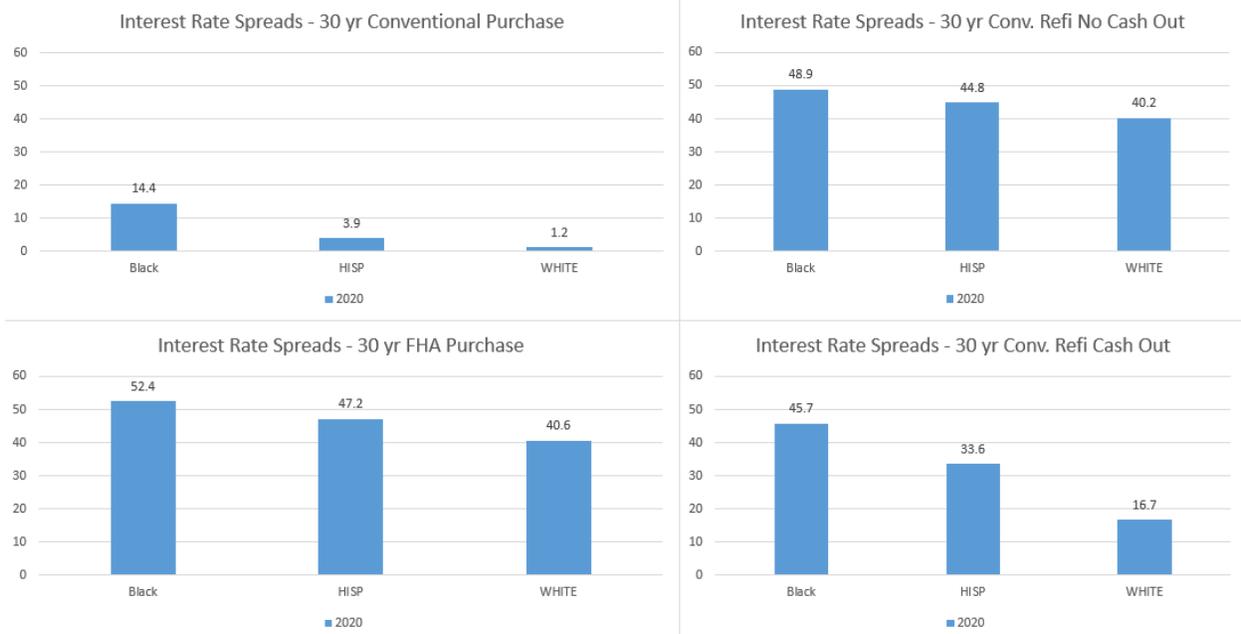
Note: Interest rate spreads are calculated as the spread between interest rate at origination less the Freddie Mac Primary Mortgage Market Survey (PMMS) rate.

Table 1: Applications by Loan Type

Loan Type	(1) Total Reported Credit Factor Fields	(2) Remove Uncommon Loan Features	(3) Restrict to 1st Lien, Owner Occupied, 1–4 Family, Site Built	(4) Restrict to 30-Year Term	(5) Restrict to Non-Jumbo	(6) Restrict to Identified Race and Ethnicity	(6) / (1)
Conventional Purchase	3,336,908	3,096,013	2,543,751	2,373,359	2,143,014	1,797,063	53.9%
FHA Purchase	907,867	902,924	875,683	872,584	850,059	721,694	79.5%
Conventional No Cashout Refinance	5,419,763	5,119,125	4,692,154	2,876,858	2,706,824	2,137,056	39.4%
Conventional Cashout Refinance	2,057,947	1,927,211	1,754,724	1,132,638	1,072,949	837,669	40.7%
Total Purchase	*4,757,452*						
Total Refi	*7,967,391*						

Table 2: Credit Factor Distributions by Racial Group and Loan Type

Conventional Purchase

Credit Score Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	663	696	733	770	794	803
HISPANIC	681	711	746	778	798	805
WHITE	695	729	766	792	805	810

Debt-to-income Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	25.1	32.1	39.1	43.9	48.1	49.9
HISPANIC	25.3	32.3	39.4	44.2	48	49.6
WHITE	21.4	27.9	35.7	42.3	46.5	48.7

Loan-to-value Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	80	90	95	97	100	101
HISPANIC	75	80	95	95	97	99
WHITE	67.7	80	90	95	97	97

FHA Purchase

Credit Score Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	622	642	664	693	729	753
HISPANIC	627	648	676	713	749	770
WHITE	626	647	673	708	749	772

Debt-to-income Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	32.7	39.4	45.6	51.8	55.9	56.9
HISPANIC	33.3	39.8	45.8	51.7	55.7	56.8
WHITE	29.1	35.9	43	49.2	54.2	56

Loan-to-value Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	96.2	96.5	96.5	96.5	100	101
HISPANIC	95	96.5	96.5	96.5	100	101
WHITE	93.85	96.5	96.5	96.5	99.9	100

Table 2, continued

Conventional No Cashout Refinance

Credit Score Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	665	702	743	779	801	809
HISPANIC	682	714	754	784	802	809
WHITE	701	738	774	797	809	813

Debt-to-income Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	21.6	28.6	36.9	44	49.1	56.1
HISPANIC	22.2	29	37.1	43.9	48.7	51.9
WHITE	18.6	24.6	32.6	40.7	46.3	49

Loan-to-value Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	54.9	67.1	76.8	84.9	91.2	94.7
HISPANIC	49.9	61.7	74.1	81.4	89.5	92.9
WHITE	47.5	59.7	73	80	88	91

Conventional Cashout Refinance

Credit Score Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	646	683	723	763	791	802
HISPANIC	666	701	740	776	797	806
WHITE	684	720	759	789	804	810

Debt-to-income Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	23.5	31	39.1	44.6	49.6	59.1
HISPANIC	24	31.1	39.1	44.5	49	54.1
WHITE	20.4	27	35.3	42.5	46.9	49.5

Loan-to-value Ratio Percentile

Protected Class (P)	10th	25th	50th	75th	90th	95th
BLACK	47.8	59.7	70	79.5	80	83.7
HISPANIC	45.8	57.4	68.6	77.2	80	80
WHITE	44.5	57.1	68.7	77.7	80	80

Note: Black refers to HMDA records in which either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, Native Hawaiian and Pacific Island (NHPI), and American Indian and Alaskan Native (AIAN) are defined similarly. Hispanic is defined as any record in which the applicant or co-applicant identified as Hispanic. White is defined as those records in which the applicants identified solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records in which multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race and ethnicity fields available in HMDA, see FFIEC, "Filing Instructions Guide for HMDA Collected in 2022," https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Table 3: Credit Factor Variable Bins for Estimation Models

Bins	Credit Score	Debt-to-income Ratio	Loan-to-value Ratio	Income (000s)
1	[0,580)	[0,28]	[0,70]	[0,40]
2	[581-620)	(28,36]	(70,80]	(40,60]
3	[621,660)	(36,43]	(80,90]	(60,70]
4	[661,700)	(43,45]	(90,95]	(80,140]
5	[701,740)	(45,50]	(95,96.5]	(140,210]
6	>740	>50	>96.5	>210

Note: Income is not used in estimating denials model, equation (1).

Table 4: Summary of Estimation Results, Denials Model, Equation (1)

Difference Between Black and White Applicants			
Loan Type	**Odds Ratio**	**Average Marginal Effect**	**Statistical Significance**
Conventional Purchase	1.61	1.87%	***
FHA Purchase	1.67	4.42%	***
Conventional No Cashout Refinance	1.66	2.81%	***
Conventional Cashout Refinance	1.58	3.26%	***

Difference Between Hispanic and White Applicants			
Loan Type	**Odds Ratio**	**Average Marginal Effect**	**Statistical Significance**
Conventional Purchase	1.41	1.34%	***
FHA Purchase	1.42	3.03%	***
Conventional No Cashout Refinance	1.35	1.65%	***
Conventional Cashout Refinance	1.28	1.75%	***

Note: Logit model estimates of equation (1) including controls. Average marginal effect calculated if Odds Ratio p-value <0.01. Statistical significance denoted as (*) p<0.001, (**) p<0.01, (*) p<0.05.

Table 5: Comparison of Denial Rate Differences Calculated With and Without Controls

Difference Between Black and White Applicants

Loan Type	(1) No Controls	(2) With Controls	(2) / (1)
Conventional Purchase	7.83%	1.87%	76.13%
FHA Purchase	6.74%	4.42%	34.44%
Conventional No Cashout Refinance	12.55%	2.81%	77.61%
Conventional Cashout Refinance	13.99%	3.26%	76.70%

Difference Between Hispanic and White Applicants

Loan Type	(1) No Controls	(2) With Controls	(2) / (1)
Conventional Purchase	4.24%	1.34%	68.39%
FHA Purchase	3.53%	3.03%	14.27%
Conventional No Cashout Refinance	6.49%	1.65%	74.57%
Conventional Cashout Refinance	5.87%	1.75%	70.19%

Note: Combined Results from Figure 1 and Table 4. In this table, Black refers to HMDA records in which either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, Native Hawaiian and Pacific Island (NHPI), and American Indian and Alaskan Native (AIAN) are defined similarly. Hispanic is defined as any record in which the applicant or co-applicant identified as Hispanic. White is defined as those records in which the applicants identified solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records in which multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race and ethnicity fields available in HMDA, see FFIEC, "Filing Instructions Guide for HMDA Collected in 2022," https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Table 6: Comparison of Credit Factor Distributions by Loan Type

Conventional Purchase   **FHA Purchase**

Credit Score Percentile (% Absolute Difference from White)

Race	10	25	50	75	90	95
BLACK	4.6	4.5	4.3	2.8	1.4	0.9
HISPC	2.0	2.5	2.6	1.8	0.9	0.6

Race	10	25	50	75	90	95
BLACK	0.6	0.8	1.3	2.1	2.7	2.5
HISPC	0.2	0.2	0.4	0.7	0.0	0.3

Debt-to-income Ratio Percentile (% Absolute Difference from White)

Race	10	25	50	75	90	95
BLACK	17.3	15.1	9.5	3.8	3.4	2.5
HISPC	18.2	15.8	10.4	4.5	3.2	1.8

Race	10	25	50	75	90	95
BLACK	12.4	9.7	6.0	5.3	3.1	1.6
HISPC	14.4	10.9	6.5	5.1	2.8	1.4

Loan-to-value Ratio Percentile (% Absolute Difference from White)

Race	10	25	50	75	90	95
BLACK	18.2	12.5	5.6	2.1	3.1	4.1
HISPC	10.8	0.0	5.6	0.0	0.0	2.1

Race	10	25	50	75	90	95
BLACK	2.5	0.0	0.0	0.0	0.1	1.0
HISPC	1.2	0.0	0.0	0.0	0.1	1.0

Note: Black refers to HMDA records where either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, NHPI, and AIAN is defined similarly. Hispanic is defined as any record where the applicant or co-applicant identified as Hispanic. Finally, I define as White those records where the applicants identified as solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records where multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race / ethnicity fields available in HMDA see https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Table 7: Denials Models by Credit Score Band

Conventional Purchase

Difference Between Black and White Applicants					Difference Between Hispanic and White Applicants			
Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance		Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance
0 to 579	1.09	.			0 to 579	0.58	.	
580 to 619	1.07	.			580 to 619	0.60	-6.41	**
620 to 659	1.53	4.77	***		620 to 659	1.25	2.51	***
660 to 699	1.57	3.24	***		660 to 699	1.43	2.55	***
700 to 739	1.76	2.54	***		700 to 739	1.42	1.57	***
740+	1.57	1.30	***		740+	1.46	1.10	***

FHA Purchase

Difference Between Black and White Applicants					Difference Between Hispanic and White Applicants			
Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance		Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance
0 to 579	1.81	6.32	***		0 to 579	1.23	.	
580 to 619	1.62	7.69	***		580 to 619	1.39	5.28	***
620 to 659	1.61	4.65	***		620 to 659	1.33	2.78	***
660 to 699	1.69	4.03	***		660 to 699	1.42	2.68	***
700 to 739	1.70	3.74	***		700 to 739	1.51	2.89	***
740+	1.70	3.44	***		740+	1.63	3.16	***

Conventional No Cashout Refinance

Difference Between Black and White Applicants					Difference Between Hispanic and White Applicants			
Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance		Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance
0 to 579	2.50	.	*		0 to 579	1.87	.	
580 to 619	1.43	.			580 to 619	1.13	.	
620 to 659	1.61	7.15	***		620 to 659	1.29	3.80	***
660 to 699	1.61	5.24	***		660 to 699	1.30	2.89	***
700 to 739	1.65	3.58	***		700 to 739	1.35	2.16	***
740+	1.72	2.33	***		740+	1.42	1.49	***

Table 7, continued

Conventional Cashout Refinance

Difference Between Black and White Applicants					Difference Between Hispanic and White Applicants			
Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance		Credit Score Band	Odds Ratio	Denial Rate Difference	Statistical Significance
0 to 579	1.69	.	*		0 to 579	1.14	.	
580 to 619	1.40	.	*		580 to 619	1.55	.	*
620 to 659	1.69	8.44	***		620 to 659	1.21	3.08	***
660 to 699	1.58	5.38	***		660 to 699	1.31	3.14	***
700 to 739	1.54	3.46	***		700 to 739	1.29	2.04	***
740+	1.62	2.48	***		740+	1.31	1.40	***

Note: Logit model estimates of equation (1) including controls. Denial rate difference calculated if Odds Ratio p-value <0.01. Statistical significance denoted as (*) p<0.001, (**) p<0.01, (*) p<0.05. Black refers to HMDA records in which either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, Native Hawaiian and Pacific Island (NHPI), and American Indian and Alaskan Native (AIAN) are defined similarly. Hispanic is defined as any record in which the applicant or co-applicant identified as Hispanic. White is defined as those records in which the applicants identified solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records in which multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race and ethnicity fields available in HMDA, see FFIEC, "Filing Instructions Guide for HMDA Collected in 2022," https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Table 8: Estimates of Pricing Differences by Loan Type

	Interest Rate Spread		Discount Points		Lender Credits		Loan Costs	
	Basis Points			% of Loan Amount				
Conventional Purchase								
BLACK	6.1	***	0.054%	***	0.065%	***	0.126%	***
HISPANIC	6.4	***	0.053%	***	0.019%	***	0.110%	***
FHA Purchase								
BLACK	2.6	***	0.037%	***	0.052%	***	0.044%	
HISPANIC	0.5	*	0.036%	***	0.023%	***	0.063%	
Conventional No Cashout Refinance								
BLACK	1.9	***	0.143%	***	-0.022%	***	0.226%	***
HISPANIC	-0.1		0.048%	***	-0.009%	***	0.140%	***
Conventional Cashout Refinance								
BLACK	4.4	***	0.179%	***	-0.010%	***	0.274%	***
HISPANIC	1.0	***	0.038%	***	-0.002%		0.121%	***

Note: Simultaneous equations model of equation (2) including controls. Coefficient estimates shown for Black and Hispanic borrowers if associated p-value is <0.01. Interest rate spread in basis points. Discount points, lender credits, and loan costs expressed as a percentage of loan amount, and statistical significance denoted as (*) p<0.001, (**) p<0.01, (*) p<0.05.

- Interest Rate Spread   Loan interest rate less applicable Freddie Mac 30-Year PMMS rate
- Discount Points   Ratio of dollar amount of discount points paid over total loan amount
- Lender Credits Points   Ratio of dollar amount of lender credits received over total loan amount
- Total Loan Costs   Ratio of dollar amount of total loan costs over total loan amount.

Black refers to HMDA records where either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, NHPI, and AIAN is defined similarly. Hispanic is defined as any record where the applicant or co-applicant identified as Hispanic. Finally, I define as White those records where the applicants identified as solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records where multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race / ethnicity fields available in HMDA see https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Table 9: Estimates of Interest Rate Differences by Loan Type and Credit Score Range

Conventional Purchase

Difference Between Black and White Applicants				Difference Between Hispanic and White Applicants		
Credit Score Band		Interest Rate Difference	Statistical Significance	Credit Score Band	Interest Rate Difference	Statistical Significance
0 to 579		11.63		0 to 579	-25.46	
580 to 619		5.41		580 to 619	43.52	*
620 to 659		2.72	*	620 to 659	12.80	***
660 to 699		8.87	***	660 to 699	9.57	***
700 to 739		7.48	***	700 to 739	8.12	***
740+		4.79	***	740+	4.46	***

FHA Purchase

Difference Between Black and White Applicants				Difference Between Hispanic and White Applicants		
Credit Score Band		Interest Rate Difference	Statistical Significance	Credit Score Band	Interest Rate Difference	Statistical Significance
0 to 579		-6.80		0 to 579	2.54	
580 to 619		0.97		580 to 619	0.40	
620 to 659		1.85	*	620 to 659	0.08	
660 to 699		2.94	***	660 to 699	0.41	
700 to 739		3.20	***	700 to 739	1.38	*
740+		3.01	***	740+	0.83	*

Conventional No Cashout Refinance

Difference Between Black and White Applicants				Difference Between Hispanic and White Applicants		
Credit Score Band		Interest Rate Difference	Statistical Significance	Credit Score Band	Interest Rate Difference	Statistical Significance
0 to 579		-1.76		0 to 579	19.97	
580 to 619		-6.02		580 to 619	27.13	
620 to 659		-0.37		620 to 659	0.19	
660 to 699		2.03	***	660 to 699	0.73	*
700 to 739		1.91	***	700 to 739	-0.03	
740+		2.05	***	740+	0.10	

Table 10, continued

Conventional Cashout Refinance

Difference Between Black and White Applicants				Difference Between Hispanic and White Applicants			
Credit Score Band		Interest Rate Difference	Statistical Significance	Credit Score Band		Interest Rate Difference	Statistical Significance
0 to 579		4.04		0 to 579		5.98	
580 to 619		33.70		580 to 619		16.14	
620 to 659		5.98	***	620 to 659		1.62	
660 to 699		3.21	**	660 to 699		2.01	*
700 to 739		4.54	***	700 to 739		1.07	**
740+		4.55	***	740+		1.44	***

Note: Simultaneous equations model estimates of equation (2). Interest rate difference calculated if p-value <0.01. Statistical significance denoted as (*) p<0.001, (**) p<0.01, (*) p<0.05. Black refers to HMDA records where either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, NHPI, and AIAN is defined similarly. Hispanic is defined as any record where the applicant or co-applicant identified as Hispanic. Finally, I define as White those records where the applicants identified as solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records where multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race / ethnicity fields available in HMDA see https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Appendix

Table A: Denial Model Full Estimation Results

Variable	Conventional Purchase			FHA Purchase	
	Odds Ratio Estimate	Statistical Significance		Odds Ratio Estimate	Statistical Significance
01. BLACK	1.61	***		1.67	***
02. AIAN	1.28	***		0.67	
03. ASIAN	1.65	***		1.63	***
04. HISP	1.41	***		1.42	***
05. NHPI	1.97	***		2.10	***
07. DTI 28.01-36	0.74	***		0.68	***
08. DTI 36.01-43	0.72	***		0.67	***
09. DTI 43.01-45	0.76	***		0.68	***
10. DTI 45.01-50	1.48	***		0.82	***
11. DTI 50.01+	78.00	***		2.33	***
12. CS 1 - 580	201.58	***		21.24	***
13. CS 581 - 620	50.40	***		4.07	***
14. CS 621 - 661	5.89	***		1.71	***
15. CS 661 - 700	2.82	***		1.22	***
16. CS 701 - 740	1.45	***		1.07	*
17. LTV 70.01 - 80	1.08	***		1.01	
18. LTV 80.01 - 90	1.36	***		0.78	*
19. LTV 90.01 - 95	1.37	***		0.94	
20. LTV 95.01 - 97	5.48	***		0.69	*
21. LTV 97+	2.40	***		1.08	
22. AUS Indicator	0.35	***		0.09	***
23. Broker	1.52	**		1.33	*
24. Other Lien	1.57			7.91	***
25. Lender Diff Loan Types	0.95			0.07	***
26. Lender Origs 1- 500	0.63	**		0.94	
27. Lender Origs 501- 2000	0.69	**		0.73	*
28. Lender Origs 2001- 5000	0.67	**		0.86	
29. Lender Origs 5001-10000	0.84			1.01	

Table A, continued

Variable	Conventional No Cashout Refinance			Conventional Cashout Refinance	
	Odds Ratio Estimate	Statistical Significance		Odds Ratio Estimate	Statistical Significance
01. BLACK	1.66	***		1.58	***
02. AIAN	1.59	***		1.41	***
03. ASIAN	1.37	***		1.46	***
04. HISP	1.35	***		1.28	***
05. NHPI	1.82	***		2.11	***
07. DTI 28.01-36	0.81	***		0.81	***
08. DTI 36.01-43	0.84	***		0.82	***
09. DTI 43.01-45	0.90			0.85	**
10. DTI 45.01-50	1.52	***		1.81	***
11. DTI 50.01+	105.91	***		81.54	***
12. CS 1 - 580	358.06	***		129.76	***
13. CS 581 - 620	198.53	***		95.96	***
14. CS 621 - 661	8.76	***		7.28	***
15. CS 661 - 700	3.56	***		3.14	***
16. CS 701 - 740	1.74	***		1.66	***
17. LTV 70.01 - 80	1.01			1.32	***
18. LTV 80.01 - 90	1.24	**		6.64	***
19. LTV 90.01 - 95	2.04	***		7.39	***
20. LTV 95.01 - 97	11.65	***		15.14	**
21. LTV 97+	25.54	***		74.21	***
22. AUS Indicator	0.14	***		0.24	***
23. Broker	0.69			0.75	
24. Other Lien	0.26	**		0.99	
25. Lender Diff Loan Types	0.78			1.17	
26. Lender Origs 1- 500	0.30	***		0.22	***
27. Lender Origs 501- 2000	0.37	***		0.48	***
28. Lender Origs 2001- 5000	0.39	***		0.50	***
29. Lender Origs 5001-10000	0.70			0.85	

Note: Note: Logit model estimates of equation (1) including controls. Average marginal effect calculated if Odds Ratio p-value <0.01. Statistical significance denoted as (*) p<0.001, (**) p<0.01, (*) p<0.05. State MSA and monthly time dummies in estimation but omitted from Table A. Black refers to HMDA records where either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, NHPI, and AIAN is defined similarly. Hispanic is defined as any record where the applicant or co-applicant identified as Hispanic. Finally, I define as White those records where the applicants identified as solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records where multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information on race / ethnicity fields available in HMDA see https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.

Table B: **Pricing Model Full Estimation Results**

Conventional Purchase	Basis Points		Percent of Loan Amount		Percent of Loan Amount		Percent of Loan Amount	
Variable	Interest Rate	Stat Sig	Discount Points	Stat Sig	Lender Credits	Stat Sig	Loan Costs	Stat Sig
Interest Rate Spread			-0.0001		0.0013	***	-0.0047	***
Discount Points	-48.251	***			-0.4173	***	3.7302	***
Lender Credits	-22.975	***	-0.9722	***			7.7015	***
Loan Costs	5.055	***	-0.0466	***	0.0131	**		
BLACK	0.061	***	0.0005	***	0.0007	***	0.0013	***
AIAN	0.002		0.0003	***	0.0006	***	-0.0009	*
ASIAN	-0.054	***	0.0003	***	0.0003	***	-0.0014	***
HISP	0.064	***	0.0005	***	0.0002	***	0.0011	***
NHPI	0.037		0.0008	*	0.0006	*	0.0007	
INC 40.01-60			-0.0011	***	-0.0007	***		
INC 60.01-80			-0.0016	***	-0.0010	***		
INC 80.01-140			-0.0019	***	-0.0011	***		
INC 140.01-210			-0.0022	***	-0.0012	***		
INC 210.01+			-0.0024	***	-0.0013	***		
CS 1 - 580	2.481	***	0.0004					
CS 581 - 620	1.489	***	0.0006	*				
CS 621 - 660	0.743	***	0.0031	***				
CS 661 - 700	0.403	***	0.0016	***				
CS 701 - 740	0.139	***	0.0005	***				
LTV 70.01 - 80	0.133	***					-0.0033	***
LTV 80.01 - 90	0.114	***					-0.0034	***
LTV 90.01 - 95	0.103	***					-0.0041	***
LTV 95.01 - 97	0.218	***					-0.0182	***
LTV 97+	0.271	***					-0.0041	***
Broker	0.099	***	0.0020	***	0.0020	***	-0.0131	***
Other Lien	0.069	***	-0.0016	***	-0.0016	***	0.0124	***
Lender Diff Loan Types	-0.211	***	0.0005	***	0.0005	***	-0.0022	***
Lender Origs 1- 500	-0.042	*	-0.0019	***	-0.0013	***	0.0113	***
Lender Origs 501- 2000	-0.103	***	-0.0016	***	-0.0009	***	0.0072	***
Lender Origs 2001- 5000	-0.064	***	-0.0014	***	-0.0008	***	0.0067	***
Lender Origs 5001-10000	-0.061	***	-0.0012	***	-0.0007	***	0.0062	***

Table B, continued

FHA Purchase Variable	Basis Points Interest Rate	Stat Sig	% of Loan Amount Discount Points	Stat Sig	% of Loan Amount Lender Credits	Stat Sig	% of Loan Amount Loan Costs	Stat Sig
Interest Rate Spread			-0.0102	***	-0.0012	***	0.0229	**
Discount Points	-50.441				0.2216	***	0.3639	
Lender Credits	-10.172		-0.3668	***			17.0756	***
Loan Costs	5.145	***	0.3245	***	-0.1512	***		
BLACK	0.026	***	0.0004	***	0.0005	***	0.0004	
AIAN	-0.071	***	0.0004	*	-0.0001		-0.0017	
ASIAN	-0.042	***	0.0002		0.0000		-0.0012	
HISP	0.005	*	0.0004	***	0.0002	***	0.0006	
NHPI	-0.041		0.0004		0.0000		0.0005	
INC 40.01-60			0.0010	***	-0.0010	***		
INC 60.01-80			0.0018	***	-0.0015	***		
INC 80.01-140			0.0022	***	-0.0017	***		
INC 140.01-210			0.0025	***	-0.0020	***		
INC 210.01+			0.0023	***	-0.0021	***		
CS 1 - 580	1.336	**	0.0143	***				
CS 581 - 620	0.874	**	0.0095	***				
CS 621 - 660	0.368	***	0.0038	***				
CS 661 - 700	0.119	***	0.0012	***				
CS 701 - 740	0.038	***	0.0004	***				
LTV 70.01 - 80	-0.050						-0.0070	*
LTV 80.01 - 90	-0.086						-0.0090	**
LTV 90.01 - 95	-0.123						-0.0127	***
LTV 95.01 - 97	-0.080						-0.0195	***
LTV 97+	0.047						-0.0075	
Broker	-0.009		0.0000		0.0037	***	-0.0559	***
Other Lien	0.105		0.0019		-0.0015		0.0103	
Lender Diff Loan Types	-0.370	*	-0.0039		0.0009		-0.0038	
Lender Origs 1- 500	-0.027		-0.0020	***	0.0007	*	0.0061	*
Lender Origs 501- 2000	-0.104		-0.0013	***	-0.0001		0.0010	
Lender Origs 2001- 5000	-0.095		-0.0015	***	0.0012	***	-0.0127	***
Lender Origs 5001-10000	0.003		-0.0004	***	0.0004	***	-0.0015	

Table B, continued

Conventional No Cashout Refinance	Basis Points			% of Loan Amount			% of Loan Amount			% of Loan Amount	
Variable	Interest Rate	Stat Sig		Discount Points	Stat Sig		Lender Credits	Stat Sig		Loan Costs	Stat Sig
Interest Rate Spread				0.0003			0.0000			-0.0438	***
Discount Points	-9.482						-0.3278	***		5.3580	***
Lender Credits	-46.360	***		0.0991						-1.1702	***
Loan Costs	5.392	***		-0.4043	***		0.0860	***			
BLACK	0.019	***		0.0014	***		-0.0002	***		0.0023	***
AIAN	0.002			0.0007	***		-0.0002	*		0.0012	**
ASIAN	-0.053	***		-0.0006	***		0.0012	***		-0.0023	***
HISP	-0.001			0.0005	***		-0.0001	***		0.0014	***
NHPI	0.028			0.0016	***		-0.0003			0.0015	
INC 40.01-60				-0.0012	***		-0.0001				
INC 60.01-80				-0.0031	***		0.0001	*			
INC 80.01-140				-0.0047	***		0.0003	***			
INC 140.01-210				-0.0058	***		0.0003	***			
INC 210.01+				-0.0064	***		0.0003	***			
CS 1 - 580	1.119	***		0.0013							
CS 581 - 620	0.815	***		0.0046	***						
CS 621 - 660	0.377	***		0.0088	***						
CS 661 - 700	0.214	***		0.0047	***						
CS 701 - 740	0.086	***		0.0019	***						
LTV 70.01 - 80	0.076	***								0.0008	***
LTV 80.01 - 90	0.094	***								0.0036	***
LTV 90.01 - 95	0.110	***								0.0070	***
LTV 95.01 - 97	0.120	***								0.0064	***
LTV 97+	0.202	***								0.0113	***
Broker	0.034	**		-0.0018	*		0.0020	***		0.0110	***
Other Lien	0.166	***		-0.0037	***		-0.0007	***		0.0112	***
Lender Diff Loan Types	-0.115	***		0.0012	**		-0.0008	***		-0.0058	***
Lender Origs 1- 500	-0.142	***		-0.0028	***		-0.0017	***		0.0104	***
Lender Origs 501- 2000	-0.145	***		-0.0033	***		-0.0009	***		0.0073	***
Lender Origs 2001- 5000	-0.071	***		-0.0030	***		0.0000			0.0077	***
Lender Origs 5001-10000	-0.043	***		-0.0024	***		-0.0003	***		0.0079	***

Table B, continued

Conventional Cashout Refinance	Basis Points		% of Loan Amount		% of Loan Amount		% of Loan Amount	
Variable	Interest Rate	Stat Sig	Discount Points	Stat Sig	Lender Credits	Stat Sig	Loan Costs	Stat Sig
Interest Rate Spread			0.0039	***	-0.0001	*	-0.0176	***
Discount Points	12.071				-0.0996	***	4.2904	***
Lender Credits	-57.457	*	-0.2763				8.4431	***
Loan Costs	1.718		0.4811	***	0.0160			
BLACK	0.044	***	0.0018	***	-0.0001	***	0.0027	***
AIAN	0.007		0.0013	***	-0.0001		0.0018	**
ASIAN	-0.037	***	-0.0003	***	0.0006	***	-0.0022	***
HISP	0.010	***	0.0004	***	0.0000		0.0012	***
NHPI	0.049		0.0020	***	-0.0002		0.0011	
INC 40.01-60			0.0014	***	-0.0001	**		
INC 60.01-80			0.0025	***	-0.0001	*		
INC 80.01-140			0.0033	***	-0.0001			
INC 140.01-210			0.0039	***	0.0000			
INC 210.01+			0.0041	***	0.0000			
CS 1 - 580	2.409	***	-0.0115	***				
CS 581 - 620	1.531	***	-0.0074	***				
CS 621 - 660	0.466	***	-0.0010	***				
CS 661 - 700	0.278	***	-0.0005	***				
CS 701 - 740	0.121	***	-0.0003	***				
LTV 70.01 - 80	0.158	***					-0.0005	***
LTV 80.01 - 90	0.104	***					0.0016	***
LTV 90.01 - 95	0.201	***					-0.0011	
LTV 95.01 - 97	1.253	***					-0.0047	
LTV 97+	0.198	***					0.0098	***
Broker	0.130	***	-0.0028	***	0.0018	***	-0.0036	**
Other Lien	-0.093	***	0.0007		-0.0006	***	0.0031	
Lender Diff Loan Types	-0.049	**	0.0005	***	0.0001	***	-0.0044	***
Lender Origs 1- 500	-0.072		-0.0031	***	-0.0007	***	0.0181	***
Lender Origs 501- 2000	-0.067		-0.0025	***	-0.0004	***	0.0143	***
Lender Origs 2001- 5000	-0.005		-0.0020	***	0.0000		0.0093	***
Lender Origs 5001-10000	0.022		-0.0017	***	-0.0001	*	0.0083	***

Note: Simultaneous equations model estimates of equation (2) including controls. Error terms are assumed correlated across equations. Statistical significance denoted as (*) $p<0.001$, (**) $p<0.01$, (*) $p<0.05$. State MSA and monthly time dummies in estimation but omitted from Table B. Black refers to HMDA records where either the applicant or co-applicant (if one exists) is identified as non-Hispanic Black. Asian, NHPI, and AIAN is defined similarly. Hispanic is defined as any record where the applicant or co-applicant identified as Hispanic. Finally, I define as White those records where the applicants identified as solely White as a racial group and non-Hispanic as an ethnicity. For simplicity, I exclude records where multiple racial groups were identified, no racial group was identified, or where gender was not identified. For more information, see https://s3.amazonaws.com/cfpb-hmda-public/prod/help/2022-hmda-fig.pdf.