Racial Disparities in Mortgage Lending: New Evidence based on Processing Time

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Abstract

This paper examines racial disparities in mortgage processing time prior to the Great Financial Crisis. We find that Black borrowers experience a longer processing time than white borrowers among the mortgages securitized by government-sponsored enterprises (GSEs). In contrast, the difference is much reduced among the privately securitized (PLS) mortgages. Black borrowers also have more defaults in the PLS sample. Additionally, Black borrowers are strongly associated with the faster segments of mortgage markets, faster lenders within each segment, and the types of loan products that are processed faster, all of which turn out to be risky options for mortgage financing.

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1 Introduction

Blacks and other minorities have fallen behind in building wealth, and large racial and ethnic gaps have formed in recent decades. Expanding homeownership among minority groups has been embraced as an important public policy to reduce the wealth gap. A necessary component for this policy is to combat racial and ethnic disparities in residential mortgage lending that have long been documented in academic research and popular media. Minority home buyers need to be able to access mortgage financing at a reasonable cost and in a timely and predictable manner. Existing studies have shown that minorities are more likely to be denied a mortgage and have to bear a higher cost even if they do get credit. We add to the existing studies and investigate an important yet often overlooked dimension of mortgage lending: *processing time*—the time needed for a loan application to be processed (i.e., accepted or denied). Lengthy delays add uncertainty to the mortgage application process and could put minority home buyers at a disadvantage, especially in a competitive housing market. An investigation on whether disparities in processing time exist and an examination of the potential causes are important to fully grasp the extent of racial and ethnic disparities in mortgage lending.

The expansion of housing credit in the early 2000s led to historically high rates of home-ownership among minority groups. This period is, however, not devoid of discriminatory lending practices.[1] Furthermore, the use of lax lending standards by subprime lenders during this period is well-documented; for example, income verification was not required for many borrowers.[2] In a recent study, Wei and Zhao (2020) argue that mortgage processing

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[1] In *United States v. Countrywide Settlement*, December 21, 2011, the U.S. Department of Justice filed its largest residential fair lending settlement in history to resolve allegations of lending discrimination by Countrywide Financial Corp. from 2004 through 2008, stating that "qualified African-American and Hispanic borrowers were placed in subprime loans rather than prime loans even when similarly-qualified non-Hispanic white borrowers were placed in prime loans. ...Countrywide gave mortgage brokers discretion to request exceptions to the underwriting guidelines."

[2] "Some of the problems are surfacing in a mortgage program called 'Fast and Easy,' in which borrowrs were asked to provide little or no documentation of their finances, according to these people and to former Countrywide employees. ...Fast and Easy borrowers aren't required to produce pay stubs or tax forms to substantiate their claimed earnings." See Glenn R. Simpson and James R. Hagerty, "Countrywide Loss Focuses Attention on Underwriting", *Wall Street Journal*, April 30, 2008,

time is a good indicator of lending standards during this period. They show that processing time shortened by 6%-10% around securitization thresholds in the run-up to the 2007-2008 mortgage crisis, and those hastily processed loans became delinquent more frequently. Racial disparities in processing time can thus reflect whether lenders apply unfair lending practices to minority mortgage borrowers.[3] We focus on the time period from 2001 to 2006, the period of credit expansion before the 2007-2008 mortgage crisis. This period also saw the rise of private-label securitization (PLS), as opposed to traditional securitization by government-sponsored enterprises (GSEs).[4] In our sample, minority borrowers account for one-quarter of the total origination volume for home purchases but over one-half of the volume originated by subprime lenders, and less than one-fifth of the origination volume in the GSE segment but almost one-half in the PLS segment. Therefore an interesting approach is to examine racial disparities in mortgage lending during this time period from the perspective of mortgage processing time.

In our main analysis of racial and ethnic differences in processing time, we use the data from Home Mortgage Disclosure Act (HMDA), which include 22 million home purchase loans and 37 million refinance loans in our sample period. In our first set of findings, we find that, unconditionally, the average processing time for Black and Hispanic borrowers in 2001-2006 is 4-6 days *shorter* than white and Asian borrowers. Interestingly, the pattern is reversed in regression analysis controlling for various loan and borrower characteristics and for fixed effects on county and month: the processing time for Black borrowers is about 1.8 days *longer* than for white borrowers. Interestingly, further controlling for lender fixed effects almost doubles the difference to 3.4 days.

To explain this reversal from unconditional to conditional estimates, we delve into different segments of mortgage markets. Our second set of findings is based on the contrast

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https://www.wsj.com/articles/SB120945775409852363.

[3]An example of an unfair lending practice is mortgage lenders steering borrowers into loans with higher margins (see, e.g., Agarwal et al., 2016; Guiso et al., 2021).

[4]Private-label securitization does not have explicit or implicit federal government backing. As a result, borrowers' creditworthiness or default risk is borne by investors.

between the mortgages securitized by GSEs and those securitized by non-agency financial institutions (also known as private-label securitization, or PLS). We find that (1) the average processing time is 44 days for the GSE loans and 26 days for the PLS loans across all racial groups; and (2) white borrowers are over-represented in the GSE segment, whereas Black and Hispanic borrowers are over-represented in the PLS segment. Therefore, unconditionally, Black and Hispanic borrowers who have a larger presence in the PLS segment with a much faster processing speed have a shorter average processing time relative to white borrowers who have a larger presence in the GSE segment with a slower processing time. However, *within* the GSE segment, the average processing time for Black borrowers is about 4 days longer than white borrowers (48.0 days versus 44.2 days).

Our finding that the inclusion of lender fixed effects widens the racial disparities in processing time has important implications for across- and within-lender racial disparities. First, the larger racial disparities after including lender fixed effects imply that Black and Hispanic borrowers are more likely to obtain mortgage loans from faster lenders, even within the same segment. This explains why within the PLS segment, the average processing time for Black borrowers is actually 6 days shorter than for white borrowers (22.0 versus 28.3 days). Second, the positive racial gap in processing time following the inclusion of lender fixed effects indicates a differential treatment of minority and white borrowers by the same lender. Focusing on the PLS segment only, we obtain a similar finding: including lender fixed effect turns a negative gap in processing time between Black and white borrowers into a positive gap of 0.5 day.

Our third set of findings reveals that the time-series trend in processing time by race: (1) unconditionally, the average processing time decreases over the periods 2001-2003 to 2004-2006 for all groups of borrowers: the decrease is about 9 days for Black borrowers, 7 days for Hispanic borrowers, and 3 days for white borrowers; and (2) the differences in processing time between Black and white borrowers are much smaller in the period 2004-2006 than in the period 2001-2003: the processing time for Black borrowers is about 5 days

longer than for white borrowers during 2001-2003 and 2.4 days longer during 2004-06, after controlling for lender fixed effects and other controls. The above findings are due to the fact that the PLS segment grows dramatically during our sample period, which contributes to the disproportionately larger decreases in processing time for Black and Hispanic borrowers over our sample period. The decreasing trend in processing time also reflects the deterioration in lending standards in the PLS segment (Wei and Zhao, 2020). The diminishing racial disparities in processing time over time is a result of the decline of the market share of the GSEs. In the regression analysis, we find that the longer processing time that Black borrowers face is most pronounced in the GSE loans and least in the PLS loans. Therefore, when the GSEs still dominate, as in the first half of our sample period, we observe large disparities for Black borrowers. When the PLS market further grows, as in the second half of our sample period, we observe reduced disparities for Black borrowers. In addition, we do not find similar disparities for Hispanic and Asian borrowers.

In our fourth set of results, we find that Black borrowers tend to seek the segments of mortgage markets that process mortgages faster, faster lenders within each segment, and the types of loan products that are processed faster. Using the aggregate mortgage applications or refinance applications as a proxy for demand shocks, we find that Black borrowers face a larger impact from demand shocks relative to other groups, which can explain why Black borrowers are attracted to a faster mortgage application process. Additionally, we find that the processing time is shorter for high-cost mortgages. Bayer et al. (2018) find that lenders that have more ex post foreclosures (so-called high-risk lenders) account for a large part of high-cost mortgages received by Black and Hispanic borrowers. Consistent with their findings, we find that high-risk lenders (subprime lenders) tend to process more loans for Black and Hispanic borrowers.

Is reduced processing time for Black borrowers in the PLS market associated with higher default? To answer this question, we merge the HMDA data with the CoreLogic Loan-Performance data. The latter data contain important information on borrower credit risk

characteristics at loan origination (e.g., FICO score, LTV, and DTI) as well as information on loan performance (e.g., delinquency) mostly for privately securitized subprime mortgages.[5] The construction of the merged HMDA-CoreLogic data constitutes another critical contribution of this paper. In particular, the merged HMDA-CoreLogic data help overcome a major limitation of the HMDA data that lacks information on borrower creditworthiness, which is important in the decision-making process of mortgage lenders. In addition, the merged data allow us to measure loan performance, such as whether a loan is current, delinquent, or in foreclosure.

In our fifth set of results, using the merged HMDA-CoreLogic data, we find that the loan delinquency rate is significantly higher among Black borrowers relative to other groups. Furthermore, we find a reduced processing time and heightened delinquency rate for Black borrowers in the sample of non-traditional mortgages, low-documentation loans, and loans that are more quickly securitized. Finally, in the sample of the PLS loans that are initially intended for the GSE securitization, the processing time for Black borrowers is not reduced and the delinquency rate is much lower than for other PLS loans.

What explain the large disparities in mortgage processing time in the GSE segment but not in the PLS segment? The answer might lie in the underwriting procedures for GSE-securitized loans. In the 1990s, GSEs developed the automated underwriting systems that were distributed to loan originators: Loan Prospector at Freddie Mac and Desktop Underwriter at Fannie Mae. These software packages conduct risk evaluation from the inputs of borrower and loan characteristics, such as the FICO score, LTV ratio, DTI ratio, type of loans, and months of reserves. Then they report how the GSEs would treat the loan: either a rating for acceptance indicating that the GSEs would purchase the loan without conducting additional analysis or a lower rating that would require the originator to perform additional screening before submitting the mortgage to the GSEs for purchase. The differences in processing time could reflect whether additional analysis is required after

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[5]As noted by Keys et al. (2010), the CoreLogic LoanPerformance data encompass over 90% of the mortgage loans that are privately securitized.

loan originators enter the information into the systems. In contrast, the underwriting for the PLS loans during our sample period is known for lax lending standards and therefore forgoing additional screening that would be necessary for GSE loans.

Our findings suggest that there are differences across minority groups. In the HMDA data for purchase loans, the average processing time for Asian borrowers trends closely to that for white borrowers. Between Black and Hispanic borrowers, however, even though their time-series movements are nearly parallel, we find that the processing time for Hispanic borrowers is generally shorter, especially among the GSE loans. In regression analyses, we find that the processing time difference between Hispanic and white borrowers or between Asian and white borrowers is often close to zero or even negative. Especially among the GSE loans, Hispanic borrowers do not face as many delays as Black borrowers, even though both Black and Hispanic borrowers are under-represented in the GSE sample. In the merged HMDA-CoreLogic data for the PLS loans, both Black and Hispanic borrowers are over-represented, but potentially for different reasons. Among the PLS loans, Hispanic borrowers have higher FICO scores but a higher percentage of low-documentation loans relative to white borrowers, whereas Black borrowers have lower FICO scores but a slightly lower percentage of low-documentation loans relative to white borrowers. The FICO score is based on past credit history, and low documentation reflects insufficient records of income and assets. The GSE loans have requirements for both of these criteria, which could drive Hispanic and Black borrowers to seek mortgage financing in the PLS segment. Importantly, among the PLS loans, the loan delinquency rate of Black borrowers is much higher than white borrowers, but Hispanic borrowers have a lower delinquency rate than white borrowers. In this aspect, lax screening adds to the demise of the PLS market and hence destroys this alternative access to mortgage credit for creditworthy minority borrowers, which ultimately exacerbates the disparities in mortgage lending.

Several recent papers examine mortgage origination timeline. Foote et al. (2019) show that technology development in mortgage underwriting induces a dramatic decline in the av-

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erage processing time between 1995 and 1998. Fuster et al. (2019) find that FinTech lenders shorten processing time through enhanced efficiency. The dramatic decline in processing time in our paper is more related to the rise of non-agency securitization and the associated lax lending standards. Other studies focus on the time span from loan origination to securitization. Keys et al. (2012) show that lax screening is more pronounced for loans that have a shorter time to securitization. Adelino et al. (2019) show that the PLS mortgages that are sold faster have worse loan performance and a lower selling price. Adding to these findings, we find that loans that are sold faster after origination are also processed faster before origination. Examining the trading costs in the agency mortgage backed securities market with to-be-announced (TBA) trading, Gao et al. (2017) show that the TBA trading lowers the transaction costs for the underlying mortgage pools and dealers are reluctant to take inventory of securities that are difficult to hedge. Focusing on the coverage of credit default swaps (CDS) on the subprime mortgage pools, Arentsen et al. (2015) find that when the start date of the CDS coverage and the issuance date of the mortgage pools are close the covered pools experience higher defaults, and within these pools the loans originated after or shortly before the start of CDS coverage have an even higher delinquency rate. Our findings indicate that fast processing mortgage market segments, lenders and loan product types have higher defaults.

Our paper contributes to the literature on disparities in mortgage lending. Earlier studies document the phenomenon of redlining against minority neighborhoods (see, e.g., Holmes and Horvitz, 1994; Ross and Tootell, 2004). Using the HMDA data, Black et al. (1978) show that minorities are more likely to be denied a mortgage. Munnell et al. (1996) reach a similar conclusion after controlling for borrower characteristics collected from loan applications in Boston in 1990, which are unavailable in the HMDA data. Giacoletti et al. (2020) argue that at least half of the observed approval gap for Black borrowers is attributable to within-month variation in loan officers' subjectivity. Conditional on the sample of originated mortgages, studies have shown that minority borrowers have to bear a higher cost (Courchane and

Nickerson, 1997; Black et al., 2003; Ghent et al., 2014; Cheng et al., 2015; Reid et al., 2017; Bayer et al., 2018; Delis and Papadopoulos, 2018; Ambrose et al., 2020). Studying the incidence of consumer complaints on financial services, Begley and Purnanandam (2021) find the level of complaints is significantly higher in markets with lower income, lower educational attainment, and a higher share of minorities. For the mortgage loans securitized by GSEs, Bartlett et al. (2021) explore a rule from the U.S. fair lending law for identification and show that Black and Hispanic borrowers pay higher interest rates. Bhutta and Hizmo (2020) and Gerardi et al. (2020) argue that the rate gap is attributable to differences in discount points or prepayment behavior, respectively. Our findings of longer processing time for Black borrowers among the GSE loans also speak to the disparities in lending practices in this segment.

Our findings also contribute to the understanding on financial development and inequality. The level of inequality in income and wealth has risen significantly in the United States in recent decades (see, e.g., Stiglitz, 2016). The credit expansion leading to the 2007-2008 mortgage crisis was fueled by financial innovation and private securitization, transforming subprime mortgage loans from borrowers with limited income and poor credit history into purportedly "safe" assets to meet investor demand.[6] Many minority home buyers financed through private securitization which expanded access to credit unavailable through traditional mortgage lending and agency securitization. However, the promise that this financial development would improve economic opportunities for disadvantaged minorities was broken by the collapse of the subprime mortgage market. Minority homebuyers suffered disproportionately from the collapse, and racial and ethnic disparities in homeownership worsen following the 2008 financial crisis (see, e.g., Bayer et al., 2016). Our findings illustrate the difficulties faced by Black borrowers through the traditional GSE lending channel and provide an explanation for why they pursue riskier channels for financing.

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[6]Faced with a scarcity of safe assets during this period, investors bought these purportedly "safe" securities offering higher yields than traditional safe assets. The shortage of safe assets before the 2008 financial crisis has been well studied (see, e.g., Gorton, 2017).

Our paper also relates to a large literature on agency problems in mortgage lending that led to the 2007-2008 mortgage crisis.[7] These agency problems could distort lenders' incentives in loan origination and loosen lending standards, thereby accelerating mortgage processing time. Our findings are relevant to the recent literature on the relation between credit supply and the housing cycle. Mian and Sufi (2018) propose the credit-driven household demand channel as a driver for the business cycle. Justiniano et al. (2019) argue that an increase in credit supply driven by looser lending constraints can reconcile key empirical features of the housing boom before the Great Recession. Dokko et al. (2019) document that in 2005 about 60% of all purchase mortgage loans have non-traditional features, and the rise in the number of non-traditional mortgages preceded the housing boom. We find that processing time declines before the 2007-2008 mortgage crisis, led by the PLS segment in the mortgage market, and that the more risky non-traditional mortgages have a faster processing speed relative to traditional mortgages. These findings are consistent with the credit expansion driven by looser lending constraints. Furthermore, our finding that Black borrowers experience a large reduction in processing time by taking on more risky mortgages illustrates the rising household demand and leverage.

The road map for the remainder of the paper is as follows. In Section 2, we discuss the main data used in our analysis and take a preliminary look at racial disparities based on the summary statistics. Section 3 contains main results from our regression-based analysis using the comprehensive HMDA data. In this section, we further discuss the racial disparities in processing time in different segments of the mortgage market, such as GSE versus PLS segments. In Section 4, we focus on our regression-based analysis on the PLS market using the merged HMDA-CoreLogic data. The analysis in this section further sheds light on

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[7]Notable examples, among others, include Mian and Sufi (2009), Barlevy and Fisher (2011), Haughwout et al. (2011), Keys et al. (2012), Chinco and Mayer (2012), and Agarwal et al. (2014) on weakened standards; Ben-David (2011), Jiang et al. (2014), Piskorski et al. (2015), Griffin and Maturana (2016), and Garmaise (2015) on misrepresentations and fraud; Keys et al. (2010), Purnanandam (2011), Nadauld and Sherlund (2013), and Rajan et al. (2015) on a market fueled by poor ratings models and the rapid expansion of non-agency securitization markets; Demiroglu and James (2012) on affiliation-related agency issues; and Tzioumis and Gee (2013) and Agarwal and Ben-David (2014) on loan officer pay structure and the use of other credit derivatives.

racial disparities in loan performance and across loan product types. Section 5 offers a brief conclusion.

2   First Glance at Racial Disparities in Mortgage Processing Time

In this section, we take a first glance at racial disparities in mortgage processing time. We first describe the main sources of data used in our analysis and then report the summary statistics. We find preliminary evidence that Black borrowers of home purchase loans have a larger presence in the segments of the mortgage market associated with shorter processing time (e.g., the segments for PLS or non-traditional loans), whereas white borrowers have a predominant presence in the GSE segment, with their loans being processed about 5 days faster than those by Black borrowers. The preliminary findings are obtained without taking into account borrower or loan characteristics. In the following sections, we take a more rigorous regression-based approach to examine racial disparities.

2.1   Data

The 1989 revision of the HMDA requires reporting on the disposition of individual applicants. HMDA reporting standards require the following information: date of application; loan amount; census tract of property; if the property is owner occupied; purpose of the loan (purchase, improvement, or refinancing); loan guarantee (conventional, FHA, or VA); loan disposition (approved, approved but withdrawn, no lender action taken, or denied); race; gender; and applicant income. The HMDA dataset also provides the identity of the lenders, which we use to classify whether the lender is a subprime lender, a depository institution or an independent mortgage company. While mortgage loan origination has traditionally been done by depository financial institutions—commercial banks, thrifts, and savings and loans such as Wells Fargo and Washington Mutual, among others—independent mortgage

companies such as New Century Financial started taking a sizable market share between 2003 and 2007, right before the mortgage crisis.

The confidential HMDA data provide additionally the exact application date and action date (approved or denied). As such, we are able to calculate processing time for a given loan—one key variable of interest in this paper—as the difference between these two dates. Note that the public version of this data cannot be used for such calculation because it only reports the year of mortgage origination. Following Foote et al. (2019), we clean the HMDA data by dropping loans that lack information on race and gender, and by removing potentially miscoded outliers in the borrower's income entries. We also drop loans with a processing time in the bottom and top 1% of the distribution, which are most likely due to input errors. We also remove observations for second liens, investment properties, and multi-family residence.

In a typical mortgage processing timeline, a home buyer sometimes will start with getting preapproval from lenders who may or may not be used for the official loan application. In processing a preapproval, a lender will check the borrower's credit history and review information about the borrower's income, debts, and assets. The home buyer then will find a home to buy and sign a purchase agreement after negotiation. The home buyer often shops for a mortgage and chooses a mortgage lender at the start, with the intention of proceeding with the mortgage application. Afterward, a home inspection is scheduled to determine the condition of the home, a home appraisal is done to validate the home's value, and then a title company will research the home's legal history to make sure there are no other liens on the property. The mortgage lender will then verify the borrower's income, assets, debt and home value. The mortgage lender may ask the borrower for additional documents, such as explanations for sources of large bank deposits. Once the mortgage is cleared to close, the lender will provide a closing disclosure and the home buyer will schedule a date for closing.

A limitation of the HMDA data is the omission of variables that are informative about borrower creditworthiness such as credit scores, loan-to-value (LTV) ratios, and debt-to-

income (DTI) ratios. To supplement the information in the HMDA data, we merge it with the CoreLogic LoanPerformance data, which have an extensive coverage of privately securitized mortgages. The CoreLogic LoanPerformance data provide important information on borrower credit risk characteristics at loan origination, including FICO scores, combined loan-to-value (CLTV) ratios (including first and second liens), back-end debt-to-income (DTI) ratios, and whether the lender has complete documentation on the borrower's income and assets. We also have information on loan origination date, loan amount, appraised value or sale price of the property, location of the property (five-digit ZIP code), and whether the borrower-owner occupies the property. As for loan specifics, the data also include information on whether the loan rate is fixed or adjustable, the initial loan rate, the margin and first rate reset for adjustable rate loans, and whether the loan has features such as a prepayment penalty or balloon payment at maturity. The CoreLogic LoanPerformance data also specify whether a mortgage belongs to "Alt-A" or subprime segment. Adelino et al. (2020) argue that subprime mortgages are more homogeneous in (potentially unobserved) risk characteristics. This feature is important for us to compare mortgages across borrower groups, so we focus on the subprime segment in our analysis.

The Corelogic LoanPerformance data also provide information on whether a loan is current, delinquent, or in foreclosure— the basis for our loan performance measure. We use loan default within 15 months of origination as our primary loan performance measure. Following the convention in the mortgage loan industry, a loan is classified as being in default if payments on the loan are 60+ days late as defined by the Office of Thrift Supervision, the loan is in foreclosure, or the loan is real estate owned (REO).[8] In Table 1 we report key variables from these two datasets as well as those measuring local macroeconomic conditions.

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[8]Alternatively, we have also considered 90 days past due or in foreclosure for default status and within 24 months of origination for loan age and obtain qualitatively similar results with both alternatives.

2.2 Merging the HMDA and CoreLogic LoanPerformance Data

As a key step in our investigation, we merge the HMDA and CoreLogic LoanPerformance data by using the exact application and action dates together with the loan amount and other loan characteristics. The merging algorithm in our paper parallels the one used in Rosen (2011) which matches the confidential HMDA data with the McDash data from Black Knight Financial Services. The most important variables used to merge these two datasets include the geographic location (i.e., ZIP code) and certain loan characteristics such as the amount and closing date of the loan.

Specifically, to match HMDA mortgage observations with CoreLogic LoanPerformance mortgage observations, we impose the following matching criteria. The mortgage observations in both datasets are considered matched, if (1) they have the same ZIP code;[9] (2) they have the same lien type (first or second), occupancy type (owner-occupied), purpose (home-purchase), and mortgage type (conventional); (3) their origination amounts should not differ by more than $500; and (4) they have similar if not identical origination dates. Because neither dataset reports the closing date precisely, we use the following procedure sequentially: an exact-day match, followed by an iterative five-day difference match, and then followed by a same-month match. The matching rate of our merging algorithm is similar to that in Rosen (2011) in which 50% to 80% of McDash mortgage observations can be matched with the HMDA data and the matching rate tends to increase over time.

2.3 Summary Statistics and Preliminary Findings

In Table 2 we report the summary statistics for our sample of mortgage applications for the purchase or refinance of owner-occupied homes in 2001-2006 by racial and ethnic groups from the confidential HMDA data. The sample includes both accepted applications that led

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[9]Because the HMDA reports mortgages by census tracts, we map census tracts to ZIP codes based on the U.S. Census Bureau's approximations of ZIP codes (i.e., ZCTA5 values), available at https://mcdc2.missouri.edu/websas/geocorr2k.html.

to mortgage origination and applications rejected by lenders.[10] Panels A and B of the table report the summary statistics for home purchase and refinanced loans, respectively.

More than 22 million are originated home purchase loans. In our sample from the HMDA data, 4 million are rejected home purchase loan applications, 37 million are originated refinance loans, and 11 million are rejected refinance applications. About 24.1% of originated home purchase loans are from minority borrowers, and about 40.6% of the rejected home purchase loan applications are from minority borrowers, which indicates that the unconditional rejection rate is higher for minority relative to white borrowers. About 19.2% of originated refinance loans are from minority borrowers, and about 33% of the rejected refinance loan applications are from minority borrowers, which again indicates a higher unconditional rejection rate for minority borrowers. Among the minority groups, Black borrowers face the largest disparity, making up only 6.9% of accepted home purchase applications but 16.7% of the rejected applications. Hispanic borrowers also face a large disparity in the rejection rate, whereas we find no evidence of disparity for Asian borrowers.

The average processing time is about 40 days for originated home purchase loans, 24 days for rejected home purchase loan applications, 38 days for originated refinance loans, and 21 days for rejected refinance applications. Without controlling for borrower and loan characteristics, the average processing time for originated home purchase loans is longer for white and Asian borrowers relative to Black (by about 4 days) and Hispanic borrowers (by about 6 days). The differences in average processing time for originated refinance loans are smaller. The differences in average processing time for rejected loan applications are also smaller except for a longer processing time for Asian borrowers. This distribution of processing time is positively skewed, with the averages being higher than the medians.

Within the sample of originated home purchase loans from subprime lenders, the average mortgage processing time is 22.3 days with a standard deviation of 18.3 days, and both

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[10]We do not include the applications that are approved by lenders but rejected by borrowers because they do not lead to loan origination.

are significantly lower than those from the whole sample.[11] Comparing the racial/ethnic representation in the whole sample and in the sample of subprime lenders, we find that white borrowers are under-represented in the subprime lender sample, making up 48.6%, as opposed to 75.9% in the whole sample, Black borrowers are over-represented at 18.8% (vs. 6.9% in the whole sample), Hispanic borrowers are over-represented at 27.4% (vs. 11.4% in the whole sample), and Asian borrowers are fairly represented at 5.2% (vs. 5.8% in the whole sample).

To illustrate the time-series pattern of average processing time by race, we plot in Figure 1 the averages and standard deviations of processing time by race in each year between 2001 and 2006 based on the originated mortgages for home purchases (Panel A) as well as refinance (Panel B). From Panel A of the figure, we see that the average processing time for home purchase mortgages generally decreases during our sample period and more drastically for Blacks and Hispanics after the year 2003 than for Asians and whites, which shows a bifurcated pattern between Black and Hispanic on one side and white and Asian on the other side. The average processing time for originated home purchase loans decreases by about 3 days for white and Asian borrowers from the period 2001-2003 to the period 2004-2006, whereas it decreases by 9 days for Black and by 7 days for Hispanic borrowers.

The time-series pattern for the standard deviations of processing time also shows a bifurcated pattern of a near-parallel decline for Black and Hispanic borrowers and relative stability for white and Asian borrowers. One interesting observation appears when comparing the averages and standard deviations of processing time between white and Black borrowers. Up to the year 2003, the averages are close, but the standard deviation is higher for Black than for white borrowers, which indicates that some Black borrowers face inordinate delays in mortgage processing. After the year 2003, both the average and the standard deviation of processing time are lower for Black borrowers, which indicates an increase in processing speed even for the Black borrowers who used to face inordinate delays. Wei and Zhao (2020)

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[11]The average processing time for originated home purchase loans from subprime lenders is 22.3, 21.7, 22.6, and 23.0 days for white, Black, Hispanic, and Asian borrowers, respectively.

argue that the reduction in processing time in the period 2004-2006 indicates a loosening of lending standards, which can provide a potential explanation for these time-series patterns.

Turning to the refinance mortgage, shown in Panel B of Figure 1, we observe that the time-series trends in the averages and standard deviations of processing time are almost parallel across all of the groups. The average processing time for refinance loans drops by about 10 days from the period 2001-2003 to the period 2004-2006, but the drop is even across all racial/ethnic groups. Similar patterns also exist for the standard deviations of processing time across borrower groups. The sharp decline in processing time from 2003 to 2004 coincides with the decline in refinance volume from 11.1 million in 2003 to 5.1 million in 2004 in our sample. As the demand for refinancing drops after 2003, the mortgage processing speed increases. However, it is interesting that the processing time decreases evenly across borrower groups for refinance mortgages, but in a bifurcated pattern for home purchase loans. One explanation is that we focus on owner-occupied mortgages and the sample of home purchase mortgages includes many new entrants into the housing market, a key feature in the credit expansion before the 2008 mortgage crisis.

We plot in Figure 2 the averages and standard deviations of processing time between 2001 and 2006 for the rejected mortgage applications for home purchases (Panel A) and refinance (Panel B). Interestingly in Panel A, the average processing time for rejected home purchase mortgage applications increases from the period 2001-2003 to the period 2004-2006 for each borrower group (by about 9 days for white applicants and 3 days for other groups). This finding indicates that mortgage rejection takes longer after the year 2003. The time-series pattern for the standard deviations of processing time again shows a bifurcated pattern of a near-parallel trend for Black and Hispanic applicants and for white and Asian applicants. Note that the standard deviations of processing time actually decline for Black and Hispanic applicants after 2003, even though in the same period the average processing time for these groups increases, which is an indication of more homogeneous mortgage processing for these two groups of borrowers.

Panel B of Figure 2 shows the time series from the rejected refinance applications. The average processing time decreases from the period 2001-2003 to the period 2004-2006 fairly evenly by 6 to 8 days across borrower groups, and the standard deviations also decline fairly evenly. To sum up, refinance applications, either approved or rejected, get processed faster over our sample period, but home purchase mortgage applications get faster approvals and slower rejections over our sample period. The contrast between refinance and home purchase loans indicates a structural change in the mortgage market for home purchase loans.

The most significant change in the mortgage market during our sample period is the rise of subprime mortgages fueled by private-label securitization, as opposed to securitization by the GSEs. It is therefore important to discern how the changes in the mortgage market contribute to the changes in mortgage processing speed. The HMDA data provide important information on loan purchaser types for us to identify different market segments. The loan purchaser type is the type of institution that purchases a particular loan from the lender that originates the loan. The types of purchasers include GSE, PLS ("PLSP"), commercial banks and savings associations ("Bank"), lender-affiliated institutions ("Affiliate"), insurance companies and mortgage banks and finance companies ("MC"), and an unspecified other type ("Other"). Additionally, if the mortgage loans are not sold to a purchaser within the calendar year of origination ("Unsold"), they are also identified. We label the PLS purchaser type as "PLSP", which refers to the case in which mortgage lenders sell loans directly to private-label securitization. As we show later in the merged HMDA-CoreLogic data of the PLS loans, loans initially unsold or purchased by other types of institutions can eventually be sold to private-label securitization. The HMDA data changes the codification of loan purchaser type after the year 2003 to reflect the changes in the mortgage market: PLSP is added and mortgage banks and finance companies are included with insurance companies.[12]

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[12]The classification of the purchaser type for insurance companies changed after 2004 in the HMDA data. It includes only life insurance companies before 2004 and adds credit union, mortgage bank, and finance company after 2004. The number of loans purchased by insurance companies is negligible before the category expands after 2003. We therefore attribute the loans in this category to mortgage banks and finance companies. While mortgage financing is traditionally done by depository financial institutions—commercial banks, thrifts, and savings and loans—independent mortgage financing companies had taken a sizable market

In Table 3, we report the summary statistics for the home purchase mortgages across loan purchaser types as provided in the HMDA data. The number of loans sorted by the purchaser type is reported in Panel A. There have been significant increases for the purchaser types of PLSP, Bank, Affiliate, and MC. In Panel B, we report the percentage of loans from each borrower group. In aggregate during the period 2001-2003 (2004-2006), 79.6% (72.7%) of home purchase loans are originated for white borrowers, 5.6% (8.0%) for Black borrowers, 9.3% (13.3%) for Hispanic borrowers, and 5.5% (6.1%) for Asian borrowers. The share of minority borrowers grew during this period, especially the share of Black and Hispanic borrowers. White borrowers are over-represented for the GSE type, making up 82.9% (81.2%) in the period 2001-2003 (2004-2006), whereas Black and Hispanic borrowers are under-represented with 4.0% (4.6%) and 7.4% (8.1%), respectively. In sharp contrast to the GSE type, the composition in the PLSP sample is 53.4%, 15.2%, 24.5%, and 7.0% for white, Black, Hispanic, and Asian borrowers, respectively. Black and Hispanic borrowers are also over-represented in the unspecified other type and the type including mortgage bank and finance companies, but to a lesser degree. These types also sell a higher volume of loans to private securitization.

In Panel C of Table 3, we report average processing time by the borrower's racial/ethnic group and purchaser type. In the period 2001-2003, the average processing time for white, Black, and Asian borrowers is comparable and 2-3 days faster for Hispanic borrowers. This pattern holds across purchaser types with two notable exceptions. First, for the GSE type, it takes about 5 more days of processing time for Black borrowers than for white borrowers. Second, for the other type, the processing time for Black borrowers is about 6 days shorter than for white borrowers. As Black borrowers are least represented in the GSE type and most represented in the other type, we argue that Black borrowers may have their preferred segments in obtaining mortgage credits, possibly related to the length of mortgage processing time.

share between 2003 and 2007, right before the mortgage crisis.

18

In the period 2004-2006, we observe a prominent decreasing trend in processing time across all purchaser types. The average processing time for Black borrowers becomes closer to that of Hispanic borrowers. Across purchaser types, PLSP loans are processed the fastest and GSE loans the slowest, with PLSP loans processed faster by 15, 24, 17, and 16 days for white, Black, Hispanic, and Asian borrowers, respectively. Interestingly, the processing time for Black and Hispanic borrowers is also shorter among the MC and other type of purchasers. All three types consist of a higher proportion of Black and Hispanic borrowers, whereas these two groups of borrowers are most under-represented in the GSE type.

In Panel D of Table 3, we report the standard deviation of processing time by the borrower's racial/ethnic group and purchaser type. During the period 2001-2003, Black borrowers have the largest standard deviation among all purchaser types except for the Other type. During the period 2004-2006, Black borrowers have a lower standard deviation than white and Asian borrowers among all purchaser types except for the GSE and Affiliate types. The GSE type has the highest standard deviation, and the PLSP type has by far the lowest standard deviation among all types. Strikingly, for the PLSP type, the standard deviations are 7 days shorter for Black and Hispanic borrowers relative to white and Asian borrowers. Over the sample period, the standard deviation of processing time for Black borrowers is reduced least for the GSE type (3 days) and most for the Bank type (13 days), which is consistent with the finding that commercial banks increase their presence in the PLS market in later years.

We next explore the time-series patterns in different segments of the mortgage market. The time-series patterns of processing time in Figure 1 show the more drastic decline in processing time for Black and Hispanic borrowers relative to white and Asian borrowers in the sample of home purchase mortgages. By exploring the patterns in the different segments, we can discover the roots of the change in the aggregate market. In Figure 3, we plot the averages and standard deviations of processing time based on the originated mortgages for home purchases from the sample of the GSE purchaser type (Panel A), the PLS sample from

the merged HMDA-CoreLogic data (Panel B), and the sample mortgages from the subprime lenders identified in the HMDA data (Panel C).[13] Panel A of the figure shows that the average processing time for the GSE type generally decreases during our sample period, but is still longest for Black borrowers. Both the averages and standard deviations have similar trends across borrower groups. When we turn to the PLS sample in Panel B, we make a striking observation that the averages across borrower groups move in tandem and stay close to each other, especially between Black and white borrowers. The standard deviations for Black and white borrowers also closely track each other, whereas the standard deviation for Hispanic borrowers is further away from the rest. Even more striking in Panel C, where we focus on the loan sample by subprime lenders, is the tight range for the averages and standard deviations across borrower groups when they move over time, an indication of few differences in processing speed across the groups. We also note that the average processing time from subprime lenders is similar to that of the PLS sample, and both are much shorter than the GSE sample.

The time-series patterns for the GSE type, the PLS sample, and the subprime lender sample, are in contrast to the pattern in the whole sample, which shows a bifurcated pattern for Black and Hispanic borrowers and for white and Asian borrowers. We argue that Black and Hispanic borrowers are over-represented in the fast-processing segments, such as the PLS sample and the subprime lender sample, which accounts for a larger market share in the later years of our sample period, and therefore these borrowers experience a much faster processing time than white and Asian borrowers. To further corroborate this argument, we explore additional segments in the mortgage market in Figure 4. In Panel A, we plot the time-series pattern for the Bank purchaser type and find a bifurcated pattern for Black and Hispanic borrowers and for white and Asian borrowers. Both the averages and standard deviations for Black and Hispanic borrowers declined more than for white and Asian borrowers, which is

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[13]The PLS sample includes loans initially sold to all purchaser types and unsold during the origination year and covers our sample period from 2001 to 2006. The PLSP type in the HMDA data only starts from 2004.

consistent with the finding of an increased presence in the PLS sector by commercial banks in the latter part of our sample period. In Panel B, we plot the time-series pattern for lender-affiliated purchasers and find a different pattern from commercial banks in that the decline in processing time is more evenly spread across borrower groups. Hispanic borrowers see the greatest increase in processing speed, and Black borrowers experience a moderate increase in processing speed relative to white borrowers. Demiroglu and James (2012) show that mortgage screening is positively associated with the incentive alignment between the lender and sponsor (i.e. "skin in the game"). When lenders sell loans to affiliated purchasers, their incentives are better aligned, and thus the problem of lax screening is less severe. In Panel C, we plot the time-series pattern for the unspecified other purchaser type, in which Black and Hispanic borrowers are over-represented throughout our sample period. We observe a clear separation between Black/Hispanic borrowers and white/Asian borrowers with a faster processing time for Black/Hispanic borrowers throughout the sample period and even faster during the later years. The standard deviations for Black and Hispanic borrowers are also lower than for white and Asian borrowers throughout the sample period and become even lower during the later part of the sample period.

So far, our results show that the rise of the private-label securitization greatly speeds up mortgage processing time for Black and Hispanic borrowers. To delve into the PLS segment, we provide summary statistics for the merged HMDA-CoreLogic data in Table 4. In Panel A, we report the mean and standard deviation of processing time, the percentage of borrowers from each racial/ethnic group, the average FICO score, the average combined LTV ratio, the percentage of low-documentation loans, and the average delinquency rate. While the mean processing time is close among the borrower groups, the standard deviation is lower for Hispanic borrowers. The racial/ethnic representation is similar to that for the PLSP type in the HMDA data, except that the percentage for Black borrowers is higher. The average FICO score of Black borrowers is the lowest, whereas the Hispanic and Asian borrowers have higher average FICO scores than white borrowers. The combined LTV ratios

are above 90% across all groups. Hispanic and Asian borrowers have a higher percentage of low-documentation loans than Black and white borrowers. The average delinquency rate is similar at around 10% for white, Hispanic, and Asian borrowers, but much higher at 19.4% for Black borrowers.

In Panel B, we break down the processing time and racial representation by loan purchaser type as defined in the HMDA data. Across all the purchaser types, the PLSP type has the shortest average processing time, and the GSE type has the longest. As discussed in Bartlett et al. (2021), after a mortgage is purchased by GSEs, the originating lender faces the put-back risk of repurchasing the mortgage from GSEs. The reasons for put-backs can be missing or even falsified documentation on income (tax returns, pay stubs), credit score, loan purpose (residential vs. non-occupancy), or property value (appraisal). Put-backs are not negligible from mortgages issued before the 2007-2008 mortgage crisis. These put-back loans may then be sold to the PLS. The differences in processing time across borrower groups are mostly small, except Black borrowers have a longer processing time for the GSE purchaser type. We also find that Black and Hispanic borrowers are under-represented in the GSE purchaser type and over-represented in the PLSP purchaser type, consistent with the findings based on the HMDA data.

In Panel C, we break down the processing time and racial representation by loan product type. We consider different amortization schedules such as fixed rate mortgage (FRM), interest only (IO), balloon, and hybrid mortgages that have a low initial loan rate for the first 24 or 36 months and then reset to a higher loan rate. These non-traditional mortgages, as opposed to the FRM, allow borrowers to make lower monthly mortgage payments in the early years of the mortgage and require substantially higher payments later on. Demyanyk and Van Hemert (2009) show that these mortgages experienced a much higher default rate than the FRMs in the aftermath of the mortgage crisis. Interestingly, we find that these non-traditional mortgages are processed faster than the FRMs, consistent with the notion that these mortgages suffer from loose lending standards. The differences in processing time

across borrower groups are small; however, we find that Black and Hispanic borrowers are over-represented in the sample of non-traditional mortgages and under-represented in the sample of FRMs. We further compare loans with low and full documentation and find, somewhat surprisingly, that they have a similar processing time with few differences across borrower groups. Consistent with anecdotal evidence, white borrowers are under- (over-) represented in low- (full-) documentation loans. However, we also find that Black borrowers are under-represented in low-documentation loans, whereas Hispanic borrowers are over-represented in low-documentation loans. Lastly, we compare loans in terms of the time span from loan origination to securitization (OTS), defining the loans in the longest (shortest) quartile of OTS as slow (fast) OTS. Keys et al. (2012) show that lax screening is more pronounced for loans that have faster OTS. Consistent with their finding, we find that loans with fast OTS are processed faster than loans with slow OTS. The patterns of the standard deviations of processing time follow those of the averages, but the differences are much larger in magnitude. The difference in the averages between fast and slow OTS is 2.3 days for Black borrowers, whereas the difference in the standard deviations is 8.8 days, indicating a much wider distribution.

3 Racial Disparities in Processing Time Based on the HMDA Data

In this section we investigate empirically whether there are racial disparities in processing time based on the HMDA data. The sample period is from 2001 to 2006.

3.1 Baseline Results

As our first analysis, we examine whether there are systematic differences in processing time for borrowers with different racial and ethnic backgrounds. We first focus on the evidence based on the HMDA data. Although it has incomplete information on borrower

creditworthiness, it is by far the most comprehensive universe of mortgage loans and serves as a benchmark for comparison.

We consider the following loan-level regression specification:

$$PT_{i,j,c,t} = \alpha + \beta \times Race_i + \gamma \times X_{i,j,t} + \delta_{c,t} + \delta_j + \epsilon_{i,j,c,t}, \tag{1}$$

where $PT_{i,j,c,t}$ denotes the processing time for loan i originated by lender j in county c and year t, and $Race_i$ denotes the racial and ethnic background of the borrower. We also control for other borrower and loan characteristics in $X_{i,j,t}$, such as loan amount and borrower's income and gender. Loan purchaser information is also included in loan characteristics since summary statistics show that processing time varies across loan purchaser types, with the GSE being the slowest and the PLSP being fastest. Therefore, any racial disparities in processing time can be the result of different levels of exposure to these characteristics.

We include county-month fixed effects, $\delta_{c,t}$, so that we can control for the variations across geographic locations and origination cohorts. The county-month fixed effects can account for varied local and macroeconomic conditions, such as local housing price dynamics, local mortgage origination volume, labor market conditions, and average household income, in addition to the overall time trend that processing time declines during the sample period. We further include regression specifications with and without lender fixed effects, δ_j. Mortgage processing time varies across lenders as subprime lenders tend to be faster. Black and Hispanic borrowers are more likely to finance through subprime lenders and therefore can have a faster processing time on average. In assessing racial/ethnic disparities in processing time, we explore both between-lender and within-lender variations.

Table 5 reports the results in the sample of originated home purchase loans from the regression (1) of processing time on borrower's racial/ethnic background, controlling for other loan and borrower characteristics available in the HMDA data and county-month fixed effects. We adopt a regression specification without lender fixed effects (Specification

24

(a)) and with lender fixed effects (Specification (b)). The standard errors are clustered by lender and month. We run the regression separately for the whole sample period and two subperiods of 2001-2003 and 2004-2006 because some HMDA variables become available or change classification after 2003, and, more importantly, the summary statistics of processing time display distinct patterns in the two subperiods. The racial/ethnic dummy variables capture the differences in processing time from the base group (white borrowers).

During the period 2001-2006, we find that the difference in processing time between Black and white borrowers is 1.804 (3.412) days without (with) lender fixed effects, -1.239 (0.661) days between Hispanic and white borrowers, and 0.317 (-0.074) day between Asian and white borrowers. These estimates show an interesting twist from what we report in the summary statistics that Black and Hispanic borrowers have a shorter average processing time (4-5 days) than white borrowers and Asian borrowers have a similar average as white borrowers. After controlling for various loan characteristics and fixed effects, the processing time is longer for Black borrowers than white borrowers, and the difference between Hispanic and white borrowers is much reduced. Across the two subperiods, the processing time for Black borrowers is 2.561 (4.996) days longer than for white borrowers without (with) lender fixed effects in 2001-2003, and the estimates are 1.235 (2.416) days without (with) lender fixed effects in 2004-2006. The estimates for Hispanic borrowers are -0.545 (1.502) days without (with) lender fixed effects in 2001-2003, and -1.717 (0.118) days without (with) lender fixed effects in 2004-2006. The estimates for Asian borrowers are -0.287 (-0.485) day without (with) lender fixed effects in 2001-2003, and 0.722 (0.198) day without (with) lender fixed effects in 2004-2006. These estimates also show that the differences across borrower groups become smaller during the later part of the sample period, in contrast to the unconditional averages reported in the summary statistics. These findings suggest that Black and Hispanic borrowers are likely to be selected into the fast-processing loan sample, and when we compare like with like, Black and Hispanic borrowers have a longer processing time and the disparities are reduced in the later part of the sample period.

Comparing the estimates with and without lender fixed effects, we find that the estimates for Black and Hispanic borrowers increase when lender fixed effects are included. These patterns indicate that two determinants are at work in explaining the disparities in processing time: between-lender variations and within-lender variations. Black and Hispanic borrowers are more likely to use lenders with a faster loan processing time relative to white borrowers, but when comparing Black and Hispanic borrowers to white borrowers using the same lender, the processing time for them is slower than or comparable to that for white borrowers. In terms of the within-lender variations, we find that, on average, it takes about 5 (2.4) more days for Black borrowers in 2001-2003 (2004-2006) relative to white borrowers to have the loans processed.

The summary statistics show that processing time decreases by 3.5, 9.0, 7.1, and 2.5 days for originated purchase loans for white, Black, Hispanic and Asian borrowers respectively from the period 2001-2003 to the period 2004-2006. The regression results also show that processing time for Black and Hispanic borrowers decreases more than for white borrowers with and without lender fixed effects. The decreasing trend in processing time is documented in Wei and Zhao (2020), who argue that mortgage lenders may form overly optimistic beliefs by extrapolating from the recent housing price growth and subsequently make loans hastily by loosening lending standards. The decreasing trend is more pronounced for Black and Hispanic borrowers than for white and Asian borrowers because Black and Hispanic borrowers tend to select faster lenders.

The estimates on purchaser types are consistent with the summary statistics on the differences in processing time in the mortgage market. The loan processing speed may respond to loan demand in the secondary market so that lenders are pressured to originate to distribute. We use the GSE as the base group and find that the GSE loans are processed at about the same speed as or faster than other types during the period 2001-2003 but are usually processed more slowly during the period 2004-2006. PLSP loans are processed the fastest, and the magnitude is reduced when controlling for lender fixed effects. We

argue that lender fixed effects here may require nuanced interpretations when comparing different purchaser types because lenders may not distribute loans to all purchaser types. For example, a GSE lender may not sell loans to a PLSP purchaser. On the other hand, controlling for lender fixed effects, we find that loans from the same lender are processed at different speeds conditional on the purchaser type.[14] This is clear evidence of demand pressure from the secondary markets. The contrast between GSE and PLS loans indicates that speedy processing is associated with risky origination. Interestingly, we also find that loans purchased by commercial banks and saving associations are processed slower than the GSE loans in the period 2001-2003, but faster in the period 2004-2006. As we later show, loan purchases by commercial banks are much more likely to eventually end up in the PLS deals eventually in the period 2004-2006, but loan demand in the secondary market may also play a role in the loans purchased by commercial banks.

In terms of loan characteristics, we find that processing time is increasing in loan amount, decreasing in borrower's income, and longer when there is a co-applicant or preapproval is requested. Importantly, we find a strong negative relation between processing time and loan rates. In the HMDA data, the rate spreads for high-cost loans, whose rates are higher than the prevailing comparison rate, are reported after 2004. We find that high-cost loans and loans with higher rate spreads are processed faster. This finding is consistent with the observation that borrowers have a choice between loan rates and processing speed, where lower rates require the submission of extra documentation that can delay the process. When controlling for loan rates, we focus on the source of disparities coming from the side of the lender, not due to choices made by the borrower. We also observe that the effects of loan rates on processing time become weaker when controlling for lender fixed effects, which indicates that lenders specializing in high-cost loan origination have a faster processing speed than lenders that are not specialized.

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[14]Another example is the MC type during 2001-2003, which only includes a small number of loans purchased by insurance companies. The processing time is much longer than the GSE loans without lender fixed effects, and the difference is much reduced with lender fixed effects. These estimates suggest that a group of specialized lenders cater to insurance companies.

Next, we conduct the analysis of refinances separately. The application process for refinances is typically simpler and the processing time shorter because the borrower is not required to move to new residences. Foote et al. (2019) show a dramatic decline in the average processing time for refinances between 1995 and 1998, but no such pattern for purchase loans. Fuster et al. (2019) also find that FinTech lenders shorten the processing time more for refinances than for home purchase loans. During our sample period, the average processing time is 35.7 days for refinance loans and 40.2 days for home purchase loans.

Table 6 reports the results for refinance loans from the regression (1) of processing time on borrower's racial/ethnic background. During 2001-2006, the processing time for Black borrowers is 0.243 (1.369) days longer than for white borrowers without (with) lender fixed effects, 1.06 (1.617) days for Hispanic borrowers, and 0.286 (0.064) for Asian borrowers. Across the two subperiods, the estimates with lender fixed effects are 1.807 (1.096) days in 2001-2003 (2004-2006) for Black borrowers, and 2.159 (1.176) days for Hispanic borrowers. The estimates for Asian borrowers are economically and statistically insignificant.

The estimates from the refinance sample point to important differences compared to the purchase sample. First, the differences in processing time between Black and white borrowers are smaller in the refinance sample. Second, the decline in processing time from the period 2001-2003 to the period 2004-2006 is weaker for refinance loans. These findings are consistent with the time-series plots and indicate that the changes in the mortgage market have less of an impact on refinance loans than on home purchase loans. Similar to the sample of home purchase loans, we also observe in the sample of refinance loans that the processing time for Black and Hispanic borrowers is longer when controlling for lender fixed effects, which is consistent with the explanation that within-lender variations contribute to most of the disparities in processing time.

Next, we investigate the differences in processing time for denied mortgage applications. Table 7 reports the results for home purchase and refinance loans separately from the regression (1) of processing time. We first focus on the sample of home purchase loan applications

(Panel A). In the period 2001-2003, we find a slower processing time for minority borrowers than for white borrowers (1.53, 0.55, and 2.0 days longer for Black, Hispanic, and Asian borrowers, respectively) without controlling for lender fixed effects, but the differences become negligible after controlling for lender fixed effects. In the period 2004-2006, the processing time becomes faster for Black and Hispanic borrowers (3.65 and 3.40 days shorter for Black and Hispanic borrowers without lender fixed effects, respectively) but stays slower for Asian borrowers. The faster processing time for Black and Hispanic borrowers in the latter part of the sample echoes the increased speed for the approved applications, as we show in Table 5. Note that faster rejection of a loan application can be caused by more stringent lender screening standards or a higher fraction of less creditworthy applicants. Next, we turn to the sample of denied refinance applications (Panel B). In contrast to the sample of approved refinances, the processing time for denied refinance applications is shorter for Black and Hispanic borrowers in both 2001-2003 and 2004-2006. The processing time for Asian borrowers is longer in both periods. Further, we do not find the phenomenon of fast rejection in the 2004-2006 sample of home purchase loans.

3.2 Disparities across Mortgage Purchaser Types

Disparities in processing time can arise if delays in the screening process vary systematically across racial/ethnic groups or if loan demand from the secondary market affects minorities differently from white borrowers. Purchaser types in the HMDA data can be exploited to disentangle these two determinants of processing time. The most prominent phenomenon during our sample period is the rise of the PLS market, where most subprime mortgages are securitized. As we show in the summary statistics, Black and Hispanic borrowers account for almost half of the HMDA-CoreLogic merged sample, and the PLS market has a disproportional impact on minority borrowers. In the HMDA data, we draw a comparison between GSE loans, PLSP loans, commercial banks, mortgage financing companies, lender-affiliated institutions, and the unspecified other type. As we show in Table 5, the GSE loans have

29

the longest processing time, the PLS loans have the shortest processing time in 2004-2006, and the rest of the loans fall in between. We next conduct subsample regressions for each purchaser type in the HMDA data.

Table 8 reports the results from the regression (1) for originated home purchase loans across loan purchaser type. For each purchaser type, we report the regression results for 2001-2003 and 2004-2006 separately with and without lender fixed effects, controlling for loan and borrower characteristics and county-month fixed effects. Across purchaser types, the most striking disparity is that during 2001-2003, the processing time for Black borrowers is significantly longer than for white borrowers across segments, especially when controlling for lender fixed effects.

In the GSE sample, the processing time for Black borrowers is 8.26 (7.16) days longer than for white borrowers without (with) lender fixed effects during 2001-2003 and 5.15 (5.25) days during 2004-2006. These differences are both statistically and economically significant. The close estimates from specifications with and without lender fixed effects indicate that the differences are mostly from within-lender variations. In the summary statistics, the differences in average processing time between Black and white borrowers are 5.5 days during 2001-2003 and 2.1 days during 2004-2006. After including various controls, the differences become even larger and suggest the existence of racial disparities for Black borrowers. The estimates for Hispanic borrowers are much smaller: about one day slower than for white borrowers during 2001-2003 and near zero during 2004-2006 with lender fixed effects. The processing time for Asian borrowers is about one day faster during both subperiods.

The large gap of 7 to 8 days in processing time for Black borrowers in the GSE segment may result from a lower approval rate from the automated underwriting systems of the GSEs. As a result, a larger portion of Black applicants need to go through manual underwriting with additional analysis by the lender before obtaining final approval of their loan applications. In fact, Giacoletti et al. (2020) show that Black applicants are recommended for approval approximately 6 percentage points less frequently in the post-2018 HMDA data containing

the recommendations of the automated underwriting systems.

In the PLSP sample, which covers the period 2004-2006, the differences between Black and Hispanic borrowers and white borrowers are quite small: less than one day with lender fixed effects. Interestingly, as shown in the summary statistics, the differences in average processing time between Black (Hispanic) and white borrowers are 6.3 (4.5) days during 2004-2006. These unconditional differences disappear after adding various controls.

As shown in Figure 4, commercial banks reduce the mortgage processing time for Black and Hispanic borrowers dramatically during our sample period. In our regression analysis, the processing time for Black borrowers is 6.25 days longer than for white borrowers during 2001-2003, one of the longest among purchaser types, and 1.77 days during 2004-2006, one of the shortest among purchaser types, both with lender fixed effects. The processing time for Hispanic borrowers also decreases, but to a lesser extent. These changes may illustrate that commercial banks have responded to the rise of PLS and subprime markets by speeding up mortgage processing. Consistent with this narrative, the estimates for Black and Hispanic borrowers from the sample of mortgage financing companies, which are often argued to have less stringent lending standards, appear similar to those from commercial banks during 2004-2006.

The regression results from the samples of lender-affiliated institutions and the unspecified other types show similar trends of reduced processing time for Black and Hispanic borrowers. The reduction for Black borrowers is smaller relative to commercial banks. The potential explanations are different for the Affiliate and Other types: the Affiliate type is still slow in processing loans from Black borrowers during 2004-2006, consistent with the "skin in the game" argument, while the Other type is fast in processing loans from Black borrowers during 2001-2003. The processing time for Asian borrowers is usually not much slower relative to white borrowers, but we find significant differences in the samples for the MC and Other types during 2004-2006 without lender fixed effects, which indicates that Asian borrowers tend to select certain slow lenders in these types. Comparing the estimates with and without

lender fixed effects, we find Black borrowers tend to select fast processing lenders for each purchaser type except for the GSE segment since estimates are generally larger with lender fixed effects.

Overall, the GSE sample shows persistent disparities in processing time for Black borrowers, whereas evidence of disparities exists mostly during 2001-2003 for other types, but is not as pronounced during 2004-2006. We do not find evidence of disparities for the PLSP type. The impact of the PLS market on the overall mortgage markets during 2004-2006 can help explain the time variation in disparities since loan purchasers such as commercial banks become more involved in the PLS market. The persistent disparities for the GSE type may be because automatic underwriting for the GSE loans is less flexible in speeding up mortgage processing.

3.3 Disparities among High-Risk Mortgages

Mian and Sufi (2018) propose the credit-driven household demand channel as a driver for the business cycle. Justiniano et al. (2019) argue that an increase in credit supply driven by looser lending constraints can reconcile key empirical features of the housing boom before the Great Recession. Dokko et al. (2019) document that in 2005, about 60% of all purchase mortgage loans have non-traditional features and the rise of non-traditional mortgages preceded the housing boom. These non-traditional mortgages embedded higher risk, such as higher leverage or a larger degree of sensitivity to housing prices and/or interest rates. In the HMDA data, we try to identify these mortgages in two ways. First, we identify the mortgages originated by subprime lenders, who commonly offer these loan products. Second, we focus on high-cost mortgages, which have higher loan rates than the prevailing benchmark rates. Even though some non-traditional features include a low initial loan rate (i.e., a teaser rate), the initial rate is often reset to a much higher rate after the initial period. Motivated by our findings in Figure 3, we expect that racial disparities in processing time among these high-risk mortgages are weaker than in traditional mortgage loans.

Table 9 reports the results for high-risk mortgage loans from the regression (1) of processing time on borrower's racial/ethnic background, controlling for loan characteristics, county-month fixed effects and lender fixed effects. Compared to the results from the whole sample, we find that the differences in processing time between Black or Hispanic and white borrowers are much smaller. The estimates for Black borrowers from the sample of subprime lenders are 1.283 (0.505) days during 2001-2003 (2004-2006), as opposed to 4.996 (2.416) days in the whole sample, controlling for lender fixed effects. The estimate for Black borrowers from the sample of high cost loans is 0.915 day during 2004-2006. The estimates for Hispanic and Asian borrowers are economically insignificant in these mortgages.

Overall, our findings indicate that Black borrowers experience fewer delays in processing time when they resort to risky lenders and borrow through high-cost mortgages.

3.4 Demand Shocks and Disparities in Processing Time

Fuster et al. (2019) find that demand shocks in mortgage applications can significantly affect lenders' capacity constraints and thus mortgage processing time. We investigate how demand shocks affect disparities in processing time.

To compare the impacts of demand shocks across racial and ethnic groups, we run the following regressions:

$$PT_{i,j,c,t} = \alpha \times Applications_t + \beta \times Race_i + \gamma \times Applications_t \times Race_i + \theta \times Controls_{i,c,t} + \delta_j + \delta_c + \epsilon_{i,j,c,t},$$
(2)

where $Applications_t$ is the log of aggregate mortgage applications or refinance applications in month t, and the control variables include borrower and loan characteristics and calendar month dummies to account for seasonality. We also include fixed effects for lenders and counties. Standard errors are clustered by lender and month of origination.

Table 10 reports the results in the sample of originated home purchase loans and refinance loans separately from the regression (2) of processing time on borrower's racial/ethnic

background and application volumes, controlling for other loan and borrower characteristics available in the HMDA data and for county and lender fixed effects. In the sample of home purchase loans, we find that positive demand shocks of a one standard deviation change in aggregate application volume (refinance application volume) delay loan processing by 0.83 (0.81) day, and both have a 1% statistical significance. Furthermore, we find that positive demand shocks will delay the processing time for Black applicants even more by 0.50 (0.73) day than white applicants. The additional delay for Hispanic applicants is much smaller in comparison at 0.12 (0.14) day, and both are statistically insignificant. We do not find evidence of additional delays for Asian applicants. In the sample of refinance loans, we find that the impacts on processing time by demand shocks are larger in magnitude, but have little additional impact on Black applicants. Finally, our estimates on race dummy variables remain similar to what we have estimated earlier, which indicates that our previous findings are robust to demand shocks.[15]

Interestingly, the finding that processing time for Black applicants for home purchase mortgage is more affected by demand shocks indicates that they are more exposed to uncertainty in mortgage processing speed and serves as a potential explanation for why Black borrowers are more attracted to fast-processing lenders.

4 Results Based on the Merged HMDA-CoreLogic Data

Our results based on the HMDA data suggest that the rise of the PLS market contributes to the reduction in processing time during our sample period and especially so for Black and Hispanic borrowers since they are over-represented in this market. The delays in mortgage processing for certain borrowers may be the result of undue scrutiny or unobserved credit quality issues beyond our regression controls. Is the reduction in processing time the result of removing inordinate delays or lax screening? To shed light on this question, we delve into

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[15]We standardize the variables, log of aggregate mortgage applications and refinance applications, to have zero means, so their interactions with racial/ethnic dummy variables do not affect the estimates on these dummy variables given that the application variables are at average.

the PLS market using the merged HMDA-CoreLogic data.

The merged data provides loan performance information on whether a loan is current, delinquent, or in foreclosure. If the reduction in processing time is related to lax screening, we would expect worse loan performance or a higher default rate unexplained by our observable control variables. The unexplained loan delinquency is often considered as an indication of lax lending standards (see, e.g., Keys et al., 2010). Thus, drawing inferences from both processing time and loan default can shed light on the causes for the reduction in processing time.

Furthermore, the merged HMDA-CoreLogic data add additional loan and borrower characteristics, including FICO scores, combined loan-to-value (CLTV) ratios (including first and second liens), back-end debt-to-income (DTI) ratios, and whether the lender has complete documentation on the borrower's income and assets. These additional characteristics can be used to corroborate our findings from the HMDA data on the PLS loans. We also have information on various loan product types, which enables us to compare processing time across different loan products.

4.1   Disparities in Processing Time and Delinquency

With the merged HMDA-CoreLogic data, we can compare processing time for borrowers with varied backgrounds and examine whether processing time varies systematically with borrower background beyond the differences in borrower creditworthiness. In particular, we expand the control variables $X_{i,j,t}$ in the regression specification (1) to include additional variables, such as FICO, LTV, DTI, and indicator variables for loan product type, initial loan rate, margin for adjustable rate mortgages, and an indicator variable for a prepayment penalty. We also include lender, origination year, and county fixed effects in the regression.

To compare the ex post loan delinquency across racial and ethnic groups, we run similar regressions for processing time, but now replace processing time by a loan delinquency dummy variable that equals one if the loan becomes delinquent within 15 months of origi-

nation, or zero otherwise.

Table 11 reports the results from the regression based on the merged HMDA-CoreLogic data. The results on processing time show that the differences between Black and white borrowers are much smaller than reported in Table 5, unsurprisingly because the merged HMDA-CoreLogic data contains mortgage loans that are privately securitized. The differences between Hispanic and white borrowers are small based on the HMDA data, and also small in the merged data. One interesting observation is that Asian borrowers have a slightly longer processing time than white borrowers in the merged data, but not in the HMDA data. We also compare to the results in Table 8 for the PLSP type during 2004-2006 and find the estimates are quite close, which ensures that our results based on the HMDA data are robust to the expanded set of control variables. Comparing the estimates of the periods 2001-2003 to 2004-2006, we find that the processing time for Black and Hispanic borrowers decreases more than for white borrowers.

To examine whether there is a difference across lenders in the PLS market, we repeat the analysis for the sample of loans from subprime lenders. As shown in Table 9 based on the HMDA data, the differences between Black and White borrowers in processing time are mostly gone when focusing on the loans from subprime lenders. However, in the merged data, we find that the estimates based on the sample of subprime lenders are similar to those based on all lenders. In other words, in the PLS market, all lenders behave like subprime lenders.

The summary statistics show that the loan delinquency rate for Black borrowers is 19.4% and 10% for white borrowers. The results from the loan delinquency regression show that the delinquency rate is 6.0% higher for Black borrowers than for white borrowers during 2001-2006, 4.4% higher during 2001-2003, and 6.3% higher during 2004-2006 after controlling for various loan characteristics and fixed effects. On the other hand, the delinquency rate is about 1% lower for Hispanic borrowers than for white borrowers during 2001-2006 and also about 0.4% lower for Asian borrowers. The estimates from the sample of subprime

lenders are similar to the whole sample. Given that we include detailed controls on loan characteristics and various fixed effects, the magnitude of the unexplained delinquency gap between Black and white borrowers is economically significant.

On the relation between loan characteristics on delinquency, we find that the borrower's FICO score is negatively correlated with delinquency, low-documentation loans have a higher delinquency rate than full-documentation loans, the LTV ratio is positively associated with the delinquency rate, and the DTI ratio is also positively associated with the delinquency rate, all of which are consistent with the previous findings (Demyanyk and Van Hemert, 2009). On the other hand, the relation between loan characteristics and processing time is intriguing. The FICO score is negatively correlated with processing time, consistent with the notion of faster processing for high credit quality borrowers. However, loans with low documentation or higher leverage are also processed faster. Loans with a high DTI ratio are processed slower during 2001-2003 but faster during 2004-2006. These patterns indicate that lenders speed up the production of high-risk mortgages in the PLS market with the exception of low FICO loans, probably because the PLS investors are mostly concerned with the FICO scores.

4.2   Loan Product Types

The time period leading up to the 2007-2008 mortgage crisis has seen the proliferation of many non-traditional mortgage loan products, as opposed to the traditional fixed rate mortgages in the PLS market. These non-traditional features include hybrid loans with a low initial rate, interest only (IO), and balloon. As reported in the summary statistics, these non-traditional mortgages are processed faster than the FRMs, and Black and Hispanic borrowers are over-represented in the sample of non-traditional mortgages and under-represented in the sample of FRMs.

The growth of non-traditional mortgages is fueled by extraordinary demand for securities backed by these loan products. The heightened demand is reflected in the shortening of the

37

shelf time of the mortgages, the time span from loan origination to securitization (OTS). We classify the loans in the longest (shortest) quartile of OTS as slow (fast) OTS. Keys et al. (2012) show that lax screening is more pronounced for loans that have faster OTS. Our summary statistics also show that fast OTS loans have a faster processing time.

Table 12 reports the results from the regression based on the merged HMDA-CoreLogic data. The overall patterns in loan delinquency remain: the loans from Black borrowers experience a significantly higher default rate than those of white borrowers. The differences in processing time are generally small in magnitude for the PLS sample. However, a comparison across different loan types sheds light on the differences within the PLS sample. We find that the differences in processing time between Black and white borrowers are the largest for the FRM type, at 1.35 days, and about 0.58 day for non-traditional loan types. The differences in the delinquency rate across different loan types are more pronounced. The delinquency gap between Black and white borrowers is 4.3% for the FRM type and 6.1%, 4.5% and 7.2% for the Hybrid, IO, and Balloon types, respectively. Given that the delinquency gap is 6.0% for all of the merged sample, these differences are economically significant. Interestingly, the largest delinquency gap is for the Balloon type, which also has the smallest difference in processing time. We find a similar pattern when comparing fast and slow OTS loans: fast OTS loans have a greater delinquency gap between Black and white borrowers and a smaller difference in processing time relative to slow OTS loans. In contrast to Black borrowers, the differences across loan types are generally economically insignificant for Hispanic and Asian borrowers.

Our results from analyzing cross-sectional variations by loan types echo the same message as the results from the comparison across segments in the HMDA data: the differences in processing time between Black and white borrowers are smaller in the riskier type of securitized mortgages, by the PLS as opposed to the GSE, and even smaller in the riskier type of loan products within the PLS type, non-traditional mortgages as opposed to the FRMs. Our results on the time to securitization further show that higher investor demand

is associated with smaller disparities in processing time but larger delinquency gaps.

4.3   Comparison between Low- and Full-Documentation Loans

Mortgage lenders screen applicants by collecting both "hard" information, such as credit score, and "soft" information that can help predict borrowers' future income stability. While hard information, by definition, can easily be verified and credibly transmitted, lenders have to exert effort to collect and process soft information (Stein, 2002). Because investors purchase securitized loans based on mostly hard information, lenders bear the cost of producing soft information in the screening process. So, if lenders have a preference for borrowers of a certain racial/ethnic background, lenders can have a weaker incentive to produce soft information from screening these borrowers, and such differential lending standards can be more severe for low-doc loans.

As shown in Table 11, low-doc loans have a higher delinquency rate than full-doc loans but a shorter processing time, controlling for various loan characteristics and fixed effects. As argued in Keys et al. (2010), lax screening is more likely to exist in the low-doc loan sample, and hence we argue that the reduction in processing time associated with lax screening is also more likely to exist in the low-doc sample. We next compare low-doc loans with full-doc loans in terms of processing time and loan delinquency across different racial/ethnic groups of borrowers.

Table 13 reports the results from a regression of processing time and delinquency on borrowers' racial/ethnic background, controlling for other loan and borrower characteristics, local economic conditions and fixed effects on the lender, the county of property, and the year of loan origination for low-doc (full-doc) loans in Panel A (Panel B). First, we find the patterns that are found in the entire merged data present in both the low-doc and full-doc samples. Second, consistent with the argument of lax screening, we find that the delinquency gap between Black and white borrowers is about 7.2% in the low-doc sample and 5.2% in the full-doc sample, and the difference in processing time is higher in the full-doc sample.

We further find that for Black borrowers, the contrast in processing time between FRMs and non-traditional mortgages and between fast OTS and slow OTS loans is more pronounced in the low-doc loan sample relative to the full-doc loan sample.

We also find interesting results on the Hispanic borrowers. As reported in the summary statistics, Hispanic borrowers are over-represented in low documentation loans. However, the delinquency rate for Hispanic borrowers is lower than the for white borrowers in the low-doc sample. On the other hand, the delinquency gap between Hispanic and white borrowers is insignificant in the full-doc sample. These findings indicate that lax screening is less evident among Hispanic borrowers.

4.4 Loan Purchaser Types

In summary statistics for the merged HMDA-CoreLogic data, we break down the processing time and racial representation by loan purchaser type as defined in the HMDA data and find that the PLSP type has the shortest average processing time and the GSE type has the longest. Loan purchasers, except for the PLSP type, may originally intend to sell the loans in the PLS market or keep the loans for other purposes. The GSE type is more likely to keep the loans for their own securitization and only put back mortgages to the lender that may later be sold to the PLS. The different purposes may have implications for loan processing time and performance. If the loan purchaser intends to sell in the PLS market, we would also expect to see lax screening, as in the PLS sample; otherwise, we would expect to see different patterns in processing time and loan delinquency.

Table 14 reports the results of a regression of processing time and loan delinquency for each purchaser type. Strikingly, for the GSE type, the difference in processing time between Black and white borrowers is 6.355 days, whereas the estimate from all merged loans in the sample is 0.657. The delinquency gap between Black and white borrowers for the GSE type is 3.9% compared to 6.0% for all loans. These findings suggest less lax screening among the PLS loans that are intended for GSE securitization. On the other hand, the estimates from

all other purchaser types are similar to those from all loans except that the PLSP type has an even smaller difference in processing time and a larger delinquency gap between Black and white borrowers. These findings also provide an explanation for the time-series patterns of processing time for these purchaser types in that they behave more like the PLSP type during the period 2004-2006.

5   Conclusion

We examine racial disparities in mortgage lending through a novel dimension: processing time, or the amount of time needed to process a loan application. Among the home purchase loans originated between 2001 and 2006, the processing time for Black borrowers is about 3.4 days, controlling for loan and borrower characteristics as well as county, month, and lender fixed effects. We do not find such large discrepancies for Hispanic and Asian borrowers. We find that the difference is partly explained by the within-lender variation due to a longer processing time for minorities by the same lender and is also attributable to the large racial disparities in the segments, such as the GSE segment in which the processing time for Black borrowers is about 6.2 days longer in the sample period.

Another important finding in this paper is evidence for the association between Black borrowers and faster lenders. Specifically, we find further evidence for the concentration of Black borrowers in the space of non-traditional loans and faster subprime/high-cost lenders. Our findings point to decreased access of Black borrowers to the safer traditional mortgage financing channel (e.g., GSE). As a future research direction, it would be interesting to further analyze the possible causes behind the obstacles that minority borrowers face in obtaining mortgage financing.

References

ADELINO, M., K. GERARDI, AND B. HARTMAN-GLASER (2019): "Are lemons sold first? Dynamic signaling in the mortgage market," *Journal of Financial Economics*, 132, 1–25.

ADELINO, M., W. B. MCCARTNEY, AND A. SCHOAR (2020): "The Role of Government and Private Institutions in Credit Cycles in the U.S. Mortgage Market," NBER Working Paper No. 27499.

AGARWAL, S., G. AMROMIN, I. BEN-DAVID, S. CHOMSISENGPHET, AND D. D. EVANOFF (2014): "Predatory lending and the subprime crisis," *Journal of Financial Economics*, 113, 29–52.

AGARWAL, S., G. AMROMIN, I. BEN-DAVID, AND D. D. EVANOFF (2016): "Loan Product Steering in Mortgage Markets," NBER Working Paper No. 22696.

AGARWAL, S. AND I. BEN-DAVID (2014): "Do Loan Officers' Incentives Lead to Lax Lending Standards?" Working Paper.

AMBROSE, B. W., J. N. CONKLIN, AND L. A. LOPEZ (2020): "Does Borrower and Broker Race Affect the Cost of Mortgage Credit?" *Review of Financial Studies*, 34, 790–826.

ARENTSEN, E., D. C. MAUER, B. ROSENLUND, H. H. ZHANG, AND F. ZHAO (2015): "Subprime Mortgage Defaults and Credit Default Swaps," *The Journal of Finance*, 70, 689–731.

BARLEVY, G. AND J. D. FISHER (2011): "Mortgage Choices and Housing Speculation," Federal Reserve Bank of Chicago Working Paper.

BARTLETT, R., A. MORSE, R. STANTON, AND N. WALLACE (2021): "Consumer-lending Discrimination in the FinTech Era," Forthcoming in the *Journal of Financial Economics*.

BAYER, P., F. FERREIRA, AND S. L. ROSS (2016): "The Vulnerability of Minority Homeowners in the Housing Boom and Bust," *American Economic Journal: Economic Policy*, 8, 1–27.

——— (2018): "What Drives Racial and Ethnic Differences in High-Cost Mortgages? The Role of High-Risk Lenders," *Review of Financial Studies*, 31, 175–205.

BEGLEY, T. A. AND A. PURNANANDAM (2021): "Color and credit: Race, regulation, and the quality of financial services," *Journal of Financial Economics*, 141, 48–65.

BEN-DAVID, I. (2011): "Financial Constraints and Inflated Home Prices during the Real Estate Boom," *American Economic Journal: Applied Economics*, 3, 55–87.

BHUTTA, N. AND A. HIZMO (2020): "Do Minorities Pay More for Mortgages?" *Review of Financial Studies*, 34, 763–789.

BLACK, H., R. L. SCHWEITZER, AND L. MANDELL (1978): "Discrimination in Mortgage Lending," *American Economic Review*, 68, 186–191.

BLACK, H. A., T. P. BOEHM, AND R. P. DEGENNARO (2003): "Is there discrimination in mortgage pricing? The case of overages," *Journal of Banking & Finance*, 27, 1139–1165.

CHENG, P., Z. LIN, AND Y. LIU (2015): "Racial Discrepancy in Mortgage Interest Rates," *Journal of Real Estate Finance and Economics*, 51, 101–120.

CHINCO, A. AND C. MAYER (2012): "Distant Speculators and Asset Bubbles in the Housing Market," Working Paper.

COURCHANE, M. AND D. NICKERSON (1997): "Discrimination Resulting from Overage Practices," *Journal of Financial Services Research*, 11, 133–151.

DELIS, M. D. AND P. PAPADOPOULOS (2018): "Mortgage Lending Discrimination Across the U.S.: New Methodology and New Evidence," *Journal of Financial Services Research*, 56, 341–368.

DEMIROGLU, C. AND C. JAMES (2012): "How Important is Having Skin in the Game? Originator-Sponsor Affiliation and Losses on Mortgage-backed Securities," *Review of Financial Studies*, 25, 3217–3258.

DEMYANYK, Y. AND O. VAN HEMERT (2009): "Understanding the Subprime Mortgage Crisis," *Review of Financial Studies*, 24, 1848–1880.

DOKKO, J., B. J. KEYS, AND L. RELIHAN (2019): "Affordability, Financial Innovation, and the Start of the Housing Boom," FRB of Chicago Working Paper No. WP-2019-1, Available at SSRN: https://ssrn.com/abstract=3341616 or http://dx.doi.org/10.21033/wp-2019-01.

FOOTE, C. L., L. LOEWENSTEIN, AND P. S. WILLEN (2019): "Technological Innovation in Mortgage Underwriting and the Growth in Credit, 1985–2015," Federal Reserve Bank of Boston Research Department Working Papers No. 19–11. https://doi.org/10.29412/res.wp.2019.11.

FUSTER, A., M. PLOSSER, P. SCHNABL, AND J. VICKERY (2019): "The Role of Technology in Mortgage Lending," *Review of Financial Studies*, 32, 1854–1899.

GAO, P., P. SCHULTZ, AND Z. SONG (2017): "Liquidity in a Market for Unique Assets: Specified Pool and To-Be-Announced Trading in the Mortgage-Backed Securities Market," *The Journal of Finance*, 72, 1119–1170.

GARMAISE, M. J. (2015): "Borrower Misreporting and Loan Performance," *Journal of Finance*, 70, 449–484.

GERARDI, K., P. WILLEN, AND D. H. ZHANG (2020): "Mortgage Prepayment, Race, and Monetary Policy," Working Paper.

GHENT, A. C., R. HERNÁNDEZ-MURILLO, AND M. T. OWYANG (2014): "Differences in subprime loan pricing across races and neighborhoods," *Regional Science and Urban Economics*, 48, 199–215.

GIACOLETTI, M., R. Z. HEIMER, AND E. G. YU (2020): "Using High-Frequency Evaluations to Estimate Discrimination: Evidence from Mortgage Loan Officers," Working Paper.

GORTON, G. (2017): "The History and Economics of Safe Assets," *Annual Review of Economics*, 9, 547–586.

GRIFFIN, J. M. AND G. MATURANA (2016): "Who Facilitated Misreporting in Securitized Loans?" *Review of Financial Studies*, 29, 384–419.

GUISO, L., A. POZZI, A. TSOY, L. GAMBACORTA, AND P. E. MISTRULLI (2021): "The cost of steering in financial markets: Evidence from the mortgage market," *Journal of Financial Economics*.

HAUGHWOUT, A., D. LEE, J. S. TRACY, AND W. VAN DER KLAAUW (2011): "Real Estate Investors, the Leverage Cycle, and the Housing Market Crisis," *FRB of New York Staff Report*.

HOLMES, A. AND P. HORVITZ (1994): "Mortgage Redlining: Race, Risk, and Demand," *Journal of Finance*, 49, 81–99.

JIANG, W., A. NELSON, AND E. VYTLACIL (2014): "Liar's Loan? – Effects of Origination channel and Information Falsification on Mortgage Loan Delinquency," *Review of Economics and Statistics*, 91, 1–18.

JUSTINIANO, A., G. E. PRIMICERI, AND A. TAMBALOTTI (2019): "Credit Supply and the Housing Boom," *The Journal of political economy*, 127, 1317–1350.

KEYS, B. J., T. MUKHERJEE, A. SERU, AND V. VIG (2010): "Did Securitization Lead to Lax Screening? Evidence from Subprime Loans," *Quarterly Journal of Economics*, 125, 307–362.

KEYS, B. J., A. SERU, AND V. VIG (2012): "Lender Screening and the Role of Securitization: Evidence from Prime and Subprime Mortgage Markets," *Review of Financial Studies*, 25, 2071–2108.

MIAN, A. AND A. SUFI (2009): "The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis," *Quarterly Journal of Economics*, 124, 1449–1496.

——— (2018): "Finance and Business Cycles: The Credit-Driven Household Demand Channel," *Journal of Economic Perspectives*, 32, 31–58.

MUNNELL, A. H., G. M. B. TOOTELL, L. E. BROWNE, AND J. MCENEANEY (1996): "Mortgage Lending in Boston: Interpreting HMDA Data," *American Economic Review*, 86, 25–53.

NADAULD, T. D. AND S. M. SHERLUND (2013): "The Impact of Securitization on the Expansion of Subprime Credit," *Journal of Financial Economics*, 107, 454–476.

PISKORSKI, T., A. SERU, AND J. WITKIN (2015): "Asset Quality Misrepresentation by Financial Intermediaries: Evidence from the RMBS Market," *Journal of Finance*, 70, 2635–2678.

PURNANANDAM, A. (2011): "Originate-to-distribute Model and the Subprime Mortgage Crisis," *Review of Financial Studies*, 24, 1881–1915.

RAJAN, U., A. SERU, AND V. VIG (2015): "The Failure of Models that Predict Failure: Distance, Incentives, and Defaults," *Journal of Financial Economics*, 115, 237–260.

REID, C. K., D. BOCIAN, W. LI, AND R. G. QUERCIA (2017): "Revisiting the subprime crisis: The dual mortgage market and mortgage defaults by race and ethnicity," *Journal of Urban Affairs*, 39, 469–487.

ROSEN, R. (2011): "Competition in mortgage markets: The effect of lender type on loan characteristics," Federal Reserve Bank of Chicago Economic Perspectives.

ROSS, S. L. AND G. M. TOOTELL (2004): "Redlining, the Community Reinvestment Act, and private mortgage insurance," *Journal of Urban Economics*, 55, 278–297.

STEIN, J. C. (2002): "Information Production and Capital Allocation: Decentralized versus Hierarchical Firms," *Journal of Finance*, 57, 1891–1921.

STIGLITZ, J. E. (2016): *New theoretical perspectives on the distribution of income and wealth among individuals, In: Stiglitz, J. E., Basu, K. (Eds.), Inequality and Growth: Patterns and Policy Volume I: Concepts and Analysis*, Pallgrave Macmillan.

TZIOUMIS, K. AND M. GEE (2013): "Nonlinear Incentives and Mortgage Officers' Decisions," *Journal of Financial Economics*, 107, 436–453.

WEI, B. AND F. ZHAO (2020): "Processing Time and Lending Standards: The Role of Extrapolative Expectations in Mortgage Loans," Working Paper.

Figures & Tables

FIGURE 1: Processing Time for Originated Mortgage Loans
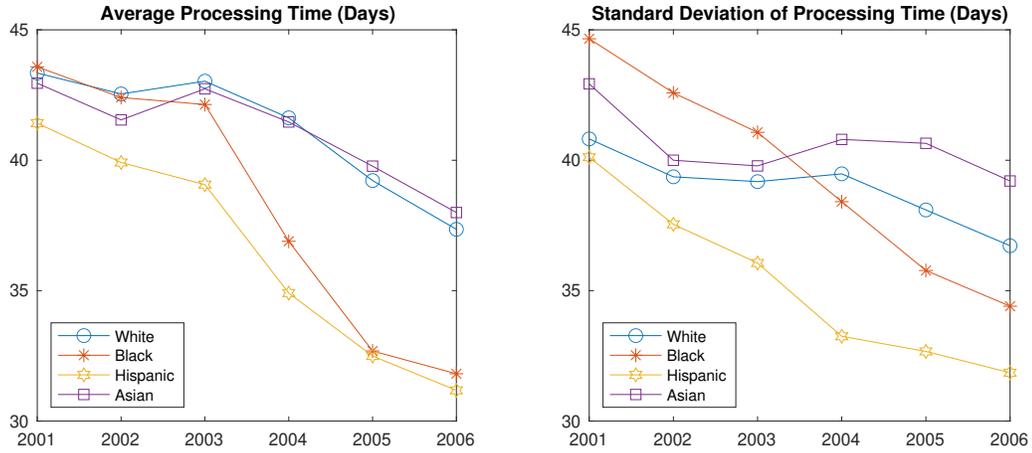
A. Home Purchase Mortgage
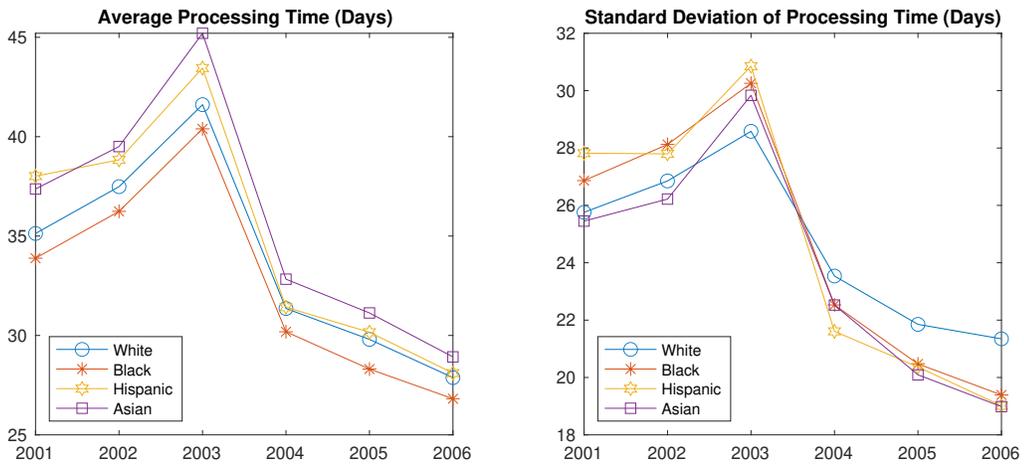
B. Refinance Mortgage

NOTE: This figure presents the time series of processing time for mortgage loan applications that were approved and originated between 2001 and 2006. Panel A and Panel B plot the average processing time (left panels) and the standard deviation (right panels) for home purchase loans and refinancing loans, respectively.

FIGURE 2: Processing Time for Denied Mortgage Applications
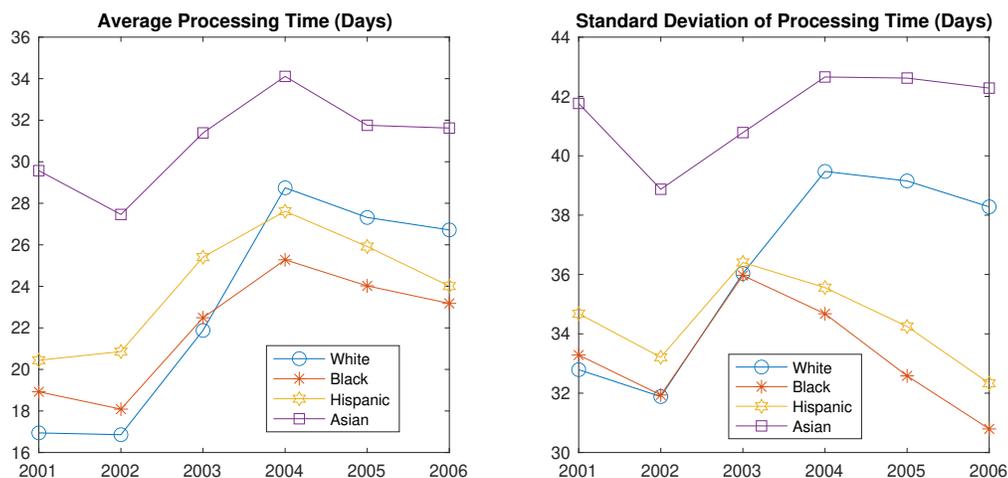
A. Home Purchase Mortgage
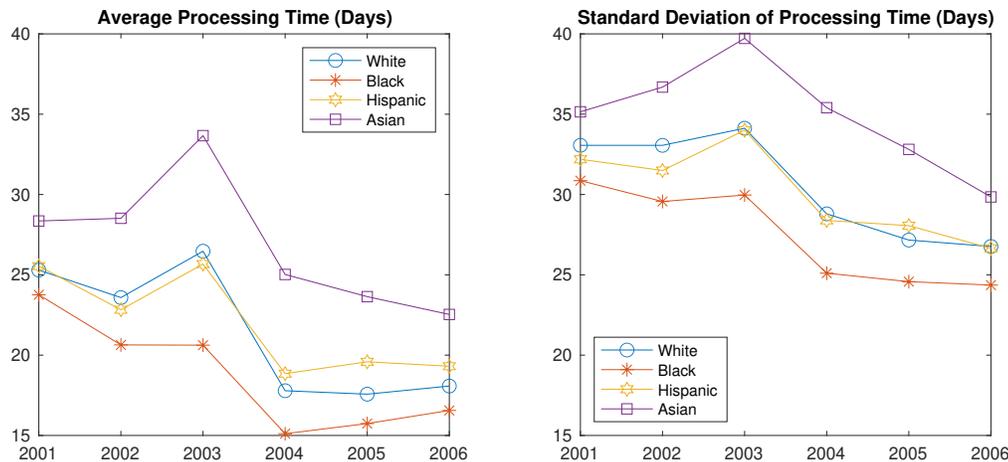
B. Refinance Mortgage

NOTE: This figure presents the time series of processing time for mortgage loan applications that were denied between 2001 and 2006. Panel A and Panel B plot the average processing time (left panels) and the standard deviation (right panels) for home purchase loans and refinancing loans, respectively.
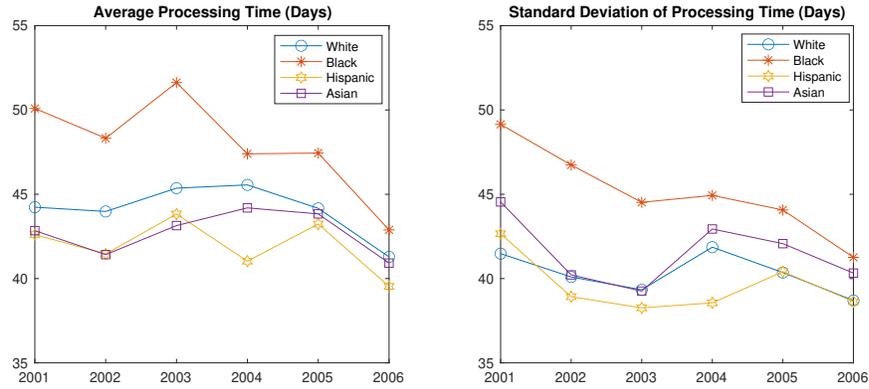
A. GSE
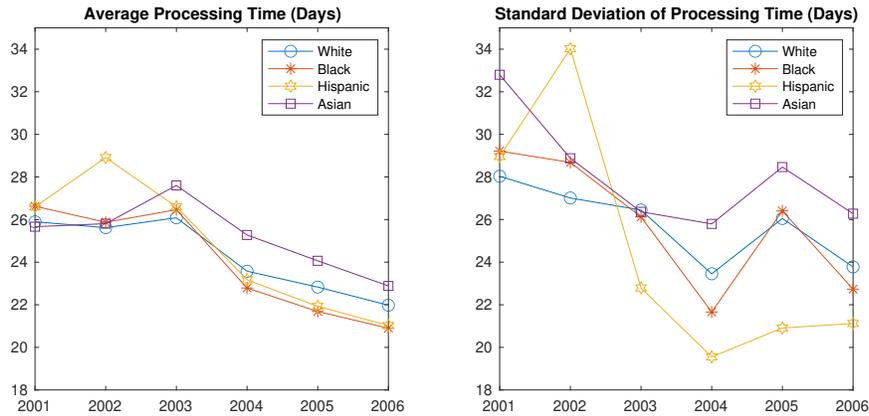
B. PLS
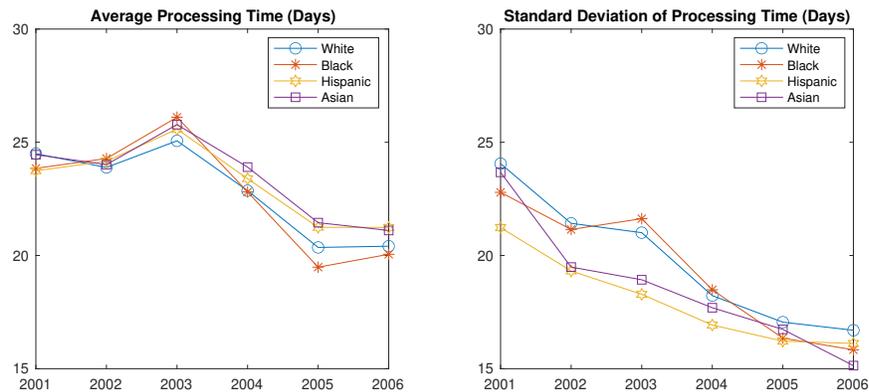
C. Subprime Lenders

NOTE: This figure presents the time series of processing time for home purchase mortgage loans that were approved and originated between 2001 and 2006. Panels A, B, and C plot the average processing time (left panels) and the standard deviation (right panels) for home purchase loans purchased by GSE, PLS, and originated by subprime lenders, respectively.

FIGURE 4: Processing Time for Originated Mortgage from Bank, Affiliate and Other Segments
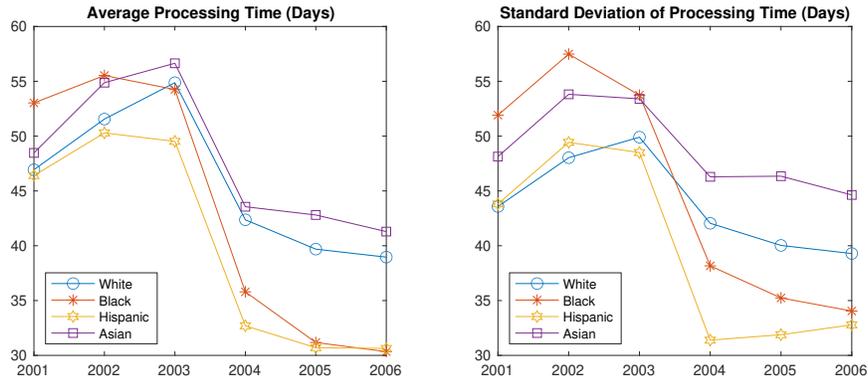
A. Banks
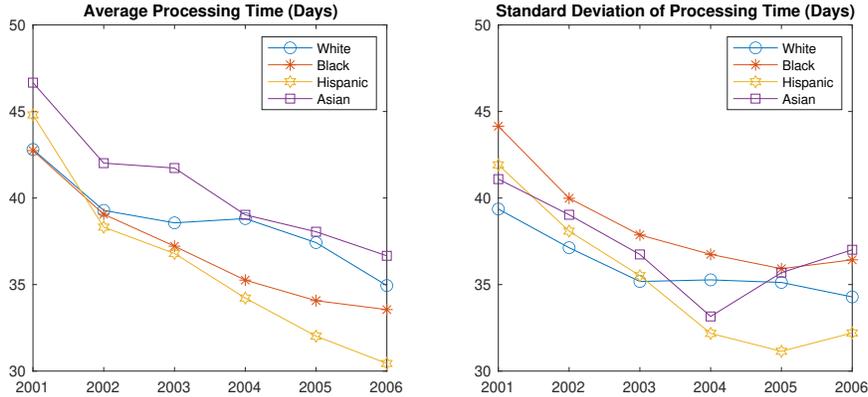
B. Affiliate
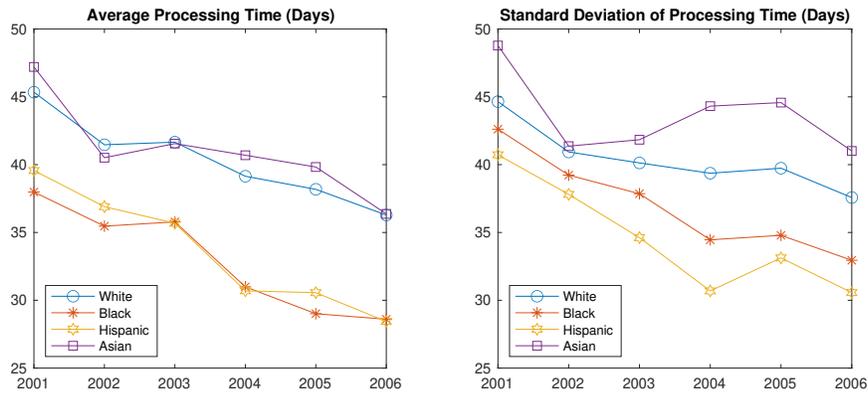
C. Others

NOTE: This figure presents the time series of processing time for home purchase mortgage loans that were approved and originated between 2001 and 2006. Panels A, B, and C plot the average processing time (left panels) and the standard deviation (right panels) for home purchase loans purchased by banks, affiliates, and other types of purchasers, respectively.

49

TABLE 1: Key Variables

Variable List	Definition
Panel A: Variables from the confidential HMDA data	
Action Date	Date that action was taken on application
Applicant Race	Indicator variable for the race and ethnicity of the loan applicant
Applicant Sex	Indicator variable to classify male or female
Applicant Income	Total gross annual income of applicant in thousands of dollars (nominal)
Application Date	Date of loan application
Loan Amount	Loan amount granted or requested in thousands of dollars
Coapplicant	Indicator variable that equals one if there is a coapplicant in the application
Preapproval	Indicator variable that equals one if the preapproval is requested in the application
High Cost	Indicator variable that equals one if the mortgage rate is higher than the prevailing benchmark rate
Rate Spread	The difference between the mortgage rate and the prevailing benchmark rate; only available for high cost mortgages
Jumbo	Indicator variable that equals one if the mortgage is a jumbo loan
Purchaser type	The types of institutions purchasing loans from the originators, including Government-Sponsored Enterprises("GSE"), private-label securitization("PLSP"), commercial banks and savings associations ("Bank"), lender-affiliated institutions ("Affiliate"), insurance companies and mortgage banks and finance companies ("MC"), an unspecified other type ("Other"). The mortgage loans that are not sold to a purchaser within the calendar year of origination are also identified ("Unsold").
Panel B: Variables from the CoreLogic LoanPerformance data	
Default	Indicator variable for whether the loan is in default within fifteen months of origination: (a) payments on the loan are 60+ days late; (b) the loan is in foreclosure; or (c) the loan is real estate owned (REO)
Document Type	Loan documentation level (low or full)
DTI	Back-end debt-to-income ratio
FICO	FICO score at origination
Initial Rate	Initial or original interest rate as of the loan's first payment date
LTV	Combined loan-to-value (CLTV) ratio (including first and second liens)
Prepayment Penalty	Indicator variable for whether the loan has a prepayment penalty
Loan product type	Fixed rate mortgage (FRM), adjustable rate mortgage (ARM), interest only (IO), balloon, and hybrid mortgages
Margin	Margin for an adjustable-rate or hybrid mortgage over an index
MBS Issuance Date	Date that the MBS is issued, used to calculate the time span from loan origination to securitization (OTS)
Panel C: Local macro variables	
Wage	The average wage in the borrower's county in the year of loan origination
HPA	The 36-month change in the housing price index for the borrower's county prior to loan origination
Loan Number	The number of loans originated in the borrower's county in the origination year
Unemployment	The unemployment rate in the borrower's state in the year of loan origination

NOTE: This table reports the list of key variables used in our empirical analysis.

TABLE 2: Summary Statistics

	Accepted					Rejected				
	All	White	Black	Hispanic	Asian	All	White	Black	Hispanic	Asian
Panel A: Origination										
Mean	40.2	41.2	37.0	35.5	41.0	23.6	22.9	22.3	24.5	31.5
SD	38.7	39.0	38.9	34.7	40.5	36.0	36.6	33.1	34.3	41.9
P25	17	18	14	15	17	1	1	1	1	3
Median	29	30	25	25	28	8	7	8	11	15
P75	49	50	44	42	47	31	29	31	34	42
Obs.(M)	22.5	17.1	1.6	2.6	1.3	4.1	2.4	0.7	0.8	0.2
% of Borr.		75.9%	6.9%	11.4%	5.8%		59.4%	16.7%	18.6%	5.4%
Panel B: Refinancing										
Mean	35.7	35.9	32.7	35.2	38.1	20.9	21.2	17.8	21.4	27.1
SD	26.2	26.3	25.4	25.7	26.3	30.2	30.7	26.9	29.9	35.5
P25	19	19	17	19	21	1	1	1	1	2
Median	29	29	26	28	31	8	8	6	9	14
P75	45	45	41	43	48	29	29	25	30	38
Obs.(M)	36.9	29.8	2.3	3.1	1.7	11.2	7.5	1.8	1.5	0.4
% of Borr.		80.8%	6.3%	8.3%	4.5%		67.0%	16.1%	13.3%	3.5%

NOTE: This table reports summary statistics for all borrowers, white, Black, Hispanic, and Asian borrowers, respectively, based on the confidential HMDA data.

TABLE 3: Summary Statistics Across Loan Purchaser Types

Panel A. Total number of originated home purchase loans (in Thousands)								
	All	GSE	PLSP	Bank	Affiliated	MC	Unsold	Other
2001-2003	10,556	3,240		301	664		4,140	2,179
2004-2006	11,969	2,877	535	604	984	937	3,799	2,233

Panel B. Percentage of originated home purchase loans in each borrower group								
	All	GSE	PLSP	Bank	Affiliated	MC	Unsold	Other
				2001-2003				
White	79.6%	82.9%		81.9%	77.2%		79.7%	74.8%
Black	5.6%	4.0%		4.7%	6.9%		5.8%	7.6%
Hispanic	9.3%	7.4%		7.3%	9.5%		9.5%	11.8%
Asian	5.5%	5.7%		6.0%	6.4%		5.0%	5.7%
				2004-2006				
White	72.7%	81.2%	53.4%	71.8%	72.4%	67.3%	74.4%	65.8%
Black	8.0%	4.6%	15.2%	7.4%	7.5%	10.2%	7.7%	11.0%
Hispanic	13.3%	8.1%	24.5%	13.9%	12.6%	16.5%	12.5%	17.2%
Asian	6.1%	6.1%	7.0%	6.9%	7.5%	6.1%	5.4%	6.0%

Panel C. Average processing time (Days)								
	All	GSE	PLSP	Bank	Affiliated	MC	Unsold	Other
				2001-2003				
White	43.0	44.6		48.5	40.2		41.5	42.6
Black	42.6	50.1		48.8	39.5		42.7	36.2
Hispanic	39.9	42.7		44.3	39.7		39.6	36.8
Asian	42.4	42.5		48.5	43.3		40.9	42.5
				2004-2006				
White	39.5	43.8	28.3	41.7	37.0	39.3	38.1	38.0
Black	33.6	45.9	22.0	33.8	34.2	31.2	35.3	29.5
Hispanic	32.8	41.3	23.8	32.3	31.8	30.6	34.4	29.9
Asian	39.8	43.1	28.4	41.1	37.9	43.7	38.9	39.2

Panel D. Stardard Deviation of Processing Time (Days)								
	All	GSE	PLSP	Bank	Affiliated	MC	Unsold	Other
				2001-2003				
White	39.7	40.3		44.4	37.3		37.7	41.7
Black	42.5	46.5		49.4	40.6		40.7	39.5
Hispanic	37.5	39.7		42.5	38.5		35.3	36.9
Asian	40.7	41.1		47.4	38.9		37.3	43.4
				2004-2006				
White	38.2	40.5	27.9	39.6	34.9	40.9	36.2	39.0
Black	36.2	43.5	20.9	36.2	36.3	35.3	36.0	34.1
Hispanic	32.6	39.2	20.1	31.9	31.8	32.2	32.0	31.6
Asian	40.3	41.9	28.3	41.9	35.4	48.5	36.7	43.6

NOTE: This table reports summary statistics for white, Black, Hispanic, and Asian borrowers based on the confidential HMDA data.

TABLE 4: Summary Statistics for the Merged HMDA-CoreLogic Sample

Panel A: All loans

	Mean PT	S.D. PT	% of Borr.	FICO	CLTV	LowDoc	Delinq.
White	23.5	25.2	52.0%	630	91.8	33.3%	10.0%
Black	22.6	24.7	20.6%	618	93.4	31.3%	19.4%
Hispanic	22.8	21.9	23.4%	648	93.5	56.5%	10.3%
Asian	24.7	27.3	4.0%	654	91.7	57.2%	9.5%

Panel B: By initial loan purchaser types

	GSE	PLSP	Bank	Affil.	MC	Other	Unsold
				Mean Processing Time			
White	46.7	20.0	24.5	22.7	23.2	22.9	25.8
Black	51.0	18.9	23.5	22.2	23.3	22.6	24.2
Hispanic	43.1	19.3	23.3	22.5	24.0	22.8	23.9
Asian	47.0	19.5	24.6	24.9	25.2	24.5	25.6
			Standard Deviation of Processing Time				
White	56.1	17.4	23.7	23.1	24.6	24.2	28.7
Black	64.8	20.8	22.4	22.9	24.7	24.9	25.8
Hispanic	54.1	14.7	20.7	19.5	25.6	22.0	23.2
Asian	59.4	16.2	22.4	27.7	26.0	26.8	29.5
				% of Borrowers			
White	63.3%	42.8%	52.4%	52.9%	58.7%	53.3%	50.4%
Black	11.1%	26.1%	18.3%	19.0%	18.8%	20.9%	20.1%
Hispanic	18.7%	27.3%	24.6%	24.3%	18.7%	22.0%	25.4%
Asian	6.9%	3.8%	4.8%	3.9%	3.8%	3.8%	4.2%

Panel C: By loan product types

	FRM	IO	Balloon	Hybrid	Low Doc	Full Doc	Fast OTS	Slow OTS
				Mean Processing Time				
White	27.4	22.9	20.8	22.7	23.3	23.7	22.5	24.9
Black	27.6	21.9	19.7	21.8	22.4	22.7	21.8	24.1
Hispanic	28.4	21.8	20.7	22.0	22.8	22.8	22.1	24.1
Asian	30.4	24.2	22.7	23.8	24.2	25.4	23.2	26.4
				Standard Deviation of Processing Time				
White	31.2	27.1	21.3	23.6	25.4	25.1	22.1	28.6
Black	31.6	27.9	18.5	23.2	24.0	25.1	20.7	29.5
Hispanic	33.1	20.3	19.4	19.7	21.6	22.1	19.4	25.3
Asian	35.3	26.9	24.8	25.6	26.7	28.2	22.7	31.4
				% of Borrowers				
White	57.5%	46.2%	40.0%	51.1%	44.1%	57.1%	51.5%	53.7%
Black	18.9%	17.0%	23.8%	20.9%	16.5%	23.3%	20.6%	20.6%
Hispanic	20.2%	31.2%	31.8%	23.9%	33.6%	16.7%	24.2%	21.8%
Asian	3.4%	5.7%	4.4%	4.1%	5.8%	2.8%	3.7%	3.9%

NOTE: This table reports summary statistics for white, Black, Hispanic, and Asian borrowers based on the merged HMDA-CoreLogic data.

Table 5: Baseline Regression Results: Home Purchase Loans

	2001-2006		2001-2003		2004-2006	
	(a)	(b)	(a)	(b)	(a)	(b)
Black	1.804***	3.412***	2.561***	4.996***	1.235***	2.416***
	(.5176)	(.3739)	(.7646)	(.4635)	(.417)	(.3202)
Hispanic	−1.239***	.6613**	−.5449	1.502***	−1.717***	.118
	(.3975)	(.2622)	(.5168)	(.3329)	(.3933)	(.2757)
Asian	.317	−.0744	−.2866	−.4846	.7219	.1984
	(.5658)	(.2639)	(.5829)	(.3024)	(.6217)	(.3061)
PLS	−6.842***	−1.402**			−8.064***	−2.528***
	(2.338)	(.6353)			(2.955)	(.7412)
Bank	.5074	−1.161	3.512*	1.683**	−1.576	−2.902**
	(1.522)	(.9814)	(2.053)	(.6503)	(1.858)	(1.09)
Affiliated	−4.638**	−.8226	−3.669	−.1968	−5.629*	−.5617
	(2.276)	(.9292)	(2.514)	(.6247)	(2.949)	(1.512)
MC	1.237	−.8014	43.7***	2.186	−1.268	−1.992**
	(3.748)	(.6857)	(12.92)	(2.863)	(3.477)	(.8439)
Unsold	−3.495*	−1.089*	−2.059	−.7259	−4.894*	−1.02
	(1.759)	(.6133)	(1.463)	(.5028)	(2.448)	(.8407)
Other	−1.914	−.9255	−.7835	.6568	−3.05	−2.216**
	(1.927)	(.628)	(1.825)	(.4018)	(2.778)	(.9314)
High cost	−10.31***	−3.967***			−10.1***	−4.125***
	(1.52)	(.9432)			(1.434)	(.9228)
Rate spread	−.8159***	.0356			−.7871**	.0084
	(.2902)	(.1744)			(.2909)	(.1572)
log(loan amount)	3.678***	3.282***	4.266***	3.446***	2.776***	2.828***
	(.3584)	(.2719)	(.3983)	(.3129)	(.465)	(.3805)
Jumbo	−.9391	−1.201***	−2.457***	−2.533***	.4854	−.5225**
	(.6815)	(.3172)	(.7721)	(.4065)	(.5183)	(.2507)
log(income)	−.9233***	−1.104***	−1.144***	−1.19***	−.7993***	−.8624***
	(.3052)	(.1075)	(.2435)	(.1562)	(.2002)	(.0982)
Coapplicant	5.889***	4.139***	5.727***	4.132***	5.94***	3.851***
	(.4099)	(.2524)	(.4616)	(.3242)	(.4601)	(.3135)
Preapproval	15.01***	10.69***			15.01***	12.45***
	(2.037)	(1.929)			(2.028)	(2.054)
Female	.0199	−.0825	−.1241	−.1295	.0524	−.0691
	(.2361)	(.0623)	(.2108)	(.0796)	(.2618)	(.0854)
R^2	0.084	0.201	0.072	0.188	0.094	0.218
Obs.	22383172	22382874	10483349	10483101	11899823	11899464

NOTE: This table reports loan-level regression results for all mortgage loans in the confidential HMDA data that are originated between 2001 and 2006 for the purchase of owner-occupied single-family homes, condos, and co-ops. The county by origination month fixed effects are included in model specification (a) and (b), and the lender fixed effects are added in model specification (b). See Table 1 for detailed information on the key variables. Standard errors are clustered by lender and month, and the t-statistics are reported in parentheses. Significance level: *($p < .10$); **($p < .05$); and ***($p < .01$).

TABLE 6: Baseline Regression Results: Refinance Loans

	2001-2006		2001-2003		2004-2006	
	(a)	(b)	(a)	(b)	(a)	(b)
Black	.2431	1.369***	−.1577	1.807***	.5933***	1.096***
	(.3232)	(.1875)	(.5588)	(.2668)	(.1849)	(.1108)
Hispanic	1.06**	1.617***	1.308*	2.159***	.8087***	1.176***
	(.4657)	(.3035)	(.7033)	(.3987)	(.2735)	(.1747)
Asian	.2856	.0644	.2586	−.0884	.3667	.2789
	(.4086)	(.2888)	(.5676)	(.3922)	(.2488)	(.2044)
PLS	−5.136***	−2.122**			−4.68***	−1.434***
	(1.644)	(1.004)			(1.565)	(.3122)
Bank	−2.136	−.8187	−2.829	.263	−1.177	−1.241**
	(1.298)	(.6536)	(1.809)	(.6463)	(.8493)	(.485)
Affiliated	−3.711*	−1.049	−4.823*	−1.43	−2.255	.5236
	(1.896)	(1.034)	(2.636)	(1.083)	(1.622)	(1.218)
MC	−4.036***	−.5412	−2.007	1.706	−3.73***	−1.557***
	(1.392)	(.7068)	(3.927)	(3.464)	(1.193)	(.4545)
Unsold	−2.511**	−2.849***	−2.341	−2.919**	−2.693***	−2.413***
	(1.229)	(.9685)	(1.562)	(1.436)	(.8458)	(.5136)
Other	−4.87***	−1.186*	−5.102***	−.5198	−4.309***	−1.608***
	(1.352)	(.6008)	(1.655)	(.6423)	(1.088)	(.5205)
High cost	−5.643***	−1.078			−5.703***	−1.914***
	(1.01)	(.6737)			(.976)	(.4283)
Rate spread	.2368	.6196***			.1929	.4521***
	(.1813)	(.1188)			(.1809)	(.1073)
log(loan amount)	2.18***	2.087***	2.398***	2.081***	1.562***	1.649***
	(.3819)	(.2596)	(.4631)	(.2855)	(.2962)	(.248)
Jumbo	1.303***	.5921*	2.054***	.616	.9837**	.597**
	(.4176)	(.3108)	(.6728)	(.5381)	(.3839)	(.2404)
log(income)	.132	−.2001**	.1246	−.2433**	.2063	−.0253
	(.168)	(.0948)	(.2227)	(.1167)	(.1342)	(.099)
Coapplicant	.3934**	−.1589	.6913***	−.1185	−.0618	−.3626***
	(.1766)	(.133)	(.2479)	(.1764)	(.1687)	(.1013)
Female	.07	.013	.2269	.0442	−.1052	−.0376
	(.1489)	(.0856)	(.2337)	(.1358)	(.0714)	(.0379)
R^2	0.109	0.214	0.090	0.217	0.063	0.162
Obs.	36730820	36730551	23245303	23245103	13485517	13485197

NOTE: This table reports loan-level regression results for all refinance mortgage loans in the confidential HMDA data that are originated between 2001 and 2006 for owner-occupied single-family homes, condos, and co-ops. The county by origination month fixed effects are included in model specification (a) and (b), and the lender fixed effects are added in model specification (b). See Table 1 for detailed information on the key variables. Standard errors are clustered by lender and month, and the t-statistics are reported in parentheses. Significance level: $^*(p < .10)$; $^{**}(p < .05)$; and $^{***}(p < .01)$.

TABLE 7: Baseline Regression Results: Denied Loan Applications

Panel A: Denied applications for purchase loans

	2001-2006		2001-2003		2004-2006	
	(a)	(b)	(a)	(b)	(a)	(b)
Black	−1.311	−.9365**	1.53**	.0638	−3.646**	−1.862***
	(1.022)	(.3631)	(.7202)	(.206)	(1.473)	(.5336)
Hispanic	−1.796**	−1.782***	.5455	−.3972*	−3.397***	−2.711***
	(.8116)	(.4217)	(.3759)	(.1965)	(1.236)	(.6264)
Asian	2.019***	.9618**	1.999**	.2873	1.749**	1.084*
	(.6276)	(.4016)	(.7692)	(.3149)	(.7743)	(.5397)
R^2	0.106	0.275	0.139	0.317	0.073	0.260
OBs.	3966553	3965745	1810828	1810085	2155725	2154871

Panel B: Denied applications for refinance loans

	2001-2006		2001-2003		2004-2006	
	(a)	(b)	(a)	(b)	(a)	(b)
Black	−2.296***	−1.542***	−2.989***	−2.142***	−1.969***	−1.281***
	(.4969)	(.2592)	(.6675)	(.3708)	(.5827)	(.2973)
Hispanic	−.9166*	−1.301***	−1.709***	−1.151***	−.3808	−1.216***
	(.4903)	(.3595)	(.5207)	(.4079)	(.6654)	(.4435)
Asian	1.44***	.7069***	.7726	.69*	2.017**	.7723**
	(.5184)	(.2653)	(.6832)	(.3532)	(.7795)	(.3725)
R^2	0.073	0.231	0.076	0.233	0.047	0.266
Obs.	11042393	11041586	4634902	4634252	6407491	6406591

NOTE: This table reports loan-level regression results for all denied loan applications in the confidential HMDA data that are originated between 2001 and 2006 for refinance or purchase of owner-occupied single-family homes, condos, and co-ops. The county by origination month fixed effects are included in model specification (a) and (b), and the lender fixed effects are added in model specification (b). See Table 1 for detailed information on the key variables. Standard errors are clustered by lender and month, and the t-statistics are reported in parentheses. Significance level: $^*(p < .10)$; $^{**}(p < .05)$; and $^{***}(p < .01)$.

TABLE 8: Processing Time across Mortgage Purchaser Types

Top panel

	GSE				PLSP				Banks	
	2001-2003		2004-2006		2004-2006		2001-2003		2004-2006	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Black	8.261***	7.16***	5.147***	5.25***	-.9032**	.5351*	3.938**	6.254***	.6844	1.768***
	(.8225)	(.583)	(.645)	(.6077)	(.3421)	(.2681)	(1.684)	(.8405)	(.5434)	(.3952)
Hispanic	.786	1.089**	-1.706**	.0057	-1.522***	-.6595*	-.4434	2.158***	-2.163***	-.4072
	(.596)	(.4399)	(.7641)	(.4124)	(.246)	(.3419)	(.9408)	(.3959)	(.5051)	(.3421)
Asian	-1.478*	-1.279***	-1.293	-1.017	-.1341	.441	1.279	-.2439	.5549	.4167
	(.799)	(.4224)	(1.176)	(.6622)	(.3223)	(.2859)	(1.294)	(.5227)	(.7832)	(.2969)
R^2	0.083	0.184	0.090	0.175	0.155	0.206	0.187	0.330	0.177	0.291
Obs.	3218407	3218128	2851258	2850844	518609	518494	288642	288425	584348	584090

Bottom panel

	Affiliate institutions				MC				Others	
	2001-2003		2004-2006		2004-2006		2001-2003		2004-2006	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Black	1.587	4.94***	2.014**	2.831***	.9141	1.702***	-2.382***	3.844***	.3508	1.836***
	(1.524)	(1.123)	(.8068)	(.6344)	(.7366)	(.3877)	(.859)	(.4212)	(.6418)	(.326)
Hispanic	.862	2.815***	-1.191***	-.1853	-2.756***	-.2217	-2.708***	1.693***	-1.515**	-.2975
	(.9519)	(.7698)	(.4039)	(.4935)	(.8756)	(.2861)	(.6895)	(.3302)	(.7163)	(.2146)
Asian	-.912	-.8822	-.4225	-.183	4.22**	.8243**	1.146	.7161**	2.888**	1.467***
	(1.077)	(.7383)	(.5792)	(.5326)	(1.934)	(.3761)	(.8797)	(.3405)	(1.171)	(.3865)
R^2	0.194	0.306	0.180	0.269	0.162	0.375	0.096	0.297	0.142	0.354
Obs.	644256	644107	963955	963778	916608	916417	2156148	2155901	2210716	2210434

NOTE: This table reports loan-level regression results for home purchase loans by the purchaser type in the confidential HMDA data that are originated between 2001 and 2006 for the purchase of owner-occupied single-family homes, condos, and co-ops. The county by origination month fixed effects are included in model specification (a) and (b), and the lender fixed effects are added in model specification (b). See Table 1 for detailed information on the key variables. Standard errors are clustered by lender and month, and the t-statistics are reported in parentheses. Significance level: *$(p < .10)$; **$(p < .05)$; and ***$(p < .01)$.

TABLE 9: Processing Time for High-Risk Mortgages

| | Subprime lenders | | | | High-cost loans | |
| | 2001-2003 | | 2004-2006 | | 2004-2006 | |
	(a)	(b)	(a)	(b)	(a)	(b)
Black	.8423**	1.283***	.2598	.5046***	−.211	.915***
	(.3201)	(.2177)	(.1882)	(.158)	(.1999)	(.1314)
Hispanic	.1186	.3201*	.1714	−.1654*	−.57	−.0982
	(.23)	(.1766)	(.5294)	(.0886)	(.4014)	(.1786)
Asian	−.0896	.0647	.2383	.3743***	.3184	.5539***
	(.2721)	(.1805)	(.1759)	(.1209)	(.2169)	(.1539)
PLSP			−6.505**	−4.574*	−9.813***	−2.352***
			(3.125)	(2.348)	(2.764)	(.8038)
Bank	−.3004	1.754***	−4.905*	−6.138***	−6.399***	−2.206**
	(2.469)	(.4468)	(2.642)	(2.016)	(2)	(.8147)
MC	41.3*	45.9***	−4.611*	−5.822***	−7.889***	−2.046**
	(20.84)	(11.07)	(2.711)	(2.102)	(1.923)	(.8413)
Affiliate	−2.508	2.017**	−3.77	−4.77**	−8.315***	−.5015
	(2.93)	(.8905)	(2.936)	(2.263)	(2.235)	(1.077)
Unsold	−1.008	2.613***	−4.874*	−5.195**	−4.514**	−.4099
	(2.708)	(.5054)	(2.858)	(2.39)	(2.173)	(.9874)
Other	.4298	2.209***	−4.291	−4.535*	−8.449***	−1.965*
	(2.622)	(.5084)	(2.811)	(2.493)	(1.963)	(.9709)
High cost			−1.468	.3467		
			(.9595)	(.3986)		
Rate spread			−.2164	−.1862*	−1.017***	−.2912***
			(.1984)	(.1043)	(.202)	(.0959)
log(loan amount)	.5876*	.5198**	−1.167***	−.7026***	−1.079***	−.0271
	(.3398)	(.219)	(.4021)	(.1931)	(.3244)	(.176)
Jumbo	1.279***	.7062**	1.201***	.8995***	1.452***	.9903***
	(.4694)	(.326)	(.2275)	(.1159)	(.2943)	(.2117)
log(income)	−.9158***	−.8428***	−.1846	−.2991***	−.0309	−.4757***
	(.2446)	(.1693)	(.18)	(.0814)	(.162)	(.104)
Coapplicant	2.851***	1.09***	1.113***	1.156***	2.422***	1.674***
	(.7192)	(.2828)	(.1921)	(.1058)	(.2763)	(.1584)
Preapproval			6.105**	4.721*	10.89***	6.483***
			(2.756)	(2.708)	(3.292)	(1.449)
Female	−.1913	−.4198***	−.0684	−.2651***	−.302*	−.2987***
	(.1693)	(.0943)	(.2159)	(.0367)	(.1663)	(.052)
R^2	0.142	0.236	0.109	0.220	0.104	0.259
Obs.	523843	523841	1353646	1353640	2116258	2115477

NOTE: This table reports loan-level regression results for home purchase loans by the purchaser type in the confidential HMDA data that are originated between 2001 and 2006 for the purchase of owner-occupied single-family homes, condos, and co-ops. The county by origination month fixed effects are included in model specification (a) and (b), and the lender fixed effects are added in model specification (b). See Table 1 for detailed information on the key variables. Standard errors are clustered by lender and month, and the t-statistics are reported in parentheses. Significance level: $^{*}(p < .10)$; $^{**}(p < .05)$; and $^{***}(p < .01)$.

TABLE 10: Processing Time and Mortgage Application Volume

	Purchase Loan Sample		Refinance Sample	
	(1)	(2)	(1)	(2)
Black	3.428***	3.511***	1.333***	1.341***
	(.3634)	(.3616)	(.1769)	(.1746)
Hispanic	.6319**	.6455**	1.464***	1.489***
	(.2578)	(.2595)	(.2744)	(.276)
Asian	−.1277	−.1236	−.1096	−.1319
	(.271)	(.2725)	(.2947)	(.2972)
Application	.8314***		2.691***	
	(.1301)		(.5549)	
Application*Black	.4994**		.1013	
	(.2216)		(.2488)	
Application*Hispanic	.1197		.3745	
	(.1304)		(.4345)	
Application*Asian	−.0966		.0276	
	(.1403)		(.2477)	
Refi. Vol.		.8147***		2.498***
		(.124)		(.5209)
Refi. Vol.*Black		.731***		.1731
		(.2061)		(.2318)
Refi. Vol.*Hispanic		.1433		.4529
		(.1338)		(.4276)
Refi. Vol.*Asian		−.0699		.0995
		(.1368)		(.2701)
Other controls	Y	Y	Y	Y
F.E. (Lender, Cnty, Month)	Y	Y	Y	Y
R^2	0.190	0.190	0.188	0.187
Obs.	22386745	22386745	36732318	36732318

NOTE: This table reports loan-level regression results for home purchase loans by the purchaser type in the confidential HMDA data that are originated between 2001 and 2006 for the purchase of owner-occupied single-family homes, condos, and co-ops. See Table 1 for detailed information on the key variables. We add calendar month dummies to account for seasonality. We also include fixed effects for lenders and counties. Standard errors are clustered by lender and month of origination, and the t-statistics are reported in parentheses. Significance level: $^{*}(p < .10)$; $^{**}(p < .05)$; and $^{***}(p < .01)$.

TABLE 11: Regression Results Based on the Merged HMDA-CoreLogic Data

	All			Subprime lenders		
	2001-2006	2001-2003	2004-2006	2001-2006	2001-2003	2004-2006
	Processing Time					
Black	0.657***	1.332***	0.490***	0.451***	0.825***	0.349***
	(0.075)	(0.155)	(0.081)	(0.074)	(0.160)	(0.080)
Hispanic	0.002	0.791***	−0.169	0.279***	0.828***	0.134
	(0.097)	(0.197)	(0.108)	(0.100)	(0.210)	(0.111)
Asian	0.614***	0.473*	0.644***	0.541***	0.721**	0.531***
	(0.128)	(0.268)	(0.144)	(0.116)	(0.289)	(0.125)
FICO	−0.015***	−0.020***	−0.014***	−0.018***	−0.024***	−0.015***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Lowdoc	−0.845***	−1.140***	−0.723***	−0.478***	−0.544***	−0.367***
	(0.066)	(0.133)	(0.073)	(0.061)	(0.127)	(0.068)
LTV	−0.050***	−0.041***	−0.051***	−0.034***	−0.014**	−0.037***
	(0.003)	(0.007)	(0.003)	(0.002)	(0.006)	(0.003)
DTI	0.001	0.016**	−0.006*	0.000	0.009	−0.009***
	(0.003)	(0.007)	(0.003)	(0.003)	(0.007)	(0.003)
R^2	0.188	0.195	0.193	0.111	0.124	0.113
	Delinquency					
Black	0.060***	0.044***	0.063***	0.062***	0.047***	0.065***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Hispanic	−0.010***	−0.009***	−0.010***	−0.009***	−0.007***	−0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Asian	−0.004**	−0.006***	−0.004*	−0.003	−0.003	−0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
FICO	−0.001***	−0.000***	−0.001***	−0.001***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lowdoc	0.023***	0.011***	0.023***	0.023***	0.012***	0.024***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
LTV	0.001***	0.000***	0.002***	0.002***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DTI	0.000***	0.000***	0.000***	0.000***	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.084	0.069	0.088	0.087	0.076	0.092
Fixed effects	Y	Y	Y	Y	Y	Y
Other controls	Y	Y	Y	Y	Y	Y
Obs.	1345535	266822	1078245	809688	163264	646224

NOTE: This table reports loan-level regression results based on the merged HMDA-CoreLogic data. The dependent variable is processing time (top panel) and delinquency (bottom panel). We include borrower and loan characteristics, local economic conditions, and lender, origination year, and county fixed effects in the regression. Standard errors are clustered by lender and loan cohort, and the t-statistics are reported in parentheses. Significance level: *($p < .10$); **($p < .05$); and ***($p < .01$). See Table 1 for detailed information on the key variables.

TABLE 12: Regression Results Based on the Merged HMDA-CoreLogic Data across Loan Types

	Loan type				Originate-to-sell	
	FRM	Hybrid	IO	Balloon	Fast	Slow
	Processing time					
Black	1.351***	0.579***	0.584***	0.342*	0.335***	1.023***
	(0.207)	(0.077)	(0.160)	(0.176)	(0.108)	(0.121)
Hispanic	0.050	−0.073	−0.393***	0.050	−0.021	0.107
	(0.218)	(0.096)	(0.152)	(0.204)	(0.122)	(0.138)
Asian	0.863*	0.562***	0.795***	1.089***	0.059	1.069***
	(0.455)	(0.130)	(0.258)	(0.371)	(0.211)	(0.228)
R^2	0.238	0.181	0.207	0.216	0.205	0.207
	Delinquency					
Black	0.043***	0.061***	0.045***	0.072***	0.064***	0.051***
	(0.003)	(0.003)	(0.003)	(0.006)	(0.004)	(0.003)
Hispanic	−0.009***	−0.007***	0.002	0.012**	−0.016***	−0.006***
	(0.002)	(0.002)	(0.003)	(0.005)	(0.003)	(0.002)
Asian	−0.008**	−0.002	0.012***	0.014*	−0.008**	−0.004*
	(0.003)	(0.002)	(0.004)	(0.007)	(0.003)	(0.002)
R^2	0.096	0.082	0.096	0.103	0.102	0.092
Fixed effects	Y	Y	Y	Y	Y	Y
Other controls	Y	Y	Y	Y	Y	Y
Obs.	157303	1143935	200959	98271	296862	428159

NOTE: This table reports loan-level regression results based on the merged HMDA-CoreLogic data. The dependent variable is processing time (top panel) and delinquency (bottom panel). We include borrower and loan characteristics, local economic conditions, and lender, origination year, and county fixed effects in the regression. Standard errors are clustered by lender and loan cohort, and the t-statistics are reported in parentheses. Significance level: *($p < .10$); **($p < .05$); and ***($p < .01$). See Table 1 for detailed information on the key variables.

TABLE 13: Regression Results Based on the Merged HMDA-CoreLogic Data for Low- and Full-Doc Loans

	All	Loan type				Originate-to-sell	
		FRM	Hybrid	IO	Balloon	Fast	Slow
Panel A: Low-Documentation Loans							
				Processing time			
Black	0.563***	1.590***	0.468***	0.643**	0.243	−0.012	1.236***
	(0.114)	(0.408)	(0.118)	(0.279)	(0.248)	(0.172)	(0.183)
Hispanic	0.145	−0.115	0.189	0.155	0.274	0.121	0.338*
	(0.125)	(0.357)	(0.122)	(0.223)	(0.253)	(0.166)	(0.183)
Asian	0.674***	0.626	0.694***	1.442***	0.920**	0.453	1.165***
	(0.153)	(0.612)	(0.154)	(0.366)	(0.441)	(0.281)	(0.287)
R^2	0.205	0.287	0.198	0.221	0.226	0.223	0.226
				Delinquency			
Black	0.072***	0.052***	0.074***	0.052***	0.076***	0.078***	0.065***
	(0.004)	(0.005)	(0.005)	(0.006)	(0.009)	(0.006)	(0.004)
Hispanic	−0.016***	−0.013***	−0.016***	−0.010***	−0.002	−0.025***	−0.012***
	(0.002)	(0.003)	(0.002)	(0.004)	(0.006)	(0.003)	(0.002)
Asian	−0.009***	−0.009**	−0.009***	0.013**	−0.000	−0.015***	−0.008**
	(0.003)	(0.005)	(0.003)	(0.006)	(0.009)	(0.005)	(0.003)
R^2	0.109	0.124	0.109	0.121	0.119	0.132	0.121
Obs.	514664	47962	450280	79293	48412	113343	161369
Panel B: Full-Documentation Loans							
				Processing time			
Black	0.721***	1.266***	0.617***	0.552***	0.408*	0.509***	0.939***
	(0.080)	(0.241)	(0.084)	(0.211)	(0.241)	(0.132)	(0.148)
Hispanic	−0.174*	0.019	−0.214**	−0.614***	0.005	−0.164	−0.181
	(0.096)	(0.297)	(0.095)	(0.211)	(0.264)	(0.146)	(0.169)
Asian	0.655***	1.154*	0.561***	0.363	1.763**	−0.319	1.077***
	(0.185)	(0.667)	(0.193)	(0.337)	(0.767)	(0.329)	(0.367)
R^2	0.186	0.240	0.181	0.218	0.230	0.213	0.212
				Delinquency			
Black	0.052***	0.039***	0.055***	0.041***	0.065***	0.057***	0.043***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.006)	(0.003)	(0.002)
Hispanic	−0.001	−0.006**	0.000	0.011***	0.029***	−0.005	0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.007)	(0.003)	(0.003)
Asian	0.000	−0.003	0.001	0.008**	0.029***	−0.001	0.000
	(0.002)	(0.004)	(0.002)	(0.004)	(0.011)	(0.004)	(0.003)
R^2	0.076	0.101	0.075	0.093	0.104	0.098	0.086
Obs.	830024	108493	692873	121002	49199	182753	265924
Fixed effects	Y	Y	Y	Y	Y	Y	Y
Other controls	Y	Y	Y	Y	Y	Y	Y

NOTE: This table reports loan-level regression results based on the merged HMDA-CoreLogic data separately for low-doc and full-doc loans. The dependent variable is processing time (top section of each panel) and delinquency (bottom section of each panel). We include borrower and loan characteristics, local economic conditions, and lender, origination year, and county fixed effects in the regression. Standard errors are clustered by lender and loan cohort, and the t-statistics are reported in parentheses. Significance level: *($p < .10$); **($p < .05$); and ***($p < .01$). See Table 1 for detailed information on the key variables.

TABLE 14: Regression Results Based on the Merged HMDA-CoreLogic Data Across Purchaser Types

	GSE	PLSP	Bank	Affiliate	MC	Unsold	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Processing time			
Black	6.355***	−0.190	0.525**	0.812***	0.604***	0.881***	0.736***
	(2.011)	(0.143)	(0.222)	(0.244)	(0.157)	(0.160)	(0.096)
Hispanic	−1.568	−0.267*	0.032	0.012	−0.018	0.015	−0.202*
	(1.647)	(0.144)	(0.202)	(0.263)	(0.154)	(0.180)	(0.117)
Asian	1.636	0.012	0.985***	0.957**	0.933***	0.485*	0.409**
	(2.290)	(0.252)	(0.377)	(0.451)	(0.276)	(0.292)	(0.166)
R^2	0.221	0.145	0.192	0.209	0.188	0.179	0.214
				Delinquency			
Black	0.039***	0.082***	0.067***	0.051***	0.072***	0.058***	0.057***
	(0.013)	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)
Hispanic	−0.001	−0.008**	−0.006*	−0.002	−0.001	−0.007***	−0.005**
	(0.008)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Asian	0.013	−0.001	−0.003	−0.005	0.002	0.001	−0.006***
	(0.013)	(0.006)	(0.005)	(0.005)	(0.004)	(0.003)	(0.002)
R^2	0.139	0.093	0.093	0.108	0.098	0.092	0.077
Fixed effects	Y	Y	Y	Y	Y	Y	Y
Other controls	Y	Y	Y	Y	Y	Y	Y
Obs.	11978	148665	94064	87050	186041	224809	596596

NOTE: This table reports loan-level regression results based on the merged HMDA-CoreLogic data. The dependent variable is processing time (top panel) and delinquency (bottom panel). We include borrower and loan characteristics, local economic conditions, and lender, origination year, and county fixed effects in the regression. Standard errors are clustered by lender and loan cohort, and the t-statistics are reported in parentheses. Significance level: $^*(p < .10)$; $^{**}(p < .05)$; and $^{***}(p < .01)$. See Table 1 for detailed information on the key variables.