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# Inequality in the Time of COVID-19: Evidence from Mortgage Delinquency and Forbearance*

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**Abstract**

Using a novel database that combines mortgage servicing records, credit-bureau data, and loan application information, we show that lower-income and minority borrowers have significantly higher nonpayment rates during the COVID-19 pandemic, even after controlling for conventional risk factors. A difference-in-differences analysis shows how much the pandemic has exacerbated income and racial inequalities. We then find that government and private-sector forbearance programs have mitigated these inequalities in the near term, as lower-income and minority borrowers have taken up the short-term debt relief at higher rates. Finally, we examine modification options for an estimated 2.8 million loans in forbearance, most with terms expiring by mid-year 2021.

Keywords: mortgage forbearance, inequality, COVID-19, loan modifications

JEL Classifications: D12, D63, G21, G50

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# 1 Introduction

It is well documented that the COVID-19 pandemic as a health crisis has had a disparate impact on lower-income and minority groups (see, e.g., van Dorn et al. (2020); Chakrabarti and Nober (2020)). The extent to which the pandemic has exacerbated economic inequality is less obvious. On the one hand, the Federal Reserve Bank of Philadelphia's *COVID-19 Survey of Consumers* shows that minority and lower-income individuals reported higher rates of job and income disruptions during the pandemic.[1] On the other hand, various forms of government income support targeted at lower-income families offset some of these adverse impacts. Therefore, it is an empirical question as to what the economic impact of the pandemic is on lower-income and minority groups, net of government assistance. In this paper, we study this question through the lens of mortgage loan performance.

We examine economic inequality among mortgage borrowers for at least three reasons. First, the pandemic has had an especially severe impact on the U.S. mortgage market. According to Black Knight Data & Analytics, LLC (Black Knight),[2] nearly 3.6 million serious delinquencies occurred in 2020, the largest number since the height of the Great Recession in 2009. Second, even though mortgage delinquency rates increased dramatically, the Coronavirus Aid, Relief, and Economic Security (CARES) Act mandated forbearance assistance on an unprecedented scale. During the last 8 months of 2020, an estimated 7 million mortgage loans were placed into forbearance. Our analysis can be especially helpful in studying the offsetting effects of government assistance during the pandemic. Lastly, mortgages are tied to the largest portion of household wealth, with housing providing additional benefits tied to economic well-being.

To study these issues, we use a novel matched dataset that combines borrower-level data on race and ethnicity, household income, and non-mortgage credit attributes with administrative data on mortgage performance and forbearances. This allows us to examine mortgage payment and forbearance status by key borrower demographic and income characteristics. The dataset includes detailed payment records and forbearance statuses obtained from the largest mortgage service bureau in the U.S. This overcomes challenges with credit-bureau reporting, which, under the CARES Act,

[1] https://www.philadelphiafed.org/consumer-finance/consumer-credit/cfi-covid-19-survey-of-consumers-wave-5-updates. In 2020, the Consumer Finance Institute conducted 6 national surveys of consumers focused on changes in job status, income levels, and personal financial security.

[2] https://www.blackknightinc.com/black-knights-December-2020-mortgage-monitor.

freezes delinquency status at pre-pandemic levels for forbearances.[3]

The questions we address include the following: First, what is the extent of racial and income disparities among distressed mortgage borrowers, and how has the pandemic affected these disparities? Second, conditioning on nonpayment, who took up forbearance and who missed this temporary debt-relief opportunity? The CARES Act mandates no fees, penalties, or additional interest for forbearances on federally insured mortgages, policies which were almost wholly adopted by private-sector investors.[4] Given this, one would expect that borrowers in financial difficulty would have taken up forbearance. However, a significant number of delinquent mortgages were never in forbearance, so this was not the case. In that regard, did lower-income and minority borrowers fall further behind?

Third, for those who entered forbearance during the pandemic, what is the racial and income composition of those most likely to still be in nonpayment? Since the pandemic, around half of all mortgages that entered forbearance still remain, with the 12-month period allowed under the CARES Act set to expire for most by mid-year 2021. Accordingly, what are the most effective policy options mortgage servicers have for keeping borrowers in their homes, and how much will this targeted assistance cost the government and private investors?[5]

Our main findings are as follows. We find that between April and November 2020, minorities and lower-income borrowers have twice as high a nonpayment rate as Whites and higher-income borrowers. After controlling for conventional risk factors, Black borrowers have more than 30 percent higher rates of nonpayment, lower-income borrowers 50 percent higher. Using difference-in-differences (DID) estimation, we find that income and racial disparities in nonpayment, which were extremely small in 2016-2019, have been exacerbated during the pandemic. These results confirm that the pandemic has indeed worsened economic inequality among mortgage borrowers.

As for the success of forbearance programs in alleviating disparities, we find that

[3]While credit bureaus identify forbearances with "narrative codes," they do not distinguish COVID-19 forbearances from other types of forbearances. They also report only the *scheduled* payments, and during the pandemic scheduled payments are often set to zero with loan statuses frozen at pre-pandemic levels. The administrative data we use report actual payments and were specially designed to report COVID-19-related forbearance and loss mitigation activities and include a full array of investor, loan, borrower and property characteristics.

[4]Federally insured mortgage loans include FHA/VA and those insured by Freddie Mac and Fannie Mae, the two Government-Sponsored Enterprises (GSEs). Private-sector mortgages include portfolio loans and private-label mortgage-backed securities (PLMBS).

[5]At the time of this writing, legislation is proposing extending forbearances an additional 6 months but again does not legislate any long-term debt solutions.

minority and lower-income borrowers took up forbearances at significantly higher rates. Among all borrowers who missed payments, some 6 percent did not take up forbearance and thus missed this temporary debt-relief opportunity. We find that lower-income and minorities have higher forbearance take-up rates, even after controlling for conventional risk factors. This is encouraging, as higher take-up rates mitigate the effects of large gaps in payment difficulties experienced by minority and low-income mortgage borrowers during the pandemic, even if only in the short term.

Finally, we estimate that around half of all borrowers who entered forbearance due to the pandemic are still not making payments as of January 2021. We find that lower-income borrowers are about 15 percent more likely to still be in nonpayment. Extrapolating to the whole mortgage market, we estimate about 2.8 million mortgages were still in forbearance at year-end 2020, representing some $600 billion in mortgages. Most of these forbearances will reach their 12-month limits by mid-year 2021. To the extent that many of these borrowers are facing longer-term income shocks, it puts into special focus the immediacy of the problem for policymakers and servicers to find long-term solutions.

As for long-term solutions, broad consensus has emerged among servicing industry professionals and academics that reducing mortgage payments is the most effective loss-mitigation tool for borrowers unable to resume timely mortgage payments.[6] We estimate an outer-bound cost to investors for payment-reduction modifications of 20 percent and 30 percent to range from $3 billion to $7 billion for our full sample. Extrapolating to the estimated 2.8 million borrowers in forbearance, outer-bound costs range from $11 billion to $33 billion, $8 billion to $25 billion for federally insured mortgages.[7] While these figures are high, this very targeted assistance is a small fraction of the costs of broader government assistance programs enacted in 2020 and proposed in 2021 COVID-relief legislation.

Our paper contributes to the literature in a number of ways. First, we add to the large literature on consumer debt relief. Post-financial crisis, an oft-studied area is mortgage loan modifications (see, e.g., Agarwal et al. (2011); Mayer et al. (2014); Agarwal et al. (2017); Ganong and Noel (2020)). Cherry et al. (2020) is among the first to systematically examine how mortgage forbearances have provided targeted,

[6]This is a central finding in Ganong and Noel (2020), who also report that JPMorgan Chase targeted 30 percent payment reductions after the Great Recession and that Freddie Mac found 25 percent payment reductions effective. Similarly, as discussed later, Wells Fargo targeted payment reductions of 20 percent to 30 percent after the Great Recession.

[7]The reason these are high-end costs is because we assume all 2.8 million borrowers opt for loan modifications.

temporary relief to consumers during the pandemic. Bandyopadhyay (2020) analyzes borrower responses to mortgage forbearance programs. We conduct new analyses that help us understand how forbearance programs have reached borrowers and where gaps exist.

Second, we focus on income and racial disparities in mortgages and contribute to the literature on economic inequality in the U.S. (See, e.g., Noah (2012), Davydiuk and Gupta (2020)). There is a large concern that the costs of the pandemic are being borne disproportionately by minority and lower-income groups (See, e.g., Chetty et al. (2020); Mongey et al. (2020)).[8] Agarwal et al. (2020) further show that higher-income mortgage borrowers were able to benefit significantly more from refinancing during the pandemic. Equitable recovery has become a primary concern among policymakers.[9] Therefore, it is important to understand sources of inequality and policies that help mitigate it. In that regard, we show that the pandemic exacerbated financial inequality and that mortgage forbearance programs have helped alleviate inequalities in the short term with targeted forbearance programs, and we examine costs of modification options for longer-term debt relief.

Finally, given the importance of reaching troubled borrowers in longer-term distress, we describe a mapping tool jointly developed by the Federal Reserve Banks of Atlanta and Philadelphia to assist servicers and community groups in identifying areas with high shares of delinquencies and forbearances.

The rest of the paper is organized as follows. We provide a brief background on the CARES Act and mortgage forbearance in the next section. In Section 3, we explain our data and methodology. We report our results in Section 4. We discuss some long-term debt relief options in Section 5 and conclude in Section 6.

## 2 The CARES Act and Mortgage Forbearance

A loan is in forbearance when the lender or servicer allows a borrower to temporarily pause paying or pay a lower amount, with the agreement that the borrower will pay back later.[10] Forbearance has long been used for hurricane relief and short-term

[8] Also see, e.g., Zia Qureshi, "Tackling the inequality pandemic: Is there a cure?" Brookings Institution Report, November 17, 2020.

[9] See, e.g., the White House, "Executive Order on Ensuring an Equitable Pandemic Response and Recovery," January 21, 2021; and the Federal Reserve Bank of New York, "From Equitable Growth to Equitable Recovery," June 8, 2020.

[10] See Consumer Finance Protection Bureau (CFPB), "What is Mortgage Forbearance?" August 29, 2019.

credit card debt relief (see, Agarwal et al. (2005); Billings et al. (2019)).[11] Mortgage forbearance during the pandemic has taken the form of paused payments instead of reduced payments.

Section 4022 (§4022) of the CARES Act mandates that borrowers of federally backed mortgages (i.e., mainly from FHA/VA and the GSEs)[12] may request forbearances for up to 12 months. No fees, penalties, or additional interest will accrue on the loan beyond what is scheduled. Moreover, §4021 mandates special reporting by credit bureaus for loans in pandemic-related forbearance. If an account was current prior to the pandemic, it shall be reported as current during forbearance. If an account is delinquent, its status shall remain unchanged during forbearance unless the borrower brings the account current and then it shall be reported as current. Servicers of private-sector mortgages (i.e., mainly portfolio loans and loans in private-label mortgage-backed securities (PLMBS)) have largely adopted these same forbearance practices.

What has been critical to widespread adoption of forbearances during the pandemic is that requirements to obtain a forbearance are negligible: Borrowers need only request it; no specific financial hardship or proof of inability to pay need be provided. This stands in sharp contrast to the primary federal program initiated during the Great Recession, the Home Affordable Modification Program (HAMP), which required proof of hardship and income documentation to compute complicated net present value (NPV) analysis.[13] The liberal forbearance requirements were made palatable by the fact that most borrowers are not in negative-equity positions and that, reflecting the nature of the pandemic-induced recession, forbearance is a temporary suspension of payment, not a permanent modification of loan terms.

As for the duration of federal forbearance programs, §4022 states that forbearance is available during the "covered period," but it does not define what that period is. The CARES Act also does not specify how forbearances will be resolved once the 12-month forbearance period ends. How forbearances are resolved are subject to a number of institutional constraints. For agency securitizations from the GSEs and

[11] See also Daniel Hartley, Eleni Packis, and Ben Weintraut, "Flooding and finances: Hurricane Harvey's impact on consumer credit," *Chicago Fed Letter*, 2019, No. 415.

[12] The Federal Housing Administration (FHA) and Veterans Administration (VA) offer government-insured mortgages and the two Government-Sponsored Enterprises (GSEs), Fannie Mae and Freddie Mac, are presently under conservatorship, insured by the U.S. government.

[13] As described by Agarwal et al. (2017) and Ganong and Noel (2020), reporting and program requirements were so extensive that many servicers adopted their own private programs. As a result, of the 10 million modifications initiated during the Great Recession, only 1.8 million were done through HAMP.

Government National Mortgage Association (GNMA), currently around two-thirds of the mortgage market, loan terms cannot be modified without removing loans from security pools. For borrowers able to resume timely payment but unable to make up missed payments in a timely way, they prefer executing a no-interest balloon payment or "partial claim" due at payoff. Loans in PLMBS do not face this constraint but are subject to pooling and servicing agreements that may limit options. Portfolio lenders are subject to the fewest constraints, and some have preferred extending the existing terms of the loan by the number of missed payments for these borrowers. Long-term solutions for borrowers unable to resume timely payment are discussed in Section 5.

## 3 Data and Research Design

Our primary data source is a proprietary database from Black Knight Data & Analytics, LLC (Black Knight), aka "McDash Flash" data, so named because it is available on a daily basis. McDash Flash data are assembled from Black Knight's Mortgage Servicing Platform (MSP),[14] which processes payments for around two-thirds of all mortgages in the U.S., including most all the large bank and non-bank servicers and subservicers. McDash Flash is a very large representative sample of the U.S. mortgage market, covering the full spectrum of mortgage products, including bank and non-bank portfolio loans, and PLMBS, FHA/VA,[15] and GSE loans. The McDash Flash database was specially designed to track forbearance and loss mitigation activities during the pandemic, and it includes actual payments made and their dollar amounts; forbearance and loss mitigation start and scheduled end dates; the type of forbearance or loss mitigation activity being pursued; and bankruptcies and bankruptcy chapter.

We merge loan information from McDash Flash to three other databases to get a comprehensive view of borrowers' demographic information and financial condition, unmatched in any study. These include the Black Knight McDash data, the Equifax Credit Risks Insight Servicing McDash (CRISM) data, and the Confidential Home Mortgage Disclosure Act (CHMDA) data. The Black Knight McDash data contain the performance history on over 200 million loans and a full array of loan, product, borrower, and property information for each loan in the database. CRISM contains anonymized borrower-level credit bureau data from Equifax matched to the Black

[14] For more information, see https://www.blackknightinc.com/what-we-do/data-services/.

[15] We classify all government-insured loans as FHA/VA, as they encompasses loans in GNMA securities and "GNMA buybacks," which are loans pulled out of GNMA securities and brought on balance sheet at servicers when loans become 90 days delinquent.

Knight McDash data and contain a fully array of anonymized data from borrowers' credit-bureau accounts. CHMDA data provide mortgage application information and include borrowers' race, sex, and household income at loan application. For joint loans, we pull only primary borrower information from both CRISM and CHMDA for first mortgage loans and incorporate Black Knight McDash's mortgage performance data and McDash Flash forbearance data, creating a borrower-level dataset. Appendix A explains the matching algorithm and related match statistics, and Appendix Table A1 details the representativeness of our sample throughout the matching process.

Due in part to the ease of obtaining forbearances, about 8 percent of all mortgages in the U.S. have entered forbearance since the onset of the pandemic. If we extrapolate the numbers to the full mortgage market, that is close to 7 million mortgages.[16]

As shown in Figure 1, we classify borrowers into three groups: those who are delinquent but not in forbearance (the red area in Figure 1); those in forbearance and not making payments (the blue area); and those reported in forbearance but making timely payments (the purple area). The share of all loans delinquent or reported in forbearance peaked at 12.6 percent in May 2020, declining to 8.3 percent by year-end 2020.

We are most interested in borrowers in distress. Therefore, we focus on the group of borrowers who are delinquent or in forbearance and not paying on their mortgages (the combined blue and red areas in Figure 1).[17] These two groups combined represent about 9 percent of all mortgage balances. Given the ease and low costs of obtaining forbearances, it is striking to see that over 2.5 million borrowers did not take advantage of forbearances and fell into delinquency. Therefore, in addition to examining who fell into mortgage distress, we examine borrowers who fell into mortgage distress but missed forbearance opportunities.

Our study focuses on three outcomes. First, we explore which borrowers were most likely to fall into nonpayment during the pandemic[18] by defining the outcome

[16]Following the approach used by Black Knight, we assume there are 53 million mortgage loans in the U.S. and $11.2 billion in first-lien mortgage balances. See Table A4 for our method of extrapolation.

[17]Among those in forbearance and not paying, it is possible that a small fraction of borrowers do not have real payment difficulties. They are not paying simply because they are permitted not to pay. We believe this is a small share because forbearance precludes refinance opportunities in the current low-interest-rate environment.

[18]We define the pandemic time period for our sample as April-November 2020, as the lockdown of the economy began in March and our estimation sample ends in November, although the McDash Flash data are observed more frequently. McDash Flash starts in April 2020.

variable as ever falling into nonpayment during the pandemic:

$$EverNonpayment = \begin{cases} 1 & \text{if ever missed payment during the pandemic} \\ 0 & \text{if never missed payment during the pandemic.} \end{cases} \quad (1)$$

So as long as borrowers missed a payment, whether in forbearance or not, they will be identified as having been in nonpayment during the pandemic.

Second, we explore which borrowers were most likely to miss forbearance opportunities by examining the likelihood of ever entering forbearance, given that they have been in nonpayment sometime during the pandemic:

$$EverMissOpportunity = \begin{cases} 1 & \text{if never taken forbearance AND} \\ & \quad \text{ever in nonpayment during pandemic} \\ 0 & \text{if ever taken forbearance AND} \\ & \quad \text{ever in nonpayment during pandemic.} \end{cases} \quad (2)$$

Note that we do not consider borrowers as ever having missed an opportunity if they first enter nonpayment and then enter forbearance at a later date, or they enter forbearance and nonpayment but exit forbearance while maintaining nonpayment status.[19]

Third, we examine the most recently observed (January 2021) status of borrowers who have ever entered forbearance during the pandemic. A borrower who has entered forbearance during the pandemic may:

1. Exit forbearance with a current status;
2. Stay in forbearance while staying current on his or her mortgages;
3. Stay in forbearance and be in a nonpayment status;
4. Exit forbearance, be in a nonpayment status, but enter into some form of loss mitigation; or
5. Exit forbearance and be in delinquency.

[19] We exclude these groups for two reasons. First, many borrowers have forbearance status reported in the month after they enter delinquency, suggesting that there may be a reporting lag. Second, borrowers who exit forbearance before their 12-month provision while still being delinquent usually enter into loss mitigation, which means that they are still receiving some assistance.

We consider those in groups 3-5 as being in a nonpayment status in January. Therefore, we define the latest nonpayment status of the borrower as:

$$LatestNonpayment = \begin{cases} 1 & \text{if in nonpayment in January 2021 AND} \\ & \quad \text{ever in nonpayment during pandemic} \\ 0 & \text{if in current status in January 2021 AND} \\ & \quad \text{ever in nonpayment during pandemic.} \end{cases} \tag{3}$$

Given outcomes defined in (1), (2), and (3), our research design is as follows. We examine the differential rates of nonpayment and missed forbearance opportunities during the pandemic and latest observed rates of nonpayment status with respect to borrower demographic, income, and financial condition using a linear probability model. Our specification is:

$$Y_{iz} = \alpha + D'_{iz}\boldsymbol{\beta} + X'_{iz}\boldsymbol{\Gamma} + \tau_z + \varepsilon_{iz}, \tag{4}$$

where $Y_{iz}$ is $EverNonpayment$, $EverMissOpportunity$, or $LatestNonpayment$ for borrower $i$ in zip code $z$; $D_{iz}$ is a vector of demographic and income characteristics; $X_{iz}$ is the borrower credit profile; $\tau_z$ is a zip-code fixed effect; and $\varepsilon_{iz}$ is the error term. We are interested in the vector of coefficients $\boldsymbol{\beta}$, which estimates the differential probability of a borrower with certain demographic or income characteristics falling into nonpayment, missing a forbearance opportunity during the pandemic, or staying in nonpayment by January 2021.

Our main demographic variables are age, race, Hispanic status, and household income at application.[20] To make household income at application comparable across Metropolitan Statistical Areas (MSAs) and origination years, we calculate the income relative to MSA median family income at application by dividing CHMDA-reported household income by MSA median family income at loan application using Census Bureau data. Then we divide income data into 4 quartiles, with the 1st quartile being the lowest income one. In addition, we include gender and split age into bins (age less than 35, 35-44, 45-54, 55-64, and 65 and older).

For our credit profiles, we include various characteristics as of loan origination and as of January 2020 (the observation just before the onset of the pandemic). Characteristics include loan origination year, origination amount, origination credit score (in

[20]Note that we do not observe borrower's relative household income over time, only at the time of application.

bins of below 620, 620-719, and above 720), original loan-to-value (LTV) ratio, rate spread at origination, investor type, the log of monthly payments in January 2020, whether delinquent before March, credit score in January 2020, and mortgage interest rates in January 2020. Moreover, we include information pertinent to the borrower's other credit accounts, including total number of accounts, number of accounts past due, whether more than one account is past due, and log of past due amount of non-first-mortgage accounts. For all our specifications, our reference group is White, non-Hispanic, male borrowers less than 35 years old, with relative household income in the 4th quartile, credit score in January 2020 between 620 and 719, and credit score at origination between 620 and 719.

To further examine the impact of the pandemic on financial distress, we compare borrower loan performance before and during the pandemic. To do this, we include data in 2019 from January to November.[21] We use a difference-in-differences (DID) specification with the 2019 and 2020 data:

$$EverNonpayment_{izt} = \alpha_0 + \alpha_1 P_{izt} + \sum_j \gamma_j T_{j,izt} + \sum_j \beta_j \left(T_{j,izt} * P_{izt}\right) + X'_{izt}\mathbf{\Gamma} + \tau_z + \varepsilon_{izt}, \quad (5)$$

where the variable $P_{izt}$ is equal to 1 for borrower $i$ in zip code $z$ at time $t$ from the 2020 sample, $T_{j,izt}$ are demographic or income characteristic $j$, $\mathbf{X}$ is a vector of other characteristics of the borrower, and $\tau_z$ is a zip-code fixed effect. Therefore, the coefficient $\beta_j$ is the DID estimate for characteristic $j$. This is the additional likelihood of falling into nonpayment during the pandemic vis-à-vis 2019 for borrowers with characteristic $j$ compared to the reference group.

Our sample is a 20 percent random sample of our matched data, resulting in a sample of 1.95 million borrowers for 2020 and 1 million borrowers when we restrict our sample to only include loans that report forbearances. We use the larger sample to examine nonpayment rates and the smaller sample to examine forbearance opportunities. Table 1 presents summary statistics from our regression sample and shows that the sample of borrowers with loans that have reliable forbearance status reporting is representative of the larger sample. We first present results on nonpayment from the cross-section regression described in (4), then results using the DID specification

[21] To ensure comparability, we measure nonpayment status from April to November of the sample year when examining our samplesprior to 2020.

described in (5).

# 4 Results

## 4.1 Mortgage Nonpayment

Table 2 presents cross-sectional nonpayment regression results. Column (1) shows results from a specification that includes only the racial composition of borrowers in our sample, indicator variables for the borrower being Black, Asian, Other, or Missing Race, and for the borrower being of Hispanic Origin, compared against a White borrower reference group. Column (2) shows results from a specification with only income-related variables: three indicator variables for belonging to the 1st, 2nd, and 3rd quartile of borrower income relative to MSA median family income, referenced against the 4th, highest-income quartile. The specification in Column (3) includes both race and income variables. Finally, Column (4) includes our full set of controls described in Section 3, including zip-code fixed effects.

From Columns (1)-(3), we see very strong bivariate differences in nonpayment rates during the pandemic by race and income group. In particular, Black and Hispanic borrowers tend to have significantly higher rates of nonpayment: Black borrowers have 9.8 percentage point higher rates and Hispanic borrowers have 6.4 percentage point higher rates than their White counterparts on an overall average 8.0 percent rate of nonpayment. We see that borrowers in the 1st quartile of relative income are 4.8 percentage points more likely to be in nonpayment than those in the 4th quartile, and the differences are monotonically decreasing as borrowers have higher incomes. Those in the 2nd quartile are 3.5 percentage points more likely and those in the 3rd quartile are 1.7 percentage points more likely to be in nonpayment than those in the 4th quartile.

The bivariate differences with respect to race subside substantially when controlling for various other demographic and credit characteristics. However, they remain elevated even when including our full set of controls. In Column (4) we see that Black borrowers are 2.7 percentage points more likely to be in nonpayment than White borrowers, Asian borrowers 1.7 percentage points more likely, and Hispanic borrowers 2.3 percentage points more likely. For Black and Hispanic borrowers, the results represent about a 30 percent increase in nonpayment rates to the overall mean. The bivariate differences with respect to income persist as well. The coefficients on income quartile indicators in Column (4) with all controls are at a similar magnitude as in Columns

(2) and (3). For those in the first relative income quartile, the results represent about 52.5 percent higher nonpayment rates compared to the overall mean.

Moreover, borrower credit characteristics in January 2020 are highly correlated with their nonpayment status before and during the pandemic. The pre-pandemic credit score in January 2020 is a significant indicator of nonpayment during the pandemic. Those in the lowest credit score bin are 11.3 percent more likely to fall into nonpayment status than those in the credit score 620-719 bin reference group, while those in the highest credit score bin are 5.7 percentage points less likely to fall into nonpayment status. Those with higher loan balances, higher monthly payments, and higher numbers of delinquent other credit bureau accounts are more likely to be in nonpayment during the pandemic as well. Relative to GSE loans, FHA/VA loans have higher nonpayment rates, while PLMBS and portfolio loans have slightly lower rates. Finally, we note that zip-code fixed effects seem to contribute the most to the $R^2$ in Column (4), indicating that spatial variation is a very important aspect of explaining nonpayment rates.

However, it is possible that minority and lower-income borrowers also have a higher likelihood of entering into nonpayment during pre-pandemic times. When we run the same regression over the same months in 2019, we see only very minor differences in nonpayment rates by racial and income characteristics (Table A2).[22]

To examine this question more systematically, we turn to the DID specification described in (5). Table 3 presents the results using our 2019 and 2020 sample of borrowers. The results in Column (1) show that Black borrowers are 5.1 percentage points more likely to fall into nonpayment during the pandemic compared to White borrowers, even *after* taking into account the baseline nonpayment rate differences during 2019. This is also true for Asian and Hispanic borrowers, at 2.2 percentage points and 5.2 percentage points higher rates, respectively. These results change very little even after including controls, as shown in Column (3). Income of the borrower at application is also correlated with nonpayment rates when controlling for the baseline differences in 2019. Those in the 1st, 2nd, and 3rd income quartiles are 2.3 percentage points, 1.9 percentage points, and 0.9 percentage points more likely to fall into nonpayment, respectively, relative to the highest-income 4th quartile, after taking into account the baseline nonpayment rates. These coefficients fall only modestly when including the full set of controls, to 1.6 percentage points, 1.5 percentage points,

[22]Given our very large sample sizes, statistical significance is virtually assured. What is surprising about our 2019 results, which we further corroborate with earlier years, is how small in magnitude these pre-pandemic differences are.

and 0.8 percentage points, respectively.

We also use a multi-period DID regression specification using years from 2016-2020 and the same controls as Column (3) of Table 3. We present the results on our key demographic variables in Figure 2 with 2019 as the baseline. We see that the differential nonpayment rates we describe above only arise between 2019 and 2020 for every demographic variable, confirming that our DID results are capturing the deviation from the 2016-2019 non-recessionary trends in nonpayment rates.

Overall, our results show that racial and income disparities were very small in the 2016-19 pre-pandemic years, after controlling for conventional risk factors. But our DID results show they increased significantly in 2020, contributing to inequality in minority and lower-income mortgage borrower populations during the pandemic.

### 4.2 Missed Forbearance Opportunities

We now explore how well borrowers, when they fall into nonpayment, use the forbearance programs available to them and how forbearance take-up rates, or missed opportunity rates, are related to borrower racial and income differences. Table 4 presents results from the cross-section regressions described in (4) for a sample of borrowers in 2020 who have ever experienced mortgage nonpayment during the pandemic. Column (1) only includes race variables, Column (2) only includes income variables, Column (3) includes the full set of controls, and Column (4) shows the results for only federally insured loans (i.e., FHA/VA- and GSE-insured) mandated to provide forbearances under the CARES Act. We see that Columns (3) and (4) show very similar results, suggesting that private-sector forbearance programs were executed similarly to government-mandated ones.[23]

We see encouraging results regarding forbearance take-up rates by minorities and lower-income borrowers. While these borrowers are more likely to fall into nonpayment, as shown in Section 4.1, these borrowers are less likely to miss forbearance opportunities, suggesting short-term relief programs are targeted at populations most in need. First, Column (1) shows that Black, Asian, and Hispanic borrowers are 0.4 percentage points, 4.7 percentage points, and 2.7 percentage points less likely to miss forbearance opportunities compared to their White counterparts. Those in the lower-income quartiles are more likely to miss forbearance, but these differences are very small once controlling for various demographic and credit characteristics, as shown

[23]One reason for this similarity is that pooling and servicing agreements generally require that third-party servicers service loans from other investors similar to their own loans.

in Column (3).

Column (3) shows lower rates of missed opportunities for minority borrowers relative to Whites once controlling for conventional risk factors. Black borrowers are 1.9 percentage points less likely, respectively, to miss forbearance opportunities than their White counterparts at an average 7 percent overall missed forbearance rate, implying a 27 percent higher forbearance take-up rate. Likewise, Hispanic borrowers are 1.6 percentage points less likely to miss forbearance opportunities, implying a similar take-up rate. The small coefficients among the income groups indicate that all income groups take up forbearances at about the same rates.

Those with credit scores less than 620 in January 2020 are 2.6 percentage points more likely to miss forbearance opportunities compared to those with 620-719 credit scores, while those with credit scores greater than 720 are 1.9 percentage points less likely to miss forbearance opportunities. This is concerning, as borrowers with lower credit scores are also significantly more likely to fall into nonpayment.

We can use our estimates of nonpayment and missed opportunity rates to calculate the effect of the pandemic on mortgage delinquency, net of forbearance. For example, without controlling for observable risk factors, Black borrowers are 5 percentage points more likely to be in nonpayment due to the pandemic, compared to 2019 (Table 3, Column 3). With a 6 percentage point overall increase in average nonpayment rate from 2019 to 2020 in our regression sample, that amounts to about a 11 percent nonpayment rate for Black borrowers. However, conditional on nonpayment, Black borrowers are about 1.8 percentage points more likely to be in forbearance (Table 4, Column 3). With an overall average of 6 percent missed opportunity rate (non-take-up conditional on nonpayment), that is a 4.2 percent in missed opportunity rate for Black borrowers. Therefore, about $11\% \times 4.2\% = 0.46\%$ of Black borrowers are ever in a nonpayment status and not in forbearance. Compared to the overall average, $6\% \times 6\% = 0.36\%$,[24] we can see that there is still a gap in the pandemic's impact, net of government assistance. However, government assistance has clearly helped shrink the disparate impact of the pandemic.

### 4.3 Outstanding Forbearances

Finally, for a sample of borrowers who have ever entered forbearance between April and November 2020, we examine the characteristics of borrowers who remain in a

[24]Note that these numbers are different from what we show in Figure 1 as we are looking at *ever* nonpayment and *ever* missed forbearance opportunity here.

nonpayment status in our most recently observed period of January 2021. To put these loans in context, we show the outstanding forbearances and flows in and out of forbearance over time in Figure 3, starting at their peak in May 2020. The figure shows very small shares entering forbearance after May, but also relatively small shares flowing out of forbearance.[25] This shows that most loans entered forbearance at the start of pandemic and have mostly stayed there, a fact that means many forbearances will be clustered together when their 12-month forbearance terms expire in 2021, as we confirm later.

Table 5 shows the results from a cross-section regression with the dependent variable being an indicator equal to one if the borrower is in a nonpayment status in January 2021. First, note the high rate of nonpayment in January 2021: As shown in the second-to-last row, 50 percent of borrowers who entered forbearance during the pandemic are still in nonpayment status in January 2021. Similar to our previous tables, Columns (1)-(3) only include race/ethnicity and/or income characteristics, while Column (4) includes our full set of controls.

Column (1) shows in our bivariate correlations that Black and Hispanic borrowers are 8.0 percentage points and 1.2 percentage points more likely to be in nonpayment in January 2021 compared to Whites, although the Hispanic coefficient is insignificant. Column (2) shows that lower-income borrowers are much more likely to be in nonpayment in January 2021, with borrowers in the 1st quartile of relative income being 12.1 percentage points more likely to be in nonpayment in January 2021 compared to their 4th quartile counterparts. Those in the 2nd and 3rd quartiles are also much more likely to be in nonpayment, at 7.8 percentage points and 3.1 percentage points.

The bivariate differences in Columns (1) to (3) diminish when including our full set of controls, with Black and Hispanic borrowers either equally or slightly less likely to be in nonpayment in January 2021. However, those in the lower-income groups still show higher rates of nonpayment, even after controls are added. Those in the 1st, 2nd, and 3rd quartiles of relative income are 7.5 percentage points, 4.7 percentage points, and 2.1 percentage points more likely, respectively, to be in nonpayment in January compared to those in the 4th quartile.

Given the high nonpayment status of borrowers and the fact that most entered forbearance at the beginning of the pandemic, the 12-month forbearance period al-

[25]Note that there are sizable increases in forbearance exits in July and October 2020. This is because servicers approve most forbearances for three-month terms, starting in April 2020. Thus, it is concerning that there are very few flows out of forbearance in January 2021.

lowed under the CARES Act is set to expire for millions of borrowers by mid-year 2021, representing a large, looming risk. Figure 4 displays extrapolated counts of loans by scheduled and assumed dates of forbearance exit. Here, scheduled dates are servicer-reported exit dates for existing forbearance plans, generally scheduled at three-month intervals. These loans, when hitting the scheduled exit date, may request to roll over if they have not reached their 12-month maximums allowed by the CARES Act. The assumed date takes the number of months in forbearance as of January 2021 and projects them out to their 12-month maximums. As seen in Figure 4, most loans are due to exit forbearance in April and May 2021. Combined with our findings that lower-income borrowers who entered forbearance during the pandemic are more likely to still be in nonpayment, the assumed end to forbearance suggests significant income shortfalls when 12-month forbearance terms expire. Long-term modifications will be needed for many of these borrowers, which we explore next.

## 5 Discussion on Long-Term Solutions

Forbearance only provides temporary relief. The GSE regulator, the Federal Housing Finance Agency (FHFA), has adopted a "waterfall" approach to prioritize how its servicers should work out loans exiting forbearance: 1) Borrowers pay back missed payments in full; 2) Servicers arrange short-term repayment plans with borrowers to bring them current on their mortgages; 3) Servicers arrange a balloon payment in which the borrower assumes a no-interest loan due at loan payoff;[26] 4) Modify the loan by adjusting rates or terms; 5) Pursue other foreclosure alternatives. Note that the first three options assume borrowers have the ability to resume timely payment after their forbearance expires. To the extent that many borrowers are still unemployed or face payroll reductions,[27] many will eventually need long-term debt relief, requiring effective, time-tested modification programs.

This is where experience with modification programs during the Great Recession reveals a surprising degree of concurrence between industry experience and academic empiricism. Industry experience has determined that reducing monthly payments by 20 percent to 30 percent is the most cost-effective long-term modification program.[28] Ganong and Noel (2020) studied results from the HAMP and private-sector

[26]FHA refers to this as a "partial claim" on the loan.

[27]See, e.g., the *Washington Post*, "Millions of jobs unlikely to come back, economists warn," February 18, 2021.

[28]During the Great Recession, JPMorgan Chase adopted payment reductions with a 30 percent

programs and provide strong empirical support for payment reductions for the 30 percent payment reduction program adopted by private industry, which they document significantly reduced default risk. Following these, we estimate expected costs of modifying loans to reduce borrowers' monthly payments down to industry recommended targets of 20 percent and 30 percent as a long-term solution for loans in forbearance once they reach their 12-month limits.

For our exercise, we compute net present value (NPV) costs of reducing mortgage payments by targets of 20 percent and 30 percent, with payment-reductions achieved in three different ways in the following order of priority:

1. Extend the loan term to 40 years by adding the 12 missed payments to the end of the loan and then extending the loan term to 40 years;

2. If 1. does not bring the payment down to target, continue by reducing the interest rate on the loan until the payment reduction target is reached, down to a floor of 2 percent.

3. If 1. and 2. do not bring the payment down to target, continue with adding in a deferral of principal (not principal forgiveness), in which the principal on the loan is reduced by enough to hit the payment reduction target, with the deferred amount due at payoff. No interest is charged on the deferred principal.

Based on our sample of loans in forbearance from McDash Flash on December 31, 2020, we calculate expected costs of achieving 20 percent and 30 percent payment reductions in the order defined above. Note that, among these options, term extensions do not cause any loss of interest, while interest rate reductions and principal deferrals both lead to lost interest income for investors. Therefore, to estimate expected costs of these payment-reduction targets, we calculate the net present value of lost interest associated with achieving our two payment reduction targets. The detailed calculation steps are outlined in Appendix B.

Table 6 summarizes our results. Our full sample contains some 710,000 loans totaling $143 billion still in forbearance. Extrapolating these numbers to the full market, we estimate 2.8 million loans still in forbearance in the U.S. mortgage market

target, counter to the 31 percent debt-to-income ratio target used in the HAMP, which Ganong and Noel (2020) tested and found superior. According to Robert Caruso, the former head of servicing at Wells Fargo, in the firm's modification of "Pick-A-Pay" negative amortization mortgages acquired from Wachovia, many different programs were tried, with the most effective determined to be payment-reduction modifications ranging from 20 percent to 30 percent.

with unpaid principal balance of about $600 billion.[29] We follow the three remedies described above for lowering mortgage payments until the 20 percent and 30 percent targets are reached.

With a 20 percent payment reduction target, 18 percent of the loans in forbearance would meet the target with Remedy 1, the term extension alone; 80 percent of the loans would be resolved with Remedy 2, which is a combination of term extensions and interest reductions; and finally, the remaining 1.7 percent can be resolved with Remedy 3, which includes the term extension, interest-rate reduction, and principal deferral. The combined total present value (PV) losses of interest income to investors with the 20 percent payment reduction target for our full sample is estimated to be $2.7 billion. If we extrapolate the number out to the full market of 2.8 million loans, the PV of lost interest income will be around $11 billion, $8 billion for government-insured mortgages.[30]

With a 30 percent payment reduction target, only 4.4 percent of loans meet the target under Remedy 1, while 92 percent meet the target under Remedy 2, with 4 percent needing Remedy 3. The combined total present value (PV) losses of interest income to investors with the 30 percent payment reduction target for our full sample is estimated to be $7.9 billion. We estimate the extrapolated total PV losses of interest income will rise to around $33 billion, $25 billion for government-insured mortgages. Note that aggressive interest rate reductions will dampen refinancing, which can offset some costs to investors.

In Table 7, we also conduct calculations with a different "waterfall," in which we consider principal deferral ahead of interest rate reductions. Results show that 100 percent of the borrowers in forbearance can get their monthly payments down by 20 percent or 30 percent with a combination of term extensions and principal deferrals. Without the need for interest rate reductions, these loan modifications will cost investors a much smaller amount in terms of lost interest income.[31]

We note that our estimates of lost interest income are outer-bound costs, as we assume that *all* borrowers in forbearance at year-end 2020 will opt for loan modifi-

[29] Consistent with the method adopted by Black Knight in its Mortgage Monitor (see fn 1), our estimate is based on a market of 53 million mortgage loans and $11.2 billion in first-lien mortgage balances. See Appendix Table A4 for a description of our extrapolation.

[30] See Appendix A3 for a breakout by investor. Government-insured loans are FHA/VA and GSE loans, while private-insured loans are portfolio and PLMBS loans.

[31] Based on our conversations with industry executives, investors seem more concerned about the moral hazard of principal deferral than the other two options. Some are concerned that Congress or other groups will eventually push for principal forgiveness instead of principal deferral.

cations remedied in the ways described. Borrowers able to resume timely payment have incentives to opt for repayment plans or partial claims.[32]

An additional consideration is moral hazard, where borrowers not presently in forbearance have incentives to opt for forbearance to lower their mortgage payments, raising total costs to investors.[33] We view this risk as minimal in the current interest-rate environment, as borrowers miss out on refinancing options and potentially incur penalties in the form of minimizing access to future credit, as described above. Modifications are also approved on a case-by-case basis, so servicers can limit moral-hazard risk by requiring borrowers to document hardship with evidence of unemployment claims or lost income. Again, modification programs limited to borrowers in true need mitigates moral-hazard risk.

## 6 Conclusions and Discussion

The COVID-19 pandemic produced unprecedented financial distress for households and businesses. Through the CARES Act, the federal government stipulated mortgage forbearances of up to 12 months for federally insured mortgages to help homeowners overcome their difficulties; private-sector mortgages adopted these same practices. Our study is the first to empirically examine the impact of the pandemic on racial and income inequality among homeowners, the effects that federal and private forbearance programs are having on alleviating those inequities, and the expected costs of targeted post-forbearance modification remedies designed to keep struggling borrowers in their homes. Overall, we show that forbearance programs have had the effect of reducing inequities, with the promise that targeted modification programs can help keep millions of mortgage borrowers in their homes.

We document that the COVID-19 pandemic had a significant disparate impact on payment behaviors of minorities and lower-income borrowers. This finding holds true even after controlling for a variety of conventional risk factors. A DID analysis suggests that the pandemic significantly worsened racial and income disparities in U.S. mortgage markets. We also show that federal and private forbearance programs have provided a lifeline to millions of struggling mortgage holders, as minority and

[32] GSE and FHA/VA rules state that borrowers can receive a refinance following a forbearance if the loan is brought current and three consecutive payments are made. While the CARES Act prohibits loans in forbearance to be reported delinquent, loan modifications are noted in "narrative codes" that lenders can see when borrowers apply for credit, and these can limit future credit opportunities for many years.

[33] See Mayer et al. (2014); An et al. (2021) for discussion about borrower strategic default behavior.

lower-income borrowers took up forbearances at significantly higher rates.

However, we find that over half of the borrowers entering forbearance early in the crisis were still in forbearance in January 2021. For the whole market, an estimated 2.8 million mortgages remain in forbearance, with lower-income borrowers most likely to be in a nonpayment status. Most all of these loans will reach their 12-month limits allowed under the CARES Act by mid-year 2021. Given that the pandemic is ongoing, the need for forbearance extensions are being advocated in new relief legislation.[34]

To the extent that many of the jobs lost during the pandemic are replaced with lower-paying ones, borrowers coming out of forbearance will need longer-term debt relief. Based on industry experience and empirical evidence with modification programs during the Great Recession (Ganong and Noel (2020)), making debt service affordable will be the key to success of modifications. We examine a number of options to reduce borrowers' monthly payments. Our calculations show that implementing payment reductions of 20 percent and 30 percent for the full 2.8 million borrowers in forbearance would cost between $11 billion and $33 billion. Even these outer-bound estimates show that relief targeted at borrowers truly in need can be implemented at a fraction of the cost of the blanket relief provided by other parts of the CARES Act and proposed legislation.

Finally, reaching out to troubled borrowers can be challenging. Based on our conversations with loan servicers, some borrowers who missed forbearance opportunities could simply be unaware of forbearance options. To better identify communities that are missing forbearance opportunities, the Federal Reserve Banks of Atlanta and Philadelphia developed map tools to help policymakers, community groups, and servicers identify where mortgage borrowers in forbearance are concentrated.[35] Figure 5 show two example maps generated from the map tool, with Panel (a) showing the map of the United States and Panel (b) showing the map of the Chicago-Naperville-Elgin, Core-Based Statistical Area (CBSA).

There are many questions that we are not able to answer in this paper. For example, how do we explain the residual difference between minority and White

[34]On January 21, 2021, it was announced that the FHFA and FHA extended foreclosure and eviction moratoriums later into the first quarter, and forbearance on federally held student loans through the end of September. On February 9, the FHFA announced that, as of February 28, borrowers who are in forbearance plans will be permitted to request an additional three-month extension, covering up to 15 months of mortgage payments overall for borrowers of GSE-owned loans.

[35]https://www.frbatlanta.org/center-for-housing-and-policy/data-and-tools/mortgage-analytics-and-performance-dashboard.aspx.

borrowers after controlling for the usual risk factors? One explanation could be that minorities have less financial support from family or kin networks to deal with emergencies (Sarkisian and Gerstel (2004)). There could be other explanations.

Another question is, what are the reasons behind borrowers not taking up forbearances? A National Housing Resource Center survey shows some borrowers fearful of making a lump-sum payment when forbearance expires, a misunderstanding of the program. Some borrowers might not even be aware of forbearance opportunities.

Finally, a significant finding from our analysis is that, controlling for income and other borrower characteristics, low-credit score borrowers not only have higher non-payment rates but also are more likely to miss forbearance opportunities. Questions remain as to how much of the difference is due to financial literacy and how to help these low-credit score borrowers. We leave these questions to future research.

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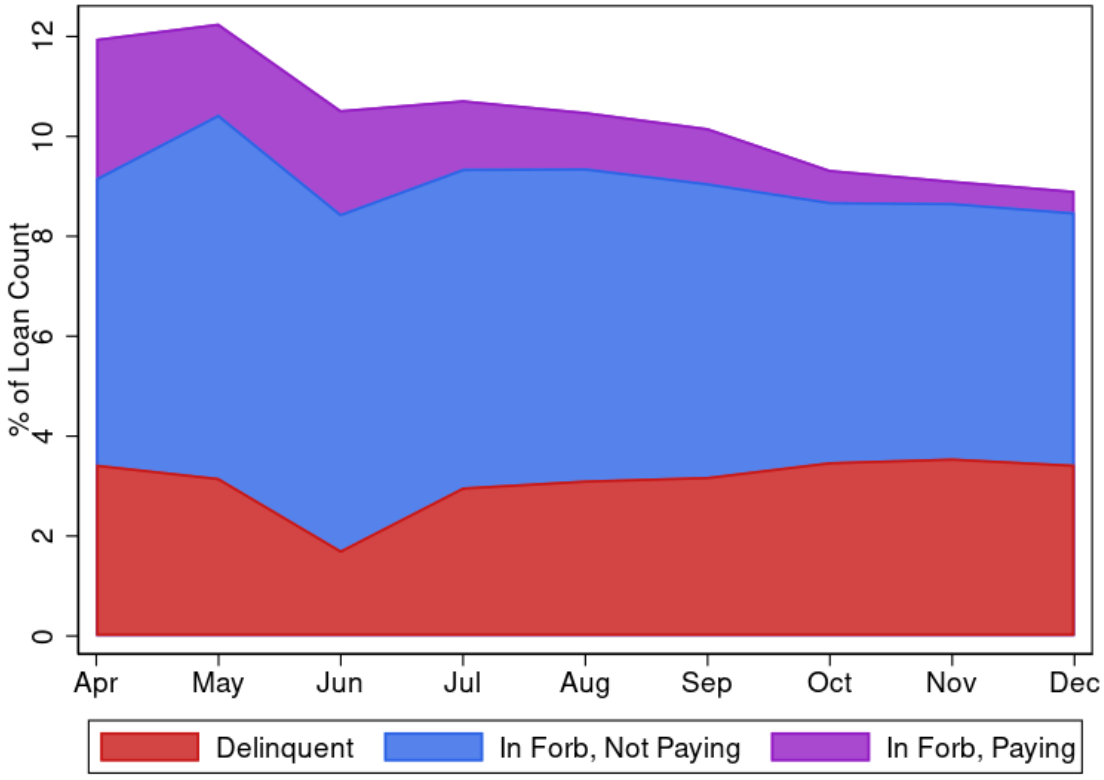
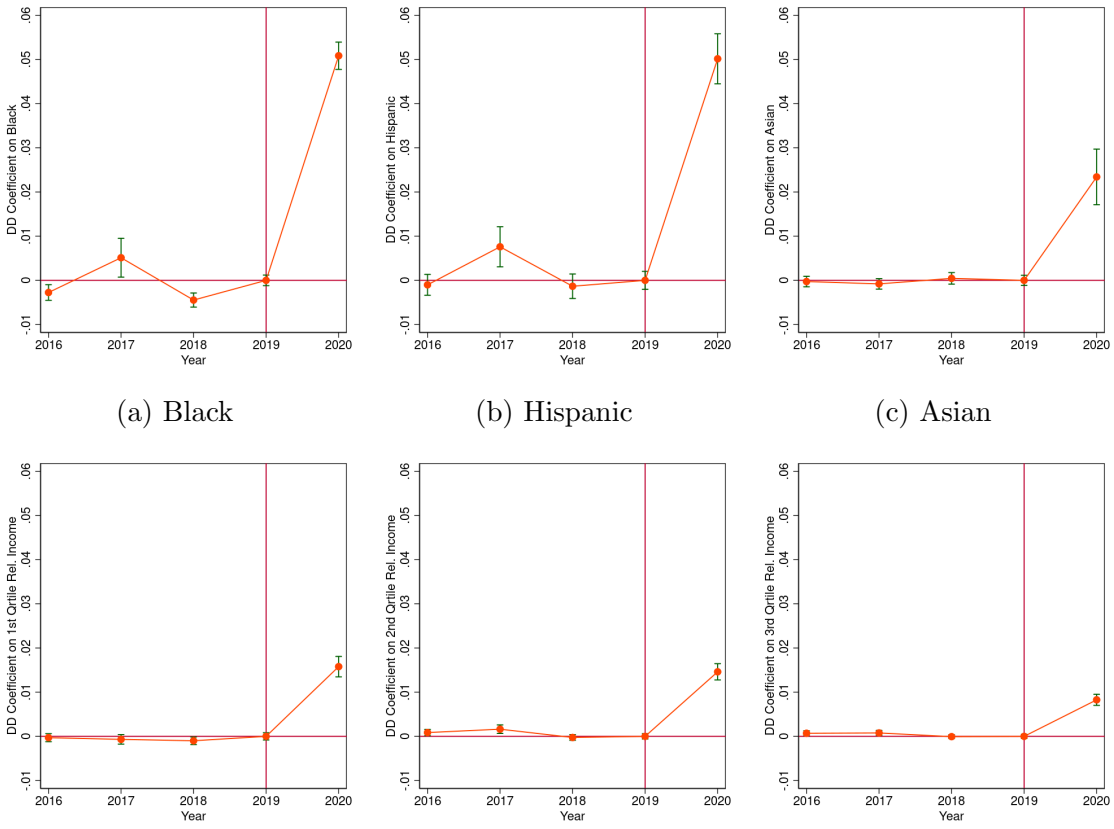
Figure 1. Delinquency and Forbearance Status of Loans




Notes: This figure plots percentage of loans that are delinquent or in forbearance based on the Black Knight Data & Analytics, LLC (Black Knight) McDash Flash data. Red area are loans that are delinquent and not in forbearance, blue area are loans that are in forbearance and not making payments, purple area are loans that are in forbearance but making payments.

Figure 2. Difference-in-Differences Coefficients, 2016-2020

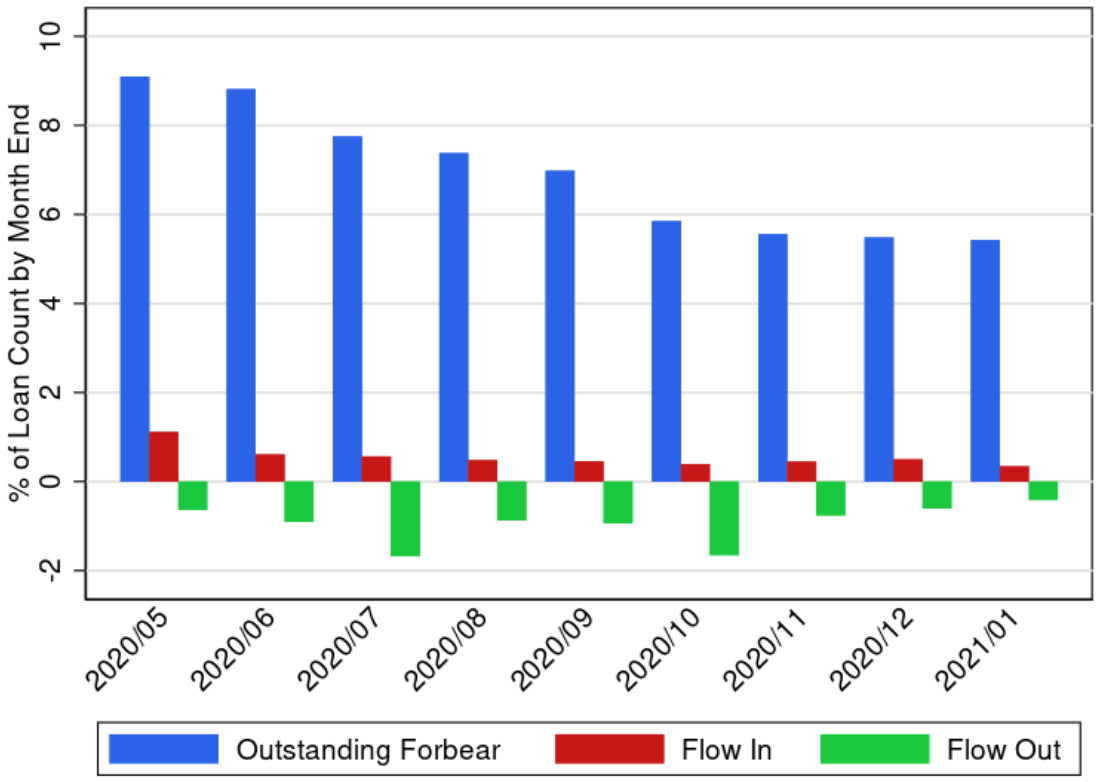



(a) Black (b) Hispanic (c) Asian

(d) 1st Qrtile Rel. Income (e) 2nd Qrtile Rel. Income (f) 3rd Qrtile Rel. Income

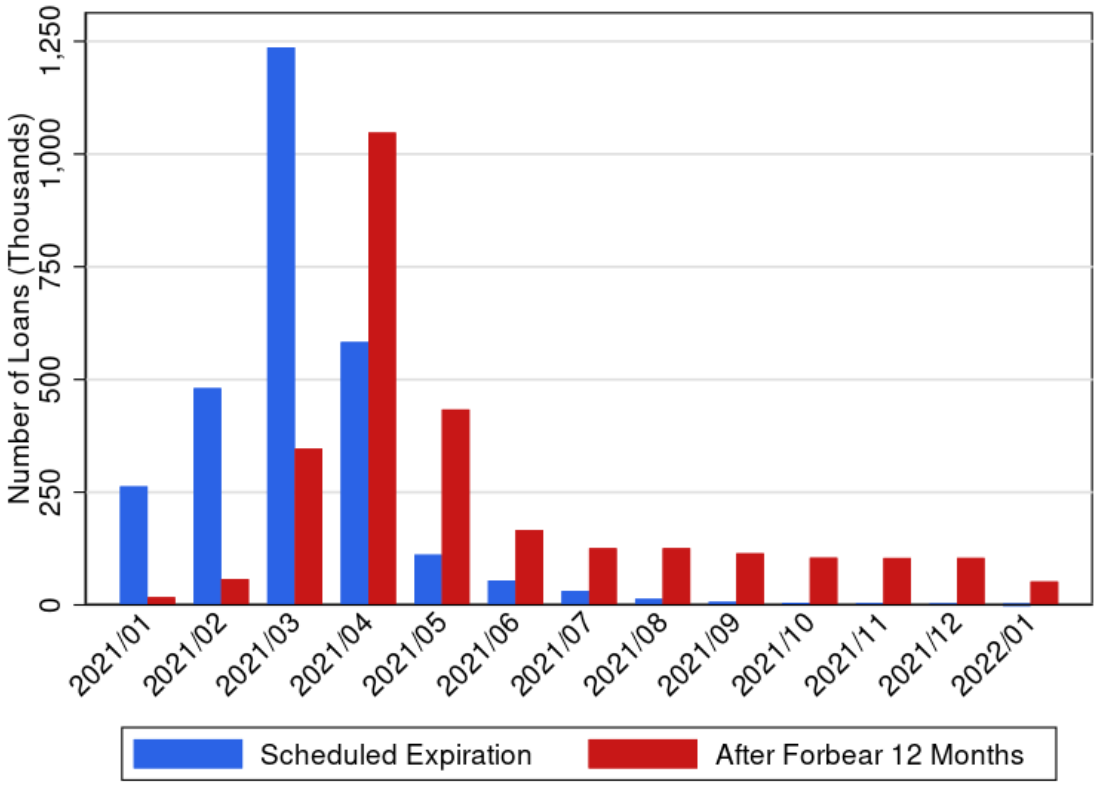
Notes: This figure plots the coefficients and 95% confidence intervals from the multi-period Difference-in-Differences (DID) regressions with our most complete specification (all controls in Column (3) of Table 3) using 2019 as the baseline. Each panel plots coefficients on (a) Black indicator, (b) Hispanic indicator, (c) Asian indicator, (d) 1st Quartile of Income Relative to MSA Median, (e) 2nd Quartile of Relative Income, and (f) 3rd Quartile of Relative Income. Data sources include: Black Knight McDash Flash, Equifax Credit Risk Insights Servicing McDash (CRISM), and Confidential Home Mortgage Disclosure Act (CHMDA). Race, Hispanic status, and borrower income at application from HMDA Data.

Figure 3. Outstanding Forbearance and Forbearance Flows Over Time



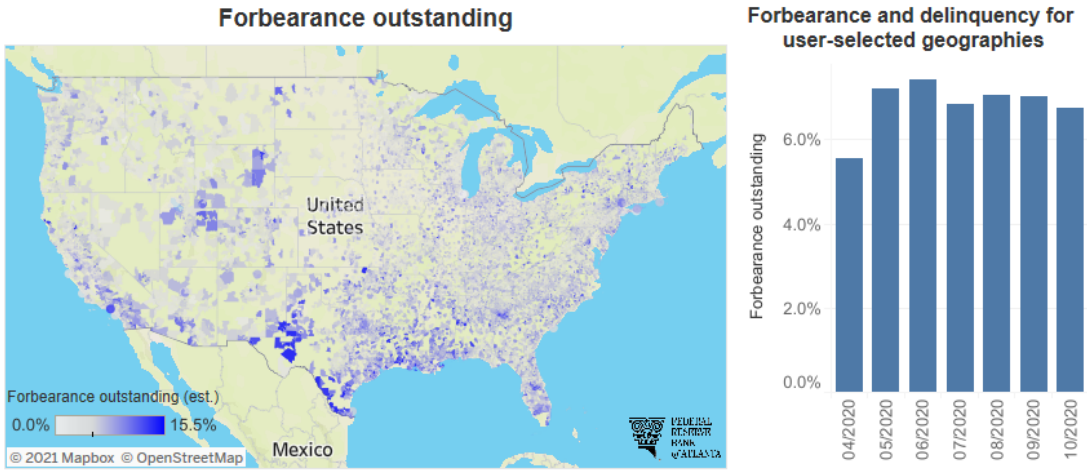

Notes: This figure plots percentage of loans outstanding forbearances as well as loans flowing into and flowing out of forbearance by month end from Black Knight McDash Flash. Blue bars represent percentage of loans in outstanding forbearance, red bars represent loans with new forbearances, and green bars represent loans exiting forbearance.

Figure 4. Loans in Forbearance by Forbearance Exit Month

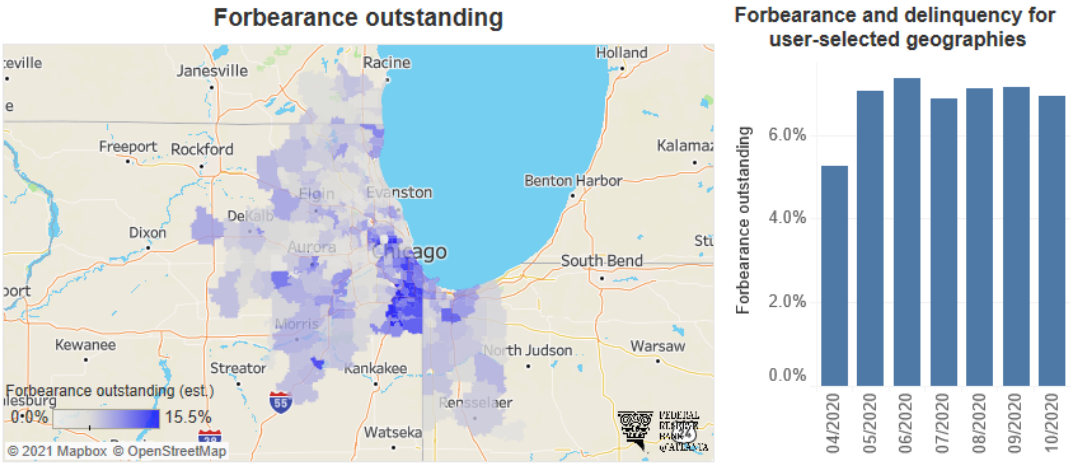



Notes: This figure plots counts of loans in forbearance by their scheduled or assumed exit date from Black Knight McDash Flash. Scheduled date is observed in our data, reported by loan servicers. Assumed exit date is calculated by assuming that the loan can stay in forbearance up to 12 months, taking into account any payments that have been made.

Figure 5. Example Maps from the Federal Reserve Bank of Atlanta's Mortgage Analytics and Performance Dashboard




(a) Map of the United States




(b) Map of Chicago-Naperville-Elgin CBSA

Notes: This figure plots example maps from the online map tool. Panel (a) plots the map for the entire United States, and Panel (b) plots the map for the Chicago-Naperville-Elgin, Core-Based Statistical Area (CBSA). Both maps show rates of forbearance at the zip code level. The map tool is available at https://www.frbatlanta.org/center-for-housing-and-policy/data-and-tools/mortgage-analytics-and-performance-dashboard.aspx. Data Sources: Federal Reserve Bank of Atlanta calculations using Black Knight McDash Flash data and Equifax Credit Risks Insight Servicing McDash (CRISM).

Table 1. Summary Statistics

| | *All Borrowers* | | *Reliable Forbearance Reporting* | |
|---|---|---|---|---|
| | Mean | Std. Dev | Mean | Std. Dev |
| Ever in Nonpayment | 0.076 | 0.265 | 0.085 | 0.279 |
| Ever in Forbearance | 0.099 | 0.299 | 0.112 | 0.316 |
| White | 0.777 | 0.417 | 0.791 | 0.407 |
| Black | 0.064 | 0.244 | 0.059 | 0.236 |
| Asian | 0.057 | 0.232 | 0.052 | 0.223 |
| Hispanic | 0.094 | 0.292 | 0.089 | 0.284 |
| Credit Score in Jan $< 620$ | 0.056 | 0.231 | 0.064 | 0.245 |
| Credit Score in Jan 620-719 | 0.236 | 0.425 | 0.189 | 0.392 |
| Credit Score in Jan $\geq 720$ | 0.708 | 0.455 | 0.747 | 0.435 |
| Borrower Income: 1st Qrtile. | 0.259 | 0.438 | 0.264 | 0.441 |
| Borrower Income: 2nd Qrtile. | 0.252 | 0.434 | 0.252 | 0.434 |
| Borrower Income: 3rd Qrtile. | 0.249 | 0.433 | 0.248 | 0.432 |
| Borrower Income: 4th Qrtile. | 0.239 | 0.427 | 0.235 | 0.424 |
| GSE Loan | 0.632 | 0.482 | 0.671 | 0.470 |
| FHA/VA Loan | 0.254 | 0.435 | 0.234 | 0.424 |
| PLMBS Loan | 0.014 | 0.117 | 0.005 | 0.074 |
| Portfolio Loan | 0.099 | 0.299 | 0.089 | 0.285 |
| Credit Score at Orig $< 620$ | 0.022 | 0.146 | 0.019 | 0.135 |
| Credit Score at Orig 620-719 | 0.334 | 0.472 | 0.322 | 0.467 |
| Credit Score at Orig $\geq 720$ | 0.644 | 0.479 | 0.659 | 0.474 |
| Log Orig Amt | 12.164 | 0.652 | 12.134 | 0.646 |
| LTV Ratio | 78.517 | 27.678 | 78.261 | 30.775 |
| Origination Year | 2014.6 | 3.373 | 2014.3 | 3.255 |
| Delinquent Before March | 0.013 | 0.111 | 0.012 | 0.109 |
| Current Interest Rate | 4.132 | 0.737 | 4.108 | 0.727 |
| Num of DPD All Accts | 0.083 | 0.522 | 0.080 | 0.511 |

Notes: This table provides summary statistics for variables in the combined dataset. All Borrowers columns include all observations, and Reliable Forbearance Reporting columns include only those with loans that Black Knight Data & Analytics, LLC (Black Knight) determines to have reliable forbearance reporting. N = 1,949,836 for All Borrowers and N = 1,068,015 for Reliable Forbearance Reporting. DPD = Days Past Due. Data sources include: Black Knight McDash Flash, Equifax Credit Risks Insight Servicing McDash (CRISM), and Confidential Home Mortgage Disclosure Act (CHMDA). Race, Hispanic status, and borrower income at application from HMDA Data.

Table 2. Mortgage Nonpayment Rates

| *Dep Var: Ever in Nonpayment* | (1) *Race Only* | (2) *Income Only* | (3) *Both* | (4) *Full Controls* |
|---|---|---|---|---|
| Black | 0.098*** | | 0.092*** | 0.027*** |
| | (0.002) | | (0.002) | (0.002) |
| Asian | 0.012*** | | 0.015*** | 0.017*** |
| | (0.004) | | (0.004) | (0.002) |
| Hispanic | 0.064*** | | 0.059*** | 0.023*** |
| | (0.004) | | (0.004) | (0.002) |
| Borrower Income: 1st Qrtile. | | 0.048*** | 0.038*** | 0.042*** |
| | | (0.002) | (0.001) | (0.001) |
| Borrower Income: 2nd Qrtile. | | 0.035*** | 0.030*** | 0.026*** |
| | | (0.001) | (0.001) | (0.001) |
| Borrower Income: 3rd Qrtile. | | 0.017*** | 0.015*** | 0.013*** |
| | | (0.001) | (0.001) | (0.001) |
| Credit Score in Jan 2020 $<$ 620 | | | | 0.113*** |
| | | | | (0.002) |
| Credit Score in Jan 2020 $\geq$ 720 | | | | -0.057*** |
| | | | | (0.001) |
| Delinquent Before March | | | | 0.447*** |
| | | | | (0.003) |
| FHA/VA Loan | | | | 0.012*** |
| | | | | (0.001) |
| PLMBS Loan | | | | -0.004* |
| | | | | (0.002) |
| Portfolio Loan | | | | -0.029*** |
| | | | | (0.001) |
| Log Orig Amt | | | | 0.019*** |
| | | | | (0.001) |
| Log Monthly Payment | | | | 0.017*** |
| | | | | (0.001) |
| Num of DPD All Accts | | | | 0.021*** |
| | | | | (0.001) |
| Observations | 1,962,159 | 1,962,159 | 1,962,159 | 1,962,159 |
| R-squared | 0.012 | 0.005 | 0.015 | 0.154 |
| Average Rate | 0.08 | 0.08 | 0.08 | 0.08 |
| Zip Code FE | N | N | N | Y |

Notes: Clustered standard errors at the county-level in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The reference group for the categorical variables is White, male, age below 35, GSE loan holders with credit scores 620-719 and borrower income relative to the MSA median 4th quartile. Other control variables include missing or other race, sex and age bins, loan origination year fixed effects, LTV ratio, credit score at origination, more than 1 account DPD and zip-code fixed effects. See Table 1 for data sources.

Table 3. Difference-in-Differences Estimate of Nonpayment Rates, 2019-2020

| | (1) | (2) | (3) |
|---|---|---|---|
| *Dep Var: Ever in Nonpayment* | *Race DD* | *Income DD* | *Full DD* |
| Black | 0.051*** | | 0.051*** |
| | (0.002) | | (0.001) |
| Asian | 0.022*** | | 0.024*** |
| | (0.004) | | (0.001) |
| Hispanic | 0.052*** | | 0.05*** |
| | (0.004) | | (0.001) |
| Borrower Income: 1st Qrtile. | | 0.023*** | 0.016*** |
| | | (0.002) | (0.000) |
| Borrower Income: 2nd Qrtile. | | 0.019*** | 0.015*** |
| | | (0.001) | (0.000) |
| Borrower Income: 3rd Qrtile. | | 0.009*** | 0.008*** |
| | | (0.001) | (0.000) |
| Credit Score in Jan <620 | | | 0.092*** |
| | | | (0.001) |
| Credit Score in Jan >= 720 | | | -0.034*** |
| | | | (0.000) |
| Delinquent Before March | | | 0.525*** |
| | | | (0.001) |
| FHA/VA Loan | | | 0.010*** |
| | | | (0.000) |
| PLMBS Loan | | | 0.006*** |
| | | | (0.001) |
| Portfolio Loan | | | -0.014*** |
| | | | (0.000) |
| Log Orig Amt | | | 0.010*** |
| | | | (0.000) |
| Log Monthly Payment | | | 0.009*** |
| | | | (0.000) |
| Num of DPD All Accts | | | 0.019*** |
| | | | (0.000) |
| Observations | 3,874,815 | 3,874,815 | 3,874,815 |
| R-squared | 0.027 | 0.021 | 0.197 |
| Zip Code FE | N | N | Y |

Notes: Clustered standard errors at the county-level in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The reference group for the categorical variables is White, male, age below 35, GSE loan holders with credit scores 620-719 and borrower income relative to the MSA median 4th quartile. Other control variables are the same as those in Table 2. See Table 1 for data sources.

Table 4. Missed Forbearance Opportunity Rates

| *Dep Var: Ever Miss Opport.* | (1) *Race Only* | (2) *Income Only* | (3) *Full Controls All Loans* | (4) *Full Controls FHA/VA,GSE* |
|---|---|---|---|---|
| Black | -0.004 | | -0.018*** | -0.019*** |
| | (0.003) | | (0.004) | (0.003) |
| Asian | -0.048*** | | -0.008*** | -0.009*** |
| | (0.003) | | (0.003) | (0.003) |
| Hispanic | -0.027*** | | -0.016*** | -0.016*** |
| | (0.003) | | (0.003) | (0.003) |
| Borrower Income: 1st Qrtile. | | 0.055*** | -0.006* | -0.007* |
| | | (0.003) | (0.004) | (0.004) |
| Borrower Income: 2nd Qrtile. | | 0.031*** | -0.008** | -0.009*** |
| | | (0.003) | (0.003) | (0.003) |
| Borrower Income: 3rd Qrtile. | | 0.017*** | -0.003 | -0.003 |
| | | (0.002) | (0.003) | (0.003) |
| Credit score in Jan $<$ 620 | | | 0.027*** | 0.026*** |
| | | | (0.003) | (0.003) |
| Credit score in Jan $\geq$ 720 | | | -0.019*** | -0.019*** |
| | | | (0.002) | (0.002) |
| Delinquent Before March | | | 0.189*** | 0.186*** |
| | | | (0.006) | (0.006) |
| Investor Type: FHA/VA | | | 0.015*** | 0.015*** |
| | | | (0.002) | (0.002) |
| Investor Type: PLMBS | | | -0.007 | - |
| | | | (0.013) | |
| Investor Type: Portfolio | | | 0.039*** | - |
| | | | (0.006) | |
| Log Orig Amt | | | -0.017*** | -0.015*** |
| | | | (0.003) | (0.003) |
| Log Monthly Payment | | | -0.010*** | -0.010*** |
| | | | (0.002) | (0.003) |
| Num of DPD All Accts | | | 0.010*** | 0.010*** |
| | | | (0.002) | (0.002) |
| Observations | 91,027 | 91,027 | 91,027 | 85,976 |
| R-squared | 0.003 | 0.006 | 0.323 | 0.325 |
| Average Rate | 0.06 | 0.06 | 0.06 | 0.06 |
| Zip Code FE | N | N | Y | Y |

Notes: Clustered standard errors at the county-level in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The reference group for the categorical variables is White, male, age below 35, GSE loan holders with credit scores 620-719 and borrower income relative to the MSA median 4th quartile. Other control variables are the same as those in Table 2. See Table 1 for data sources.

Table 5. Nonpayment Status in January 2021, Loans Ever in Forbearance

| *Dep Var: Latest Nonpayment* | (1) *Race Only* | (2) *Income Only* | (3) *Both* | (4) *Full Controls* |
|---|---|---|---|---|
| Black | 0.080*** | | 0.066*** | 0.004 |
| | (0.006) | | (0.006) | (0.008) |
| Asian | -0.052*** | | -0.050*** | -0.005 |
| | (0.008) | | (0.008) | (0.009) |
| Hispanic | 0.012 | | 0.000 | -0.016** |
| | (0.008) | | (0.007) | (0.007) |
| Borrower Income: 1st Qrtile. | | 0.121*** | 0.113*** | 0.075*** |
| | | (0.007) | (0.007) | (0.008) |
| Borrower Income: 2nd Qrtile. | | 0.078*** | 0.073*** | 0.047*** |
| | | (0.007) | (0.007) | (0.007) |
| Borrower Income: 3rd Qrtile. | | 0.031*** | 0.028*** | 0.021*** |
| | | (0.007) | (0.007) | (0.006) |
| Credit Score in Jan 2020 $<$ 620 | | | | 0.083*** |
| | | | | (0.006) |
| Credit Score in Jan 2020 $\geq$ 720 | | | | -0.111*** |
| | | | | (0.005) |
| Delinquent Before March | | | | 0.089*** |
| | | | | (0.007) |
| FHA/VA Loan | | | | 0.092*** |
| | | | | (0.006) |
| PLMBS Loan | | | | -0.005 |
| | | | | (0.019) |
| Portfolio Loan | | | | 0.174*** |
| | | | | (0.012) |
| Log Orig Amt | | | | 0.040*** |
| | | | | (0.007) |
| Log Monthly Payment | | | | -0.016*** |
| | | | | (0.005) |
| Num of DPD All Accts | | | | 0.015*** |
| | | | | (0.003) |
| Observations | 91,012 | 91,012 | 91,012 | 91,012 |
| R-squared | 0.004 | 0.008 | 0.011 | 0.241 |
| Average Rate | 0.50 | 0.50 | 0.50 | 0.50 |
| Zip Code FE | N | N | N | Y |

Notes: Clustered standard errors at the county-level in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The reference group for the categorical variables is White, male, age below 35, GSE loan holders with credit scores 620-719 and borrower income relative to the MSA median 4th quartile. Other control variables are the same as those in Table 2. See Table 1 for data sources.

Table 6. Loan Modification Options for Loans Exiting Forbearance

| | **20% Payment Reduction** | | **30% Payment Reduction** | |
|---|---|---|---|---|
| **Modifications Waterfall** | Total | Percentage | Total | Percentage |
| **Term Extension** | | | | |
| Outstanding Forbearances | 127,155 | 17.9% | 31,031 | 4.4% |
| UPB ($Bil) | 17.6 | 12.3% | 3.0 | 2.1% |
| PV Loss ($Bil) | - | 0.0% | - | 0.0% |
| **Term Extension + Rate Reduction** | | | | |
| Outstanding Forbearances | 571,249 | 80.4% | 650,997 | 91.6% |
| UPB ($Bil) | 121.7 | 85.3% | 131.2 | 91.9% |
| PV Loss ($Bil) | 2.5 | 92.6% | 7.5 | 94.1% |
| **Term Extension + Rate Reduction + Principal Deferral** | | | | |
| Outstanding Forbearances | 11,987 | 1.7% | 28,363 | 4.0% |
| UPB ($Bil) | 3.3 | 2.3% | 8.5 | 5.9% |
| PV Loss ($Bil) | 0.2 | 7.4% | 0.5 | 5.9% |
| **Total** | | | | |
| Outstanding Forbearances | 710,391 | 100% | 710,391 | 100% |
| UPB ($Bil) | 142.7 | 100% | 142.7 | 100% |
| PV Loss ($Bil) | 2.7 | 100% | 7.9 | 100% |

Notes: This table shows the number and percentage of forbearance loans that can be modified to achieve a 20% or 30% payment reduction with different modification options. We also show the present value of lost interest income associated with these modifications. See text and Appendix B for additional details on methodology employed. See Table 1 for data sources.

Table 7. Alternative Loan Modification Options for Loans Exiting Forbearance

| | **20% Payment Reduction** | | **30% Payment Reduction** | |
|---|---|---|---|---|
| **Alternative Waterfall** | Total | Percentage | Total | Percentage |
| **Term Extension** | | | | |
| Outstanding Forbearances | 127,155 | 17.9% | 31,031 | 4.4% |
| UPB ($Bil) | 17.6 | 12.3% | 3.0 | 2.1% |
| PV Loss ($Bil) | - | 0.0% | - | 0.0% |
| **Term Extension + Principal Deferral** | | | | |
| Outstanding Forbearances | 583,236 | 82.1% | 679,360 | 95.6% |
| UPB ($Bil) | 125 | 87.7% | 140 | 97.9% |
| PV Loss ($Bil) | 1.7 | 100.0% | 4.7 | 100.0% |
| **Total** | | | | |
| Outstanding Forbearances | 710,391 | 100% | 710,391 | 100% |
| UPB ($Bil) | 142.7 | 100% | 142.7 | 100% |
| PV Loss ($Bil) | 1.7 | 100% | 4.7 | 100% |

Notes: This table shows the number and percentage of forbearance loans that can be modified to achieve a 20% or 30% payment reduction with an alternative modification waterfall, where we place borrowers under term extension or term extension and principal deferral. We also show the present value of lost interest income associated with these modifications. See text and Appendix B for additional details on methodology employed. See Table 1 for data sources.

# Appendix A Data Matching Procedure

In this section, we describe the matching procedure across our datasets. The datasets we use are described in detail in Section 3 and are McDash Flash, Black Knight McDash Data, CRISM, and CHMDA data.

Matching loans in Black Knight's McDash Flash data to loans in Black Knight McDash data is straightforward as they are provided from the same source with unique loan ids. However, not all loans in the Black Knight McDash data are found in McDash Flash. Matching CRISM data with Black Knight McDash data is also straightforward, as Equifax uses loan performance data from McDash primary to match to mortgage loans held by borrowers in their credit history data and provide the unique loan identifier used in McDash. Equifax employs its own proprietary algorithm for matching loans in its credit histories with loans in the Black Knight McDash dataset, which uses loan information such as loan amount, zip code, origination date, and other criteria. Following Equifax guidance, we only take loans with a sufficiently high confidence on the match.

The bulk of our work is done to match loans in McDash to loans in CHMDA, which is information provided by the lenders at loan application. The matching algorithm is based on the work of Rosen (2011) and uses the following criteria:

1. Geography: CHMDA provides the Census Tract of the property, while McDash provides the zip code of the property. Therefore, we use a concordance between Census Tracts and zip codes provided by MABLE/Geocorr from the Missouri Census Data Center.[36] However, some Census Tracts may be matched to multiple zip codes, and vice versa. For these loans, we let them match to all possible combinations of zip code to Census Tract.

2. Loan origination characteristics: We match loans by their loan amount, lien status, occupancy, loan purpose, and loan type. For loan amounts prior to 2018, CHMDA required lenders to report loans in 1,000s of dollar amount, with rounding. As such, we only require loans to be within a $500 band between CHMDA and McDash. However, for loan amounts 2018 and after, CHMDA provides the full amounts down to the dollar. Because there were some cases in which loans were reported to the nearest $10 amount, we let loans be different up to $10.

[36] https://mcdc.missouri.edu/applications/geocorr.html.

3. Closing Date: Because there is some flexibility in how servicers and lenders report the closing date, we allow the most flexibility in this regard. First, the McDash data exhibits bunching on the 1st of the month, indicating the exact closing date is not recorded. Second, CHMDA allows some flexibility in reporting the closing date. Therefore, we first match loans using the exact dates as reported; then, for loans not matched using exact dates, we find loans that have closing dates within five days of each other; for loans still not matched, we allow any loan in the same month to be matched.

As can be seen from the procedure described above, it is possible that multiple matches for the same loan can occur. These cases include pure multiples, where two loans share the same characteristics. Or it could be an artifact of our inexact matching criteria. For example, multiple loans could be within the same loan amount band, or in Census Tracts that are large enough to have multiple zip codes. In order to avoid making judgments on these cases, we only use loans that were uniquely matched between McDash and CHMDA. Moreover, to preserve the anonymity of the data, we remove all identifying information for borrowers, servicers, and lenders.

Table A1 shows the match rates and means of various characteristics of loans and borrowers across our matches. Column (1) shows our baseline data to examine the match, which are borrowers in CRISM which has a matched McDash loan in June 2020. Going across the columns, we see that about 65 percent of the CRISM borrowers are matched to CHMDA (Column 2), 69 percent are matched to McDash Flash (Column 3), and 47 percent are matched to both (Column 4).

We also see that loans matched to CHMDA, Flash, or both datasets do not differ significantly in their borrower or loan characteristics. There seems to be some indication that those matched to Flash data are slightly better selected than those in our baseline CRISM data. For example, borrowers with loans matched to both CHMDA and Flash belong to the highest credit score group at a slighly higher rate (62 percent) compared to the full sample of CRISM borrowers (58 percent). However, other differences are small or zero.

## Appendix B Loan Modification Calculations

For each individual loan still in forbearance, we conduct calculations to see which modification option(s) will help lower the monthly payment by the target amount and what the investor losses in interest income are for the option(s).

The PVs of the income streams from various modifications are estimated and compared to the PVs of the income streams in the baseline case in which the borrower resumes timely payments with the missed payments during the forbearance period deferred to the end of the loan. To get the outer-bound cost of modifications, we assume borrowers extend their forbearances to the maximum of 12 months allowed under the CARES Act. We assume a life of five years (60 months) for each loan.[37] We also extrapolate our McDash Flash sample to the full market (see Appendix Table A4).

The income stream to the noteholder is the monthly payments for five years and the remaining balance and deferred payments paid at the end of year five. For simplicity and to account for variation in risk among our investor base, we discount income streams at the current note rate. The PV of the remaining loan in the baseline case is:

$$PV_b = UPB_b + \frac{12 * PMT_b}{(1 + R_b/12)^{60}}, \tag{A1}$$

where $PV_b$ is the present of the income stream in baseline $b$; $UPB_b$ is the unpaid principal balance of the loan at the time when the borrower comes out of forbearance, calculated as if the borrower has made all the payments during forbearance; $R_b$ is the current note rate; $PMT_b$ is the scheduled payment; and 60 is the assumed weighted average life (WAL) of the loans.

Remedy 1 is the first and least costly option, extending the loan maturity from 30 years to 40 years, a common practice during the Great Recession. For Remedy 1, the unpaid balance $UPB_b$ is reamortized for the remaining loan term to lower the payment. If it is enough to bring the loan payment down to the target, this remedy is selected. Since the income stream will be discounted at the same note rate the PV of the modified loan with Remedy 1 is therefore:

$$PV_1 = UPB_b + \frac{12 * PMT_b}{(1 + R_b/12)^{60}}, \tag{A2}$$

where the PV works out to be exactly the same as in the baseline scenario.

If extending the term does not reach the target payment, Remedy 2 extends the loan term as above and lowers the interest rate until the mortgage payment is lowered to the target rate, down to an interest-rate floor of 2 percent. For loans whose payment can be lowered to the target with Remedy 2, the new note rate is calculated as $R_m$.

[37] Based on our observation of average life of loans in McDash. The assumption can be easily changed.

The income stream to the noteholder is the target payment $PMT_2$ payable for five years at the new remaining balance by year five of $RBal_2$ along with the deferred 12 missed payments. The PV in this case is:

$$PV_2 = PMT_2 * \frac{1 - \frac{1}{(1+R_b/12)^{60}}}{R_b/12} + \frac{RBal_2 + 12 * PMT_b}{(1 + R_b/12)^{60}}. \tag{A3}$$

For loans whose terms are extended to 40 years and whose interest rates are reduced to the 2 percent floor but still cannot reach the target payment, Remedy 3 includes a principal deferral in the modification waterfall. Starting with a 40-year term and 2 percent interest rate, Remedy 3 calculates the loan balance $UPB_m$ that brings the payment down to the target $PMT_3$. The deferred principal balance is therefore $UPB_d = UPB_b - UPB_m$. The income stream to the noteholder is the target monthly payment $PMT_3$ for five years, the new remaining balance at year five, $RBal_3$, the deferred 12 missed payments, and the deferred principal balance $UPB_d$ all paid at the end of year five. The PV in this case is:

$$PV_3 = PMT_3 * \frac{1 - \frac{1}{(1+R_b/12)^{60}}}{R_b/12} + \frac{RBal_3 + UPB_d + 12 * PMT_b}{(1 + R_b/12)^{60}}. \tag{A4}$$

Appendix Table A1. Match Rates and Characteristics

| | (1) *All CRISM* | (2) *CHMDA-Matched* | (3) *Flash-Matched* | (4) *Both-Matched* |
|---|---|---|---|---|
| Match Rate | 100% | 65% | 69% | 47% |
| | | | *Means* | |
| Current Credit Score | 746.30 | 748.57 | 754.46 | 755.60 |
| Current Credit Score $< 620$ | 0.06 | 0.05 | 0.06 | 0.05 |
| Current Credit Score 620-719 | 0.19 | 0.20 | 0.16 | 0.16 |
| Current Credit Score $\geq 720$ | 0.58 | 0.61 | 0.58 | 0.62 |
| Current Credit Score Missing | 0.17 | 0.14 | 0.20 | 0.17 |
| Credit Score at Orig | 728.55 | 730.95 | 729.64 | 732.47 |
| Credit Score at Orig $< 620$ | 0.04 | 0.03 | 0.04 | 0.03 |
| Credit Score at Orig 620-719 | 0.30 | 0.31 | 0.29 | 0.30 |
| Credit Score at Orig $\geq 720$ | 0.52 | 0.55 | 0.55 | 0.58 |
| Credit Score at Orig Missing | 0.15 | 0.11 | 0.12 | 0.09 |
| Age | 52.43 | 51.51 | 52.54 | 51.85 |
| Age $< 35$ | 0.10 | 0.12 | 0.10 | 0.11 |
| Age 35-44 | 0.22 | 0.23 | 0.22 | 0.23 |
| Age 45-54 | 0.24 | 0.24 | 0.24 | 0.24 |
| Age 55-64 | 0.23 | 0.22 | 0.24 | 0.23 |
| Age $\geq 65$ | 0.20 | 0.19 | 0.21 | 0.20 |
| GSE Loan | 0.61 | 0.61 | 0.63 | 0.64 |
| FHA/VA Loan | 0.27 | 0.28 | 0.25 | 0.25 |
| PLMBS Loan | 0.04 | 0.03 | 0.04 | 0.03 |
| Portfolio Loan | 0.08 | 0.09 | 0.08 | 0.09 |
| Orig Amount | 227068.14 | 230939.35 | 227620.43 | 229701.10 |
| LTV Ratio | 78.74 | 79.30 | 78.21 | 86.18 |
| Monthly Payment | 2875.76 | 2883.66 | 2879.48 | 2893.09 |
| Closing Year | 2013.38 | 2014.08 | 2013.33 | 2013.85 |
| Current Interest Rate | 4.28 | 4.20 | 4.26 | 4.20 |
| Count of Accounts | 7.46 | 7.50 | 7.41 | 7.44 |
| Count of DPD Accounts | 0.06 | 0.06 | 0.06 | 0.05 |
| Non-FM Balance Past Due | 33.65 | 27.80 | 33.28 | 29.28 |

Notes: We start with a 20% sample of borrowers with first-mortgage loans in the CRISM data observed in June 2020. Column (2) are borrowers with loans matched only to CHMDA data. Column (3) are borrowers with loans matched only to McDash Flash data. Column (4) are loans matched to both. See Table 1 for data sources.

Appendix Table A2. Mortgage Nonpayment Rates, 2019 and 2020

| *Dep Var: =1 if Ever in Nonpayment* | (1) *2019* | (2) *2020* |
|---|---|---|
| Black | 0.008*** | 0.027*** |
| | (0.001) | (0.002) |
| Asian | -0.001*** | 0.018*** |
| | (0.000) | (0.002) |
| Hispanic | -0.001*** | 0.023*** |
| | (0.000) | (0.002) |
| Borrower Income: 1st Qrtile. | 0.005*** | 0.042*** |
| | (0.000) | (0.001) |
| Borrower Income: 2nd Qrtile. | 0.003*** | 0.026*** |
| | (0.000) | (0.001) |
| Borrower Income: 3rd Qrtile. | 0.001*** | 0.013*** |
| | (0.000) | (0.001) |
| Credit Score in Jan $<$ 620 | 0.069*** | 0.113*** |
| | (0.001) | (0.002) |
| Credit Score in Jan $\geq$ 720 | -0.012*** | -0.057*** |
| | (0.000) | (0.001) |
| Delinquent Before March | 0.602*** | 0.447*** |
| | (0.003) | (0.003) |
| FHA/VA Loan | 0.009*** | 0.012*** |
| | (0.000) | (0.001) |
| Private Securitized Loan | 0.012*** | -0.004* |
| | (0.001) | (0.002) |
| Portfolio Loan | -0.000 | -0.029*** |
| | (0.000) | (0.001) |
| Log Orig Amt | 0.002*** | 0.019*** |
| | (0.000) | (0.001) |
| Log Monthly Payment | 0.000 | 0.017*** |
| | (0.000) | (0.001) |
| Num of DPD All Accts | 0.016*** | 0.021*** |
| | (0.001) | (0.001) |
| Observations | 1,924,979 | 1,949,836 |
| R-squared | 0.370 | 0.153 |
| Average Rate | 0.02 | 0.08 |
| Zip Code FE | Y | Y |

Notes: This table shows cross-sectional results separately for 2019 and 2020 samples. Standard errors in parentheses are clustered at the county level, with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The reference group for the categorical variables is White, male, age below 35, GSE loan holders with credit scores 620-719 and borrower income relative to the MSA median 4th quartile. Other control variables are the same as those in Table 2. See Table 1 for data sources.

Appendix Table A3. Loan Modification Options by Investor Type

| | FHA/VA | GSEs | PLMBS | Portfolio | Total |
|---|---|---|---|---|---|
| **Loans in Forbearance** | 1,173,425 | 944,030 | 266,287 | 464,424 | 2,848,166 |
| **UPB ($Bil)** | 242 | 206 | 54 | 96 | 598 |
| **Lower monthly payment by 20%** | | | | | |
| **Term Extension** | | | | | |
| Number of Loans | 176,513 | 126,588 | 126,596 | 156,880 | 586,577 |
| UPB ($Bil) | 24.0 | 17.3 | 21.3 | 18.4 | 81.0 |
| PV Loss ($Bil) | - | - | - | - | - |
| **Term Extension + Rate Reduction** | | | | | |
| Number of Loans | 995,826 | 816,351 | 86,025 | 292,465 | 2,190,667 |
| UPB ($Bil) | 218.2 | 188.5 | 19.2 | 72.0 | 497.9 |
| Rate Reduction | 0.44% | 0.52% | 0.68% | 0.41% | 0.48% |
| PV Loss ($Bil) | 4.2 | 4.2 | 0.6 | 1.3 | 10.3 |
| **Term Extension + Rate Reduction + Principal Deferral** | | | | | |
| Number of Loans | 1,087 | 1,091 | 53,666 | 15,079 | 70,922 |
| UPB ($Bil) | 0.2 | 0.2 | 13.3 | 5.1 | 18.9 |
| Rate Reduction | 1.52% | 0.64% | 0.64% | 1.44% | 0.86% |
| Deferral Amount | 0.02 | 0.02 | 3.55 | 1.34 | 4.93 |
| PV Loss ($Bil) | 0.0 | 0.0 | 0.7 | 0.4 | 1.2 |
| **Total PV Loss** | 4.2 | 4.2 | 1.2 | 1.7 | 11.4 |
| **Lower monthly payment by 30%** | | | | | |
| **Term Extension** | | | | | |
| Number of Loans | 31,598 | 29,386 | 45,031 | 51,758 | 157,774 |
| UPB ($Bil) | 2.1 | 2.4 | 6.5 | 4.0 | 15.1 |
| PV Loss ($Bil) | - | - | - | - | - |
| **Term Extension + Rate Reduction** | | | | | |
| Number of Loans | 1,118,900 | 905,649 | 138,447 | 375,448 | 2,538,444 |
| UPB ($Bil) | 232.9 | 200.8 | 27.4 | 77.4 | 538.7 |
| Rate Reduction | 1.31% | 1.38% | 1.12% | 1.21% | 1.32% |
| PV Loss ($Bil) | 13.2 | 11.9 | 1.3 | 4.0 | 30.4 |
| **Term Extension + Rate Reduction + Principal Deferral** | | | | | |
| Number of Loans | 22,927 | 8,995 | 82,808 | 37,218 | 151,948 |
| UPB ($Bil) | 7.4 | 2.7 | 19.8 | 14.1 | 44.0 |
| Rate Reduction | 0.96% | 0.94% | 0.75% | 1.14% | 0.93% |
| Deferral Amount | 0.28 | 0.12 | 5.12 | 2.13 | 7.65 |
| PV Loss ($Bil) | 0.3 | 0.1 | 1.1 | 0.9 | 2.5 |
| **Total PV Loss** | 13.5 | 12.0 | 2.4 | 4.9 | 32.9 |

Notes: This table shows PV Loss of loan modification, broken down by investor. See Table 6 for additional notes and Table 1 for data sources.

Appendix Table A4. Total U.S. 1-4 Family Mortgage Market: Loan Counts and Balances

Panel A. By Loan Counts

| *Investor/Product* | *Total Market Size (Thousands)* | *Forbear Rate (Percent)* | *Extrapolated Counts in Forbear (Thousands)* |
|---|---|---|---|
| FHA/VA | 12,100 | 9.7 | 1,173 |
| GSE | 27,900 | 3.4 | 944 |
| Portfolio | 10,500 | 4.4 | 464 |
| PLMBS | 2,500 | 10.7 | 266 |
| **Total** | **53,000** | | **2,848** |

Panel B. By Loan Balance

| *Investor/Product* | *Total Market Size ($ Billions)* | *Forbear Rate (Percent)* | *Extrapolated Balance in Forbear ($ Billions)* |
|---|---|---|---|
| FHA/VA | 2,291 | 10.6 | 242 |
| GSE | 5,486 | 3.8 | 206 |
| Portfolio | 2,397 | 4 | 96 |
| PLMBS | 433 | 12.4 | 54 |
| **Total** | **10,607** | | **598** |

Notes: This table represents total counts and dollar balances of all first lien 1-4 family U.S. mortgages used to extrapolate our McDash Flash sample to the market. FHA/VA includes GNMA securities and portfolio loans that are GNMA buybacks purchased out of securities pools. Portfolio loans exclude from IMF figures home equity loans and GNMA buybacks. GNMA = Government National Mortgage Assn., FHA/VA = Federal Housing Administration/Veterans Affairs, GSE = Government-Sponsored Enterprise, and PLMBS = Private Label Mortgage Backed Securities. Counts are provided by Black Knight. Balances are as of 2019Q3 from *Inside Mortgage Finance*. For our extrapolation to the full market of forbearances, we first identify in the McDash Flash data the share of loans that are COVID-19 forbearances for each investor type above and calculate forbearance rates. The calculated forbearance rates from the data sample are then applied to the market for each investor/product segment to get the forbearances estimate for each investor/product type in the market.