

ABOUT THIS REPORT:

This paper examines the effect of foreclosure prevention policies during the pandemic on refinancing activities in the United States. By analyzing the foreclosure moratorium introduced soon after the COVID-19 began, we show the multiple benefits of preventing a foreclosure shock in the United States. Undertaking foreclosure forbearance during economic crises helps stabilize house prices, significantly reduces the refinancing cost facing households and relaxes their refinancing eligibility constraints. Our results imply that a foreclosure moratorium has significant benefits for a broad range of households who intend to refinance. Mortgage forbearance amplifies the stimulative effect of monetary policies for households and the economy overall during major shocks.

The Effects of Mortgage Forbearance on Refinancing: Evidence from the COVID-19 Period *

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June 11, 2021

Abstract

This paper examines the effect of the COVID-19 foreclosure moratorium on refinancing. Through a counterfactual analysis, we show that the foreclosure moratorium decreases significantly the refinancing cost of households and relaxes their refinancing eligibility constraints. Our results imply that granting forbearance to households facing foreclosures has positive externalities on a broader range of households who intend to refinance. Mortgage forbearance thus amplifies the stimulative effect of monetary policies.

Keywords: CARES Act, Foreclosure, Refinancing, Mortgage Forbearance, GSE, Monetary Policy.

JEL Classification: E44, G01, G2, G28.

*We would like to thank Tianyu Wang for the excellent research assistance. We are grateful to Tomasz Piskorski (discussant), Anton Korinek, Sumit Agarwal, Irena Vodenska (discussant), Chuan Du, Cynthia Balloch, and Levent Altinoglu for interesting discussions and valuable comments. We would also like to thank the seminar participants of the INET Virtual Seminar, and of the Australian Finance Banking Conference. Agostino Capponi acknowledges financial support from the Global Risk Institute.

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1 Introduction

Foreclosures can have significant consequences on the real economy. A prominent example is the 2007-2008 financial crisis, where an unprecedented wave of foreclosures hit the economy. Foreclosure shocks led to large declines in house prices and residential investment (see, for instance, Mian, Sufi, and Trebbi (2015) and Piskorski and Seru (2020)).

The recent COVID-19 pandemic imposed financial challenges on millions of homeowners in the United States, who struggled to pay their mortgages. To reduce the risk of widespread foreclosures, Congress passed the CARES Act and signed it into law on March 27, 2020. The Act offers mortgage forbearance to all mortgages backed by Ginnie Mae as well as the two government sponsored enterprises (GSEs), Fannie Mae and Freddie Mac, until June 30, 2020, and all in-progress foreclosure proceedings on such loans are paused. Later, the Federal Housing Finance Agency (FHFA) extended Fannie Mae and Freddie Mac's foreclosure moratorium until at least March 31, 2021; Federal Housing Administration (FHA) and U.S. Department of Veterans Affairs (VA) also extended the moratorium for FHA and VA guaranteed mortgages until at least June 30, 2021. The moratorium grants American homeowners the option to defer mortgage payments without penalty.

In this paper, we use the foreclosure moratorium embedded in the CARES Act to examine the impact of mortgage forbearance on refinancing activities. Our main conclusion is that by preventing foreclosures, the foreclosure moratorium stabilizes house prices, which then by collateral effects, decreases the refinancing cost of households and relaxes their refinancing eligibility constraints.

Conducting a quantitative analysis on how mortgage forbearance affects refinancing activity is important for several reasons. First, during periods of crisis such as COVID-19, mortgage refinancing is a crucial channel for households to benefit from the stimulative effect of monetary policies. In the US, house makes up around two thirds of the median household total wealth, and fixed rate mortgages are the most dominant type of debt for the household sector (Iacoviello (2011), Campbell (2012)). As a result, in adverse economic

conditions, the central bank supports mortgage refinancing through interest rate cuts and quantitative easing, which then facilitates the provision of liquidity and credit to households (see, for instance, Di Maggio, Kermani, and Palmer (2019), Keys et al. (2014)). Refinancing activities have a large impact on the real economy, especially during crisis periods. For example, refinancing reduces the interest payments of mortgagors and significantly lowers their default probability (see Agarwal et al. (2015), Agarwal et al. (2017) and Fuster and Willen (2017)). Moreover, refinancing provides liquidity to households, which effectively increases their consumption and have a large stimulus effect on the real economy (see Agarwal et al. (2015), Mian and Sufi (2011), Cloyne, Ferreira, and Surico (2019), Hurst and Stafford (2004), Canner, Dynan, and Passmore (2002) and Di Maggio et al. (2017)). However, foreclosure may dampen this stimulative effect when it is mostly needed. Second, it is important for policy makers to understand whether mortgage forbearance can support the pass-through of monetary policy through the refinancing channel. If this is the case, debt forbearance policies which target households facing foreclosures can have positive externalities on a broader range of households who intend to obtain liquidity or credit through refinancing. Such a benefit needs to be taken into consideration when designing policy intervention during crisis times.

Our paper unfolds in two parts. First, we assess the amount of foreclosures the mortgage forbearance has prevented and evaluate its impact on house prices. Second, through a counterfactual analysis, we examine how the refinancing cost of households and their refinancing eligibility constraints are affected by the mortgage forbearance. This approach helps us understand the underlying mechanism through which refinancing activities are affected by government intervention, and it sets us apart from prior work which mainly focused on how aggregated refinancing volumes or rates are impacted by policies.

We begin by evaluating the counterfactual amount of foreclosures in the absence of a forbearance program. This task is challenging for two main reasons. First, since the mortgage forbearance is nationwide, a compelling quasi-experiment using regional segmentation is

difficult to design. Second, mortgage forbearance also provides incentives for some households to be strategically delinquent (see, for instance, Mayer et al. (2014)) and postpone their monthly mortgage payments by 6-12 months. It is thus important for the counterfactual analysis to account for this strategic behavior. We circumvent those two difficulties by (i) rationally identifying mortgagors that could be strategically delinquent, and (ii) proposing a Markov transition model to create the counterfactual.

We use monthly, loan-level delinquency data to identify the mortgagors who are experiencing financial difficulty, and are thus unable to pay their monthly mortgages. We start by using two criteria to identify strategically delinquent mortgagors. The first criteria is based on a net present value (NPV) calculation of the future mortgage payments. We exploit the requirement that a mortgage in forbearance is not eligible for refinancing for a long period of time after which the loan becomes current again. This means that a strategic mortgagor has to make a choice between refinancing and strategic delinquency. The second criteria is based on observed Voluntary Prepayment Rates (VPRs) of mortgages with similar coupon and maturity. When the VPRs are sufficiently high, it means that loans with similar coupon and maturity are often prepaid, suggesting that the benefit of refinancing them is higher than strategic delinquency. We then estimate a Markov transition model for delinquent mortgages. Using the estimated transition rate from delinquencies to foreclosures along with the delinquent loans identified as non strategically delinquent in the first step, we find that the foreclosure moratorium has prevented approximately 900,000 foreclosures filings in the months from April through October 2020.

We then evaluate how foreclosure would have impacted house prices in the absence of a moratorium. It has been well documented that preventing foreclosures can stop the transmission and amplification of financial shocks through the housing market (see Calomiris, Longhofer, and Miles (2013), Guren and McQuade (2020), Arslan, Guler, and Taskin (2015), and Chatterjee and Eyigungor (2009)). These studies analyze the two-way channel between foreclosures and house prices: a surge in foreclosures causes a drop in house prices, and a

drop in house prices precipitates more foreclosures. Due to this feedback loop, an initial surge of foreclosures could lead to a persistent drop in house prices. The findings of these studies imply that the forbearance would stabilize house prices by shutting down the spillover effect of foreclosures. We confirm this stabilizing effect using monthly data and a structural vector autoregression (SVAR) model similar to the one in Calomiris, Longhofer, and Miles (2013). Our counterfactual estimate suggests that without the foreclosure moratorium, house prices would have dropped in the months from April through October 2020.

Finally, we investigate how the above-mentioned declines in house prices would have further affected households through the refinancing channel. Using GSE loan-level data as well as GSE eligibility requirements and the loan-level pricing adjustment (LLPA) table, we document that a decline in house prices, which reduces the value of home equity and increases households leverage, can negatively impact refinancing activities in three different ways through the collateral channel: tightening the refinancing eligibility constraint, lowering equity extraction, and increasing refinancing cost of households.

The first serious impact of house price declines on refinancing activities is that a significant portion of households will no longer be eligible for refinancing, because lenders normally require a minimal amount of home equity for mortgagors to refinance. Using loan-level data on GSE-backed, 30-year fixed-rate refinance loans originated since the start of the pandemic, we estimate that 3.3% of total non-cashout refinance loans (about 60,000) would have been ineligible to refinance through standard GSE programs in the absence of forbearance. The second consequence of a decline in house prices is less equity extraction from households as mortgagors need to maintain a minimum level of home equity after cash-out refinance. We show that the foreclosure moratorium allowed about 145,000 households (roughly 22% of total cash-out refinance) to extract around \$15,000 more, on average, from their home equity. The third negative effect of a house price decline is a much higher refinancing cost for households. Our counterfactual analysis shows that, in the absence of forbearance, the house price decline would have greatly increased the refinancing cost of households through changes

in their LTV ratios. We estimate that 37% of total mortgagors who refinanced from April to October 2020 (about 900,000) would have higher LLPA fees, which on average cost those homeowners an extra amount of around \$1,400 in the form of an upfront fee, or equivalently an extra \$5,600 in interest payment over the life of the loan. We also estimate that 14.5% of the total households with non-cashout refinance (about 260,000) would have been required to purchase private mortgage insurance (PMI) due to high LTV ratios, resulting in additional cost with estimates ranging from \$1,450 to \$2,900.

We then explore the cross-sectional heterogeneity of the increase in refinancing cost. We find that the group of mortgagors with low credit scores would have been more severely impacted in the absence of forbearance, and roughly 50% of them would have incurred an extra refinancing cost, resulting in either an additional up-front fee higher than \$3,700, or an average extra interest payment of \$15,500 over the life of the loan.

We use our counterfactual to quantify the impact of mortgage forbearance on aggregate consumption through the refinancing channel. Our back-of-the-envelope calculation indicates that the additional home equity extracted and the refinancing cost saved due to the moratorium can increase households' consumption by at least 6.4 billion. This implies that mortgage forbearance assists the delivery of liquidity and credit to households through the refinancing channel, which then supports the real economy during crisis times.

Our findings suggest that, without forbearance, the foreclosure shocks would not only affect the group of households which are unable to pay their mortgage in adverse economic times, but also have negative externalities on a wide range of households which borrow against their home equity. As a result, mortgage forbearance designed to prevent foreclosures can amplify the stimulative effect of monetary policy through the refinancing channel. This highlights the importance of coordinating household debt forbearance and monetary policies.

Literature Review. Our study is related to literature on the economic impact of foreclosure prevention policies. (e.g., Alston (1984); Clauretje and Herzog (1990); Collins and

Urban (2018); Gerardi, Lambie-Hanson, and Willen (2013); Mitman (2016); Agarwal et al. (2017); Eberly and Krishnamurthy (2014); Piskorski and Seru (2018)) In particular, Agarwal et al. (2015) analyze the efficacy of the Home Affordable Refinance Program (HARP). They show that by helping under-collateralized mortgage borrowers refinance, HARP led to less foreclosures, more consumption, and faster house price recovery. It is worth remarking that the mechanism in their study works in the opposite direction to ours. One potential explanation is that mortgage forbearance is a remedy imposed ex-ante to directly avoid foreclosure and support refinancing. In contrast, to reverse the situation ex-post, i.e., after foreclosure shocks occurred, corrective actions should target homeowners who have not yet defaulted but could be delinquent in the future, by providing favorable conditions to refinance their mortgages. Also, Cherry et al. (2021) analyze extensively the debt forbearance policies during the COVID-19 period, including mortgage, auto loans, student loans, and so on. They illustrate that apart from the forbearance mandated in the CARES Act, the private sector also provides substantial debt forbearance. Our contribution relative to these studies is to document and quantify how mortgage forbearance could prevent foreclosure shocks from being amplified and transmitted to a wide range of households through the refinancing channel. Our findings indicate that foreclosure prevention policies can facilitate the pass-through of lower interest rate to households who intend to refinance. Hence, this benefit should be taken into consideration for the evaluation of the program's success.

Our work also contributes to the stream of literature which has investigated the relationship between foreclosure and house prices. Several studies (see, for example Anenberg and Kung (2014), Campbell, Giglio, and Pathak (2011), Mian, Sufi, and Trebbi (2015), Harding, Rosenblatt, and Yao (2009) and Hartley (2010)) have shown that foreclosure affects house prices negatively through multiple channels. Mayer, Pence, and Sherlund (2009) show that a decline in house prices also lead to more mortgage defaults. Guren and McQuade (2020), Calomiris, Longhofer, and Miles (2013), Arslan, Guler, and Taskin (2015), and Chatterjee and Eyigungor (2009) explore the feedback mechanism between house prices and foreclo-

tures. They show that not only more foreclosures impose a downward pressure on house prices, but also that declining house prices lead to more foreclosures. Our findings suggest that the spillover effect of foreclosures is not limited to declining house prices. In fact, our study shows that the spillover effect of foreclosures could impact mortgage refinancing of the entire household sector, which has important implications on borrowing activities of the real economy.

Our results also contribute to the stream of literature that has analyzed how changes in house prices influence refinancing. (e.g., Mian and Sufi (2011); Bhutta and Keys (2016); Mian and Sufi (2014); Beraja et al. (2018); Cloyne et al. (2019)) We advance this strand of literature in multiple aspects. On one hand, our paper studies and specifies how house prices affect refinancing activities through the collateral channel at a micro level. We quantify how household's refinancing eligibility, equity extraction, and refinancing cost would have been impacted by a decline in house prices by means of our loan-level counterfactual analysis. On the other hand, our study emphasizes that in order to support refinancing, it is important to prevent large foreclosure shocks so to avoid negative spillover effects on house prices. Our empirical results highlight that debt forbearance policy aimed at preventing foreclosures can support the transmission of monetary policies through the mortgage market. In addition, our findings complement those of Agarwal et al. (2020) who show that mortgage refinancing during the COVID-19 pandemic may have the unintended consequence of contributing to wealth inequality.

The rest of the paper is organized as follows. We provide institutional details of the mortgage market in Section 2. We describe the data set in Section 3. In Section 4, we present our main results on the impact of forbearance on refinancing activities through prevention of foreclosures and stabilization of house prices. We conclude in Section 5.

2 Institutional Structure of the Mortgage Market

In this section, we provide institutional details. Section 2.1 gives a brief overview of the mortgage market. Section 2.2 discusses the delinquency and foreclosure process, as well as mortgage refinancing. Section 2.3 examines mortgage forbearance along with changes in delinquencies and foreclosures observed during the COVID-19 pandemic period.

2.1 Overview of the Mortgage Market

Mortgages are the second largest sector of the U.S. fixed-income security market behind U.S. Treasury debt. The total outstanding unpaid balance of American mortgages on 1-4 family homes is currently roughly \$11.2 trillions, according to the Federal Reserve Z1 table released in June 2020.¹ Most of these mortgages are fixed rate, that is, the monthly coupon and payment are constant, and some are adjustable rate mortgages (ARMS), which retain monthly payments but whose interest payment is reset periodically. The most common term for mortgages is 30 years (amounting to 360 payments in total), but other terms do exist and 15 years is the second most common. It has been estimated that more than about 90% of the U.S. mortgages are 30-year, fixed-rate mortgages (see Campbell (2012)).

Mortgage loans can be held by the banks or other institutions that originate them, or they can be sold into the secondary market. When sold, the loans are often “wrapped” with additional credit protection. In the event of a default, the real estate backing the mortgage (the collateral) can be seized and sold to pay off the remaining debt. Any shortfall is a loss for the debt holder, not the borrower. Unlike other countries, in the United States the borrower is not personally responsible for the debt, i.e., there is no recourse. Defaults occur most often when the homeowner cannot sell the house above the debt level, and it is not uncommon for these shortfalls to occur. There are multiple ways mortgages can be

¹The Z1 table is accessible at the Federal Reserve website (<https://www.federalreserve.gov/releases/z1/20200611/z1.pdf>). Mortgages can be made on any property. Homes built for a single family, or with 1, 2 or 3 extra apartments are referred to as 1-4 family homes. Above 4, it becomes a “multifamily” residence. The total outstanding U.S. residential mortgage debt on 1-4 family homes can be found in L.217.

wrapped; private mortgage insurance, deal structure, and, most importantly through the Federal Government, Ginnie Mae, or either of the two government sponsored enterprises, Fannie Mae and Freddie Mac.

Ginnie Mae provides US Government backing to roughly 18% of the outstanding balance. In addition, the two GSEs, Fannie Mae and Freddie Mac, provide credit backing to another 44% of the outstanding balance. The remaining balance is owned as raw loans (with no additional credit enhancement), or securitized through as non agency deals. These non agency deals played a significant role in the 2008 financial crisis, but have been a much smaller segment of the market in 2020.

2.2 Delinquencies, Foreclosures, and Refinancing

Mortgage payments are monthly, beginning one month after the loan is issued and continuing until the original loan amount, net of interest, is paid. Delinquencies occur when a homeowner is unable, or unwilling, to make mortgage payments. If the mortgagor misses a payment, then the loan is reported to be 30-day delinquent as of the calendar end of month. If the mortgagor is 30-day delinquent and then misses a second payment, he is counted as 60-day delinquent, and so forth. Mortgagors who have missed 3 or more consecutive payments are counted as 90+ delinquent. At any time, the mortgagor may make up for all or a few of the missing payments to bring the loan out of delinquency or to reduce the severity of its status. Under normal market conditions, a loan will go from 30-day, to 60-day, to 90-day delinquent and then into the foreclosure process. The mortgage servicer will repossess and sell the loans collateral, and use the proceeds to pay the bond holder.

When the interest rate decreases significantly, households who hold fixed-rated mortgages can refinance them, that is, paying off their existing mortgage with a new loan at a lower interest rate. Failing to refinance leads to a large amount of foregone savings, which on average costs households \$160 per month, or \$45,000 (unadjusted) over the remaining life of the loan (see Keys, Pope, and Pope (2016) for details).

There are two different types of refinancing: non-cashout refinance and cashout refinance. A cashout refinance replaces the homeowner's existing mortgage with a new mortgage whose loan amount is larger than the unpaid balance of the existing mortgage. The difference is cashed out by the homeowner, and used at his discretion. In contrast, with a non-cashout refinance, the homeowner borrows an amount which does not exceed the current remaining balance plus any additional closing cost.

Not all loans are eligible for a refinance through standard GSE programs. GSEs impose requirements, such as a maximum LTV ratio, which need to be met.² Loans which do not satisfy these requirements can only refinance through other special programs, such as High LTV Refinance Option (HIRO). Additionally, there are several costs associated with refinancing, including closing fees, insurance cost, and points. Points are upfront fees charged to pay off the loan-level pricing adjustment fee (LLPA) imposed by GSE in exchange for a lower interest rate from the lender.³ A LLPA is an up-front risk-based fee assessed to mortgagors with a conventional mortgage.

2.3 Mortgage Forbearance during the COVID 19 Pandemic

As COVID-19 spreads across the United States, mortgage delinquencies surge. Figure 1 provides a historical perspective and shows the national serious delinquency rate⁴ and foreclosure rate in United States since 1990. It is evident from the Figure that prior to the implementation of mortgage forbearance in March 2020, there exists a strong positive correlation between serious delinquency and foreclosure rates: the correlation between the two series is 0.89. Moreover, after the implementation of the CARES Act in March, there has been no observance of a surge in foreclosures following the surge of delinquencies. In particular, serious delinquencies rates in Q2 2020 reached the highest level since the 2008 financial crisis, but, at the same time, foreclosure rates were at almost the lowest level since 1990.

²See the GSE Eligibility Matrix at <https://singlefamily.fanniemae.com/media/20786/display>

³According to the report of Fannie Mae and Freddie Mac Guarantee Fee Review in 2015, 25 basis point upfront charge is approximately equivalent to 5 basis points of the current mortgage rate.

⁴Serious delinquency is defined as more than 90 days delinquent.

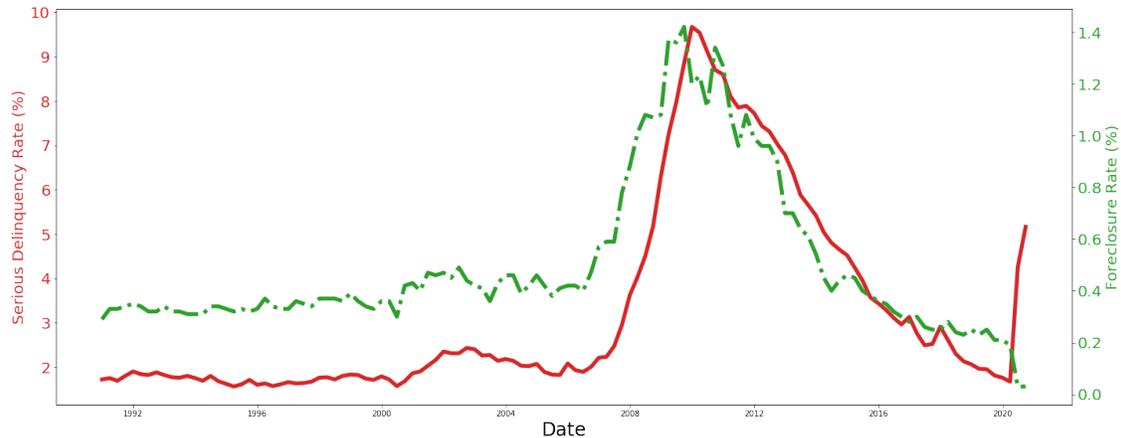


Figure 1: This plot shows the quarterly series of serious delinquency rates (solid) and foreclosure rates (dashed) in US. Source: Mortgage Bankers Association

These observations support the intended objective of the foreclosure moratorium: foreclosures exhibit a large drop despite the large increase in delinquencies.

3 Data

We use three categories of data in our analysis: delinquency and foreclosure data, house prices data, and agency mortgage-backed security loan-level data.

House Prices: We use the seasonally adjusted House Price Index (HPI) from FHFA⁵. The FHFA HPI is a weighted, repeat-sales index which measures average price changes in repeat sales on the same properties. It covers all single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975. This index is published with a two-month lag. At present, the last month of release was October 2020.

Foreclosures and Delinquencies: We use the U.S. Home Foreclosure Filings Total from Realty Trac Inc. to count properties at different stages of the foreclosure process.

⁵Our choice of using the FHFA House Price Index instead of the Case-Shiller Index is due to the following reasons. First, our loan-level counterfactual analysis is based on GSE-backed loans. FHFA’s valuation data are calculated directly from conforming mortgages provided by GSEs, which is well suited for estimating the counterfactual LTV ratios of GSE-backed loans without the foreclosure moratorium. Second, the monthly Case-Shiller Index is based on a 3-month moving average, whereas the FHFA HPI reflects the house prices in each month. Our counterfactual analysis is based on monthly house prices rather than moving averages.

Those stages include receiving a notice, auction, and actual foreclosure, in each month from 2005-01 till 2020-10.

We also use information about delinquency and foreclosures by Ginnie Mae. For each loan backed by Ginnie Mae, the loan-level data records its delinquency status in each month since 2013-11, such as current, 30-day delinquent, 60-day delinquent, and 90-day delinquent. For each month, the dataset also provides the next payment code for every loan. This allows determining whether in the following month the loan exited the delinquency state due to foreclosure, repurchase, or loss mitigation. Moreover, the dataset indicates whether a loan is in forbearance for each month. Apart from the delinquency and foreclosure status, the dataset also provides detailed, monthly information on the loan and borrower characteristics (coupon, maturity, location, LTV ratio, FICO scores). The source of this data are the third-party vendors eMBS and Recursion.

Agency Mortgage-Backed Security Loan-Level Data: Our analysis of refinancing is based on GSE-backed, 30-year fixed-rate, refinance loans originated from April 2020 to October 2020. We source this data from Recursion. According to the report released by the Urban Institute in Oct 2020⁶, 65.2% of the total originations in the second quarter of 2020 is GSE-backed, and 68% to 72% of them are refinance loans. There are approximately two million observations in our dataset.

Our Loan-level data provides information for each loan, with a code to map it to a pool. The data include static information about the origination of the loan, such as state, origination month, credit score, loan-to-value (LTV) ratio, debt to income ratio, coupon rate, loan size, originator, and loan purpose (refinancing, cash-out refinancing, new purchases, or others). Additionally, it includes information that changes monthly, such as the remaining balance, delinquency status, and mortgage servicer. Table 1 provides summary statistics of our sample.

⁶See https://www.urban.org/research/publication/housing-finance-glance-monthly-chartbook-october-2020/view/full_report

Table 1: This table provides summary statistics for the GSE-backed, 30-year, fixed-rate, refinancing mortgage loans originated from April 2020 to October 2020. The first column represents non-cashout refinance loans, and the second column represents cashout refinance loans. LTV = loan to value.

	Cashout Refi	Non-Cashout Refi
Item Count	646,031	1,813,536
Weighted Average Gross Coupon	3.34	3.12
Weighted Average Maturity	356.46	355.93
Weighted Average Original Loan Size (\$)	347,258.14	366,824.62
Orig LTV Weighted Average	64.82	69.07
Orig LTV Weighted Standard Deviation	13.30	14.79
The 25th percentile of LTV	57	60
The 50th percentile of LTV	68	72
The 75th percentile of LTV	75	80
Credit Score Weighted Average	754.35	764.58
Credit Score Weighted Standard Deviation	41.41	37.83
The 25th percentile of Credit Score	740	724
The 50th percentile of Credit Score	772	760
The 75th percentile of Credit Score	794	787

4 The Impact of Forbearance on Foreclosures, House Prices, and Refinancing

In this section, we analyze the implications of the foreclosure moratorium on the housing and mortgage market. In Section 4.1, we use a Markov transition model to quantify the counterfactual level of foreclosures in the absence of intervention. In Section 4.2, we estimate the impact of mortgage forbearance on house prices. In Section 4.3, we analyze the mechanism through which forbearance not only benefits directly households facing foreclosures, but also indirectly those who intend to refinance. In Section 4.4, we conduct a sensitivity analysis and show that a slight decline in house prices can have a large negative impact on refinancing activities.

4.1 Counterfactual Level of Foreclosures

We conduct a counterfactual analysis to assess what the amount of foreclosures would have been in the absence of forbearance. There are two main challenges imposed by such an analysis. First, we need to account for the strategic behavior of mortgagors, because forbearance may create perverse incentives for households who may strategically suspend their monthly payments for 6-12 months, and repay the missed mortgage payments in the future. Second, because mortgage forbearance is mandated nationwide, it is nontrivial to exploit regional segmentation and design a compelling quasi-experiment. Hence, a model is required to generate the counterfactual. It may be argued that the segmentation in the mortgage markets between conforming loan and jumbo loans can be used to design a quasi-experiment, especially when the forbearance mandated in the CARES Act is only for conforming loans. However, jumbo segment may not be a good candidate for a control group. This is because the loan and borrower characteristics for jumbo loans are very different from those of conforming loans. Moreover, as shown in Cherry et al. (2021), private lenders for jumbo loans also provide substantial mortgage forbearance. Thus, both segments are treated by forbearance and have a much lower level of foreclosure activities than before the pandemic. As a result, this segmentation may not provide enough variation.

We address the first concern identifying mortgagors who are likely to be strategically delinquent based both on a NPV calculation and on empirically observed prepayment rates. We then address the second concern by using a finite-state Markov transition model to generate the counterfactual foreclosures.

For each Ginnie Mae backed, 90-day delinquent mortgage in the forbearance state, we calculate the NPV of the future mortgage payments at the time the loan enters forbearance, if the mortgagor chooses to be strategically delinquent and postpones mortgage payments by one year. We then compare it with the NPV of the future mortgage payments if the mortgagor refinances at the prevailing interest rate at the time the loan enters forbearance. We discount using the 10-year treasury rate in each month and assume an up-front cost equal

to 4% of the total loan size⁷. A mortgage in forbearance is not eligible for loan refinancing, and it will typically not be available for a refinance at least for one or two years⁸ after the loan becomes current again. As a result, those who can save more money from refinance have little incentive to be strategically delinquent on their mortgage payments. Hence, we identify those loans as being very unlikely to enter the forbearance program because of strategic delinquency. This suggests that even without forbearance, those loans would still have been delinquent.⁹

Moreover, to verify that our methodology is consistent with observed prepayment rates, we examine the VPRs of mortgages, whose coupon and maturity are similar to the loan identified as not strategically delinquent in the first step of the procedure, at the month it enters forbearance. When the VPRs are sufficiently high, it means that loans with similar characteristics to those identified as not strategically delinquent are indeed often prepaid, suggesting that the benefit of refinancing them is higher than being strategically delinquent. Instead, if the corresponding annualized VPRs are less than 20%¹⁰, we remove this loan from the set of those identified as not strategically delinquent.

Based on our NPV calculation and observed prepayment rates, we estimate that around 90.6% of the mortgagors who are behind their mortgage payments are unlikely to be strategically delinquent. Restricting our sample to those households allows for a better estimates of how many household would still face foreclosure in the absence of forbearance. Admittedly, our restriction is imperfect. For example, some households may not make their financial

⁷Given that the average loan size is over \$300,000, a 4% up-front cost is a conservative parameter choice compared to existing literature, such as Keys, Pope, and Pope (2016), which assumes a transaction cost equal to \$2000 + 1% of the loan size.

⁸FHA has relaxed this requirement to 3-6 months around August 2020. However, this does not affect the loans which are part of our calculation, because they have already entered forbearance before this change occurred. Moreover, availability to refinance does not guarantee that lenders will be willing to lend to mortgagors at normal rates if they ever enter forbearance.

⁹This calculation does not apply to adjustable-rate mortgages (ARM) as it automatically adjusts the mortgage rate when interest rates go down, resulting in smaller savings from refinance. To be conservative, we assume that all ARMs in forbearance may be strategically delinquent.

¹⁰After identifying strategically delinquent loans based on the NPV calculation, the results in the second step are not sensitive to the thresholds choices. This suggests that the NPV calculation is consistent with the observed prepayments rates.

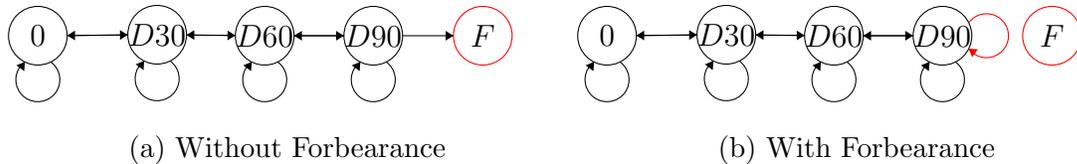


Figure 2: Panel 2a illustrates that without forbearance, loans that are 90-day delinquent (D90) can transit to foreclosures (F) with certain transition probability. Panel 2b illustrates that, with forbearance, loans that are 90-day delinquent will no longer be able to be foreclosed. Therefore, to construct the counterfactual estimation of foreclosures in the absence of forbearance, we need to identify 90-day delinquent loans that are not strategically delinquent and estimate the transition rate from 90-day delinquency to foreclosure.

decisions fully rationally.

We then use a finite-state Markov transition model to estimate how many foreclosures would have occurred without forbearance. We first collect the monthly delinquency state transition data for all Ginnie Mae backed mortgages in the period from November 2013 till October 2020. In every month, each loan then belongs to one the following states of the Markov chain: performing, 30-day, 60-day, 90-day delinquent, foreclosed, repurchased, paid-off, and loss mitigation. In particular, the states of foreclosures, repurchased, paid-off, and loss mitigation result in the removal of the loan from the pool, i.e., those states are absorbing states in the Markov chain. The specification of the Markov transition model is provided in Appendix A.

Figure 2 illustrates transition from delinquency to foreclosure in the Markov transition model. Panel 2a illustrates that without forbearance, loans that are 90-day delinquent can transit to foreclosures with a certain transition probability. In contrast, panel 2b shows that, with forbearance, loans that are 90-day delinquent will no longer be foreclosed. Therefore, to construct the counterfactual estimation of foreclosures in the absence of forbearance using the Markov transition model, we need to (1) identify 90-day delinquent loans that are not strategically delinquent and would remain delinquent without forbearance and (2) estimate the transition rate from 90-day delinquency to foreclosure.

As we have already identified loans which are not strategically delinquent, we next estimate the transition rate from 90-day delinquency to foreclosure in the absence of forbearance.

To control for loan-level characteristics, for each month we divide loans into different groups according to their current LTV ratios (30, 60, 80, 100, 120), credit scores (600, 660, 740), Ginnie Mae programs (FHA, VA, PIH, RD), and states (judicial/non-judicial). Following Jarrow, Lando, and Turnbull (1997), for each group we estimate the transition probability from 90-day delinquency to foreclosures using the sample prior to the implementation of forbearance in the following ways:

$$p_{(D90,F)} = \frac{\sum_t N_{(D90,F)}(t)}{\sum_t N_{D90}(t)},$$

where $N_{(D90,F)}(t)$ is the number of transitions from 90-day delinquency to foreclosure in month t , $\sum_t N_{(D90,F)}(t)$ is the total number of loans that transited from 90-day delinquency to foreclosure prior to the implementation of forbearance, and $\sum_t N_{D90}(t)$ is the total number of loans in the state 90-day delinquency before the implementation of mortgage forbearance.

We then estimate the expected foreclosures in the absence of forbearance using our estimated transition rate from 90-day delinquency to foreclosure and the number of delinquencies identified as non strategic. The details of the calculation are reported in Appendix A. Figure 3 plots the estimated number of foreclosures with and without the foreclosure moratorium. In the absence of intervention, foreclosures would have shot up since April whereas in the same period, the actual foreclosures have declined to the lowest level in the past 15 years. Table 2 compares our counterfactual estimation of foreclosures with the actual foreclosures. We find that in the period from April to October 2020, the foreclosure moratorium has prevented approximately 900,000 foreclosure filings that might have occurred without intervention. Clearly, the forbearance assisted those homeowners whose homes could have been foreclosed upon to avoid both financial costs and significant long-term non-pecuniary costs (see Diamond, Guren, and Tan (2020)).

It is worth remarking that our estimates are conservative. First, we cannot rule out the possibility that, without the foreclosure moratorium, the transition rate from 90-day delinquency to foreclosure would have increased relative to the period before COVID-19 due



Figure 3: Number of Estimated Total US Foreclosures Filings with the intervention of CARES Act (red dashed) and in the hypothetical scenario with no intervention of the foreclosure moratorium (green solid).

to the economic impact of the pandemic. Second, serious delinquent mortgages could be repurchased by mortgage servicers from Ginnie Mae, and the foreclosure of such mortgages would not be reported afterward. This would lead to an underestimation of the transition rate from delinquency to foreclosure without the moratorium. Third, when we identify the strategically delinquent loans, our parameter choices, such as the 4% up-front refinancing cost, are conservative compared to other studies. Given that our main objective is to study how forbearance may prevent foreclosure shocks from propagating to a wider range of households and impact refinancing activities as well as aggregate consumption, it is conceivable to be conservative regarding the magnitude of the foreclosure shock.

4.2 The Impact of Forbearance on House Prices

In the previous sections, we have analyzed the extent to which forbearance serves to avoid foreclosures. There is however, another important mitigating effect of forbearance, which is to stop foreclosure shocks from transmitting to the housing and mortgage market. In this section, we quantify the impact of forbearance on house prices.

The studies of Calomiris, Longhofer, and Miles (2013), Arslan, Guler, and Taskin (2015),

Table 2: This table reports the counterfactual estimates of foreclosures from April to October in the hypothetical scenario of no foreclosure moratorium. For comparison purposes, the actual foreclosures from April to October are also reported in the table.

	Foreclosures:							
	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Counterfactuals	55,037	58,957	79,759	157,406	201,880	222,665	183,555	959,259
Actual Foreclosures	14,148	8,767	9,247	8,892	9,889	6,872	11,673	69,488

and Chatterjee and Eyigungor (2009) document that an unanticipated increase in foreclosures leads to a flood of forced liquidations, which depresses house prices. Conversely, a drop in house prices precipitates more foreclosures. As a result of this self-reinforcing feedback loop, without any intervention, an initial surge of foreclosures turns into a lasting problem, i.e., a persistent drop in house price growth and a persistent increase in foreclosures, like the one observed in the years between 2007 and 2011.

The moratorium prevents foreclosures, and as a result, temporarily shuts down the negative spillovers to house prices. In order to estimate how much house prices would have dropped after foreclosure shocks and without intervention, we construct an econometric model to measure house price fluctuations associated only with exogenous shocks to foreclosures. We consider a five-variable VAR model, similar to the one in Calomiris, Longhofer, and Miles (2013). The biggest difference between their model and ours is that we use a standard VAR based on monthly data from February 2005 to March 2020, while theirs is a Panel VAR based on quarterly data. We deviate from their model and consider a higher frequency for two main reasons: (i) quarterly frequency is too coarse for our counterfactual analysis on refinancing, whereas monthly frequency allows us to calculate the counterfactual decline in house prices for each month from April 2020 to October 2020 without foreclosure moratorium, and the corresponding counterfactual LTV ratios of refinance loans originated

in those months; and (ii) we can assess the robustness of our model by comparing implied house price declines at a quarterly frequency with those estimated from their model (see Section E for the comparison). The detailed specification of the SVAR model is reported in Appendix B.

We use the SVAR model to estimate how much house prices would have declined without the foreclosure moratorium. We assume that the moratorium only exerts structural shocks specific to foreclosures. Using our counterfactual estimation of foreclosures done in Section 4.1 and actual foreclosures, we can identify the magnitude of shocks that the moratorium imposes on foreclosures every month. We then use the identified shocks to calculate their impact on house prices. The details of the calculation are included in the Appendix C. We find that without the foreclosure moratorium, house prices would have dropped by 0.7%, 1.3%, 1.7%, 3.5%, 5.4%, 7.2%, 9.4% relative to the realized values from April through October 2020.¹¹ Figure 4 compares the actual house prices with their counterfactual estimates. In the hypothetical scenario of no foreclosure moratorium, the counterfactual House Price Index exhibits a large, persistent drop since April. In contrast, the actual House Price Index shows a persistent increase during the same period. This comparison is consistent with our claim that the foreclosure moratorium prevents a tidal wave of foreclosures and stabilizes house prices.

4.3 The Impact of Forbearance on Refinancing

In this section, we analyze the impact of mortgage forbearance on refinancing activities. What is the mechanism through which forbearance, whose mandate is to prevent foreclosure shocks, supports refinancing activities? By stabilizing house prices, forbearance prevents a wide range of homeowners' LTV ratios from increasing. This in turn, by collateral effect,

¹¹To put those numbers into context, we observe that house prices have increased by 1% from February to March 2020. Without such an increase, house prices in March would have been 1% lower than the realized ones. As a result, prices would have stayed 1% lower relative to their realization every month since March. Moreover, house prices rose 8% from August 2019 to August 2020, a growth which would have been completely eroded without intervention.

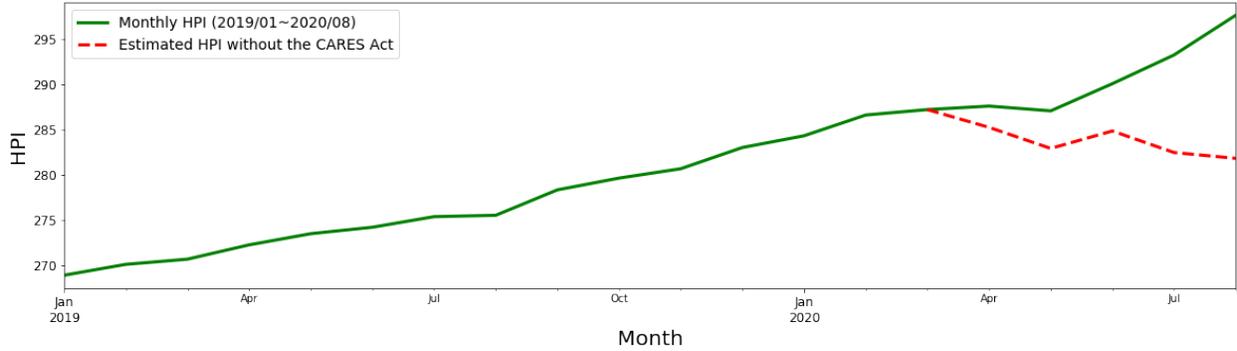


Figure 4: The actual House Price Index with the intervention of CARES Act (green solid line), and the counterfactual estimate of the House Price Index without foreclosure moratorium (red dashed line).

increases the number of homeowners eligible for refinancing, leads to more equity extraction through cash-out refinancing, reduces the up-front fee for refinancing, and lowers interest payments. In this way, forbearance not only benefits the group of households facing foreclosures, but also exerts positive externalities on all households who intend to borrow against their home equity. Using our loan-level data set, we conduct a counterfactual analysis on how forbearance impacts homeowners’ refinancing cost, equity extraction, and refinancing eligibility. We show that forbearance helps pass credit and liquidity to homeowners through the refinancing channel during the COVID-19 period.

As shown in Section 4.2, house prices would have decreased in the absence of intervention. Using the counterfactual house prices from each month, we can calculate the counterfactual LTV ratios for all 30-year, fixed-rate, GSE-backed refinance loans originated from April 2020 to October 2020. Without forbearance, the homeowners’ LTV ratios would have increased because of the decline in home equity. As discussed next, due to the collateral effect, this has negative impact on households who seek to refinance along three main dimensions

Firstly, a significant portion of mortgagors would have been ineligible to refinance in the absence of forbearance. Without the moratorium, among all 30-year, fixed-rate, GSE-backed refinance loans originated from April 2020 to October 2020, 3.3% of non-cashout refinance loans (about 60,000) would have not satisfied the GSE Standard Eligibility Requirements due

to high LTV ratios. That is, those loans' LTV ratios would have been above the maximum for traditional conventional refinances, and they could have been refinanced only through special programs such as Fannie Mae High-LTV Refinance Option (HLRO). We apply the Fannie Mae Eligibility Matrix¹² to every GSE-backed non-cashout refinance loans originated since April and check if it would still be eligible for conventional refinances in the hypothetical scenario of no forbearance and declining house prices. The ineligibility may potentially make those homeowners forgo a large amount of interest savings from refinancing. In other words, forbearance stabilizes house prices, makes a large number of homeowners eligible for traditional conventional refinances, and saves them money from interest payments. According to Agarwal et al. (2017) and Fuster and Willen (2017), refinancing significantly lowers their probability to default in the future and prevents more foreclosure shocks. Secondly, there would have been much less equity extraction from mortgagors in the absence of forbearance. Among all 30-year, fixed-rate, GSE-backed cash-out refinance loans originated since April, around 145,000 of them (about 22%) would have been forced to decrease the amount of their cashed-out home equity, and on average, they would have decreased the amount of equity cashed out by around \$15,000. This is because without forbearance, deteriorating housing prices would lead to losses in home equity for homeowners, who would be forced to decrease their home equity extraction. For each GSE cash-out refinance loan, this decrease in equity extraction is calculated by taking the positive part of the difference between the total amount of principal borrowed and the maximum amount of principal¹³ that the homeowner could have borrowed in the hypothetical scenario of no forbearance and declining home equity. For example, a homeowner with a 1-unit, principal residence worth \$300,000 borrows \$240,000 through cash-out refinance to pay off the remaining unpaid principal of \$200,000 from their existing mortgage, and then takes out \$40,000 in cash. However, if house prices

¹²The Eligibility Matrix provides the comprehensive LTV, CLTV, and HCLTV ratios requirements for conventional first mortgages eligible for delivery to Fannie Mae (same eligibility will apply to Freddie Mac).

¹³Based on the characteristics of each loan (LTV, credit score, etc...), we use the Eligibility Matrix to find the corresponding maximum LTV ratio above which the loan does not qualify for a standard conventional cash-out refinance.

were to decline to \$280,000 in the scenario without intervention, this homeowner could only borrow at most \$224,000 thorough cash-out refinance. This is because the current maximum LTV ratio eligible for standard conventional cash-out refinance is 80% (for 1-unit, principal residence). As a result, the homeowner could only extract \$24,000 in cash from their home equity, i.e., \$16,000 less than in the scenario where house prices are stabilized through forbearance. Moreover, if like in Di Maggio, Kermani, and Palmer (2019) and Mian and Sufi (2011), we assume that the marginal propensity to consume out of cashed-out equity is 1, the decline in equity extraction for the affected households would imply a decrease in total consumption by about \$2.2 billion. In other words, forbearance stabilizes house prices, allows a large number of homeowners to extract more cash from their home equity, helps passing liquidity to those households, and increases their consumption.

Thirdly, without forbearance, the refinancing cost for homeowners would increase drastically, especially for those with low credit score. The underlying reason is that homeowners would have higher LTV ratios, making it riskier to guarantee their loans, so higher loan-level pricing adjustment (LLPA) fees would be charged by GSE. The fee would be passed to the homeowners, either in the form of up-front fee (so-called points), or in the form of higher coupon. We use the LLPA Matrix¹⁴ for all the conventional refinance loans originated since April, and calculate the difference between the current LLPA fees and the LLPA fees that GSE would have charged in the hypothetical scenario of no forbearance. We find that 37% of the homeowners who refinanced between April and October 2020 (about 900,000) would be charged a higher LLPA fee, and the increase in upfront fee would be around \$1,400 on average. If the LLPA fees are rolled into interest payment, this would be equivalent to an increase of \$5,600 in interest payments over the life of the loan. According to the report of Fannie Mae and Freddie Mac Guarantee Fee Review in 2015¹⁵, a 25 basis points upfront

¹⁴The Loan-Level Price Adjustment (LLPA) Matrix provides the LLPAs applicable to loans delivered to GSE. LLPAs are assessed based upon loan features, such as credit score, loan purpose, occupancy, number of units, product type, etc. See <https://singlefamily.fanniemae.com/media/9391/display> for details

¹⁵In their website, Freddie Mac claims that one point which costs 1% principal in the form of up-front fee can approximately reduce the mortgage rate by about 0.25%. In other words, our estimation is on the conservative side.

charge is approximately equivalent to 5 basis points of the current mortgage rate. It is worth noting that a higher upfront fee would sharply decrease homeowners' incentive to refinance, according to Keys, Pope, and Pope (2016) and Agarwal, Driscoll, and Liabson (2013), and a \$1000 increase in upfront fees might reduce the refinancing threshold by 25 basis points.

In addition to a higher LLPA fee, higher LTV ratios due to declining house prices would have also forced many mortgagors to purchase private mortgage insurance (PMI) for their mortgages. We find that without intervention, 14.7% of all GSE-backed non-cashout refinance loans originated since April (about 260,000) would have needed to purchase private mortgage insurance (PMI). A PMI is required for mortgages with LTV ratios larger than 80%, and its annual cost is approximately between 0.4% and 0.8% of the borrowed amount according to Freddie Mac. Once the mortgages' LTV ratios fall below 80%, it is optional to maintain the insurance. For each non-cashout refinance loan originated since April, we first check whether it would have needed a PMI in the hypothetical scenario of no forbearance and declining house prices, and then calculate the number of insurance months and the approximate cost. We find that without foreclosure moratorium, the affected homeowners would have paid an extra amount ranging from \$1,450 to \$2,900 on average for a PMI.

There is a large degree of heterogeneity for the increase in refinancing cost caused by the variation in homeowners' credit scores. We break down the increases in refinancing cost into different groups based on the homeowners' credit score at the origination of the loan. The percentage of households that would have incurred a higher LLPA cost and the average increase in refinancing cost are much higher for groups with lower credit scores. Table 3 shows that in the hypothetical scenario of no forbearance, only 35% of the households with credit score higher than 740 would have had a higher LLPA cost, and the average refinancing cost increase for this group would have been only \$1,264 up-front or \$4,987 in terms of interest payment. However, for groups with credit scores lower than 680, more than 50% of the households would have incurred a higher LLPA cost, and the average refinancing cost increase would have been a staggering number—more than \$3,700 as up-front fee or more

than \$15,000 as interest payments. This is almost three times the extra cost incurred by mortgagors with high credit score. In other words, without the forbearance stabilizing effect on house prices, households with low credit scores might have had a much larger refinancing cost, and forced to forego the refinancing option completely.

The high sensitivity of refinancing costs to declines in house prices for households with low credit score also provides an additional explanation for the phenomenon studied by Keys, Pope, and Pope (2016): households with low credit score have a higher failure-to-refinance rate.¹⁶ That is, for those households, even though refinancing seems optimal at the prevailing interest rate, they still tend to not refinance their existing mortgage. Our analysis suggests that the refinancing cost for low credit households could be much larger than for households with high credit score after the decline in house prices. However, refinancing opportunities due to lower interest rates often emerge during or after economic downturns together with decline in house prices, which makes households with low credit score less likely to refinance.

Following Di Maggio et al. (2017) and Di Maggio, Kermani, and Palmer (2019), we assume that the average marginal propensity to consume out of a reduction in monthly mortgage payments is around 0.75. Our calculation shows that forbearance, by reducing households' refinancing cost, increases the consumption of mortgagors by another \$4.3 billion during the first nine months subsequent to the intervention.

To reiterate the core message of this section, the impact of foreclosures is not limited to households who default on their mortgages. Importantly, foreclosure has negative effects on the availability of funding (i.e., refinancing eligibility and equity extraction) and raises the cost of funding of a wider range of households. This further impedes the recovery of the real economy by reducing aggregate consumption and increasing homeowners' probability of default in the near future. In this way, mortgage forbearance, a policy preventing foreclosures, can amplify the stimulative effect of monetary policies through the refinancing channel.

It is worth emphasizing that our estimates are conservative. Even though GSE-backed

¹⁶Keys, Pope, and Pope (2016) analyze the failure-to-refinance rates for different households in 2010.

Table 3: This table reports estimates of the fraction of mortgage borrowers who could have been subject to a higher LLPA fee without intervention, and the average increase in refinancing cost either in the form of up-front fee or interest payment, across a range of borrower credit core characteristics. The sample consists of 30-year, fixed-rate, refinancing mortgage originated from April 2020 to October 2020. Our calculation follows the assumption that a 25 basis point upfront charge is approximately equivalent to 5 basis points raise in current mortgage rate, which is in the report of Fannie Mae and Freddie Mac Guarantee Fee Review in 2015.

FICO Score	Item Count	Share with increase in LLPA fees	Average LLPA cost in the form of up-front fee	Average LLPA cost in the form of interest payment
$x \geq 740$	2,030,037	35.1%	\$1,264	\$4,987
$740 > x \geq 720$	198,047	44.3%	\$1,452	\$5,773
$720 > x \geq 700$	128,834	46.3%	\$1,827	\$7,289
$700 > x \geq 680$	58,824	47.0%	\$2,529	\$10,194
$680 > x \geq 660$	28804	50.8%	\$3,610	\$14,663
$660 > x \geq 640$	14085	49.0%	\$4,214	\$17,241
$640 > x \geq 620$	845	45.0%	\$4,501	\$18,443
$620 > x$	91	35.2%	\$4,124	\$16,517
Total	2,459,567	37.0%	\$1,419	\$5,626

refinance loans make up a large of portion of the total refinance loans, there is still a significant number of refinance mortgages securitized by VA/FHA or held as portfolio loans. The forbearance also benefits borrowers holding those mortgages, because they are vulnerable to loss in home equity and decline in house prices. Moreover, there are still millions of households who would benefit from refinance but have not yet done so for various reasons, and they are likely to benefit from the foreclosure moratorium in the future.¹⁷ Additionally, because the mortgage rate continues to decrease, there will be more households that become refinance candidates and can potentially benefit from forbearance.

¹⁷There are still 18.5 million households who meet the refinancing criteria and can reduce their annual interest payment by at least 0.75% by refinancing at the mortgage rate of September (see the Black Night September Mortgage Report). This can, on average, save them \$304 per month.

4.4 Sensitivity of Refinancing to House Price Declines

In this section, we explore how sensitive the refinancing activity is to various magnitudes of declines in house prices. We calculate how the refinancing cost and eligibility of households who refinanced from April 2020 to October 2020 would be affected, under a variety of house price decline assumptions.

As shown in Table 4, the impact of the counterfactual house price decline estimated in Section 4.2 is most comparable to a naïve house price decline of 3% relative to the realized house price. The first three rows in Table 4 indicate that the share of non-cashout loans which requires extra insurance and the corresponding cost are very sensitive to the magnitude of house price declines. A 10% decline in house prices would lead to around 30% of loans requiring additional insurance at an average cost of \$6,712, while a 1% decline in house prices would lead to only around 7.3% of loans requiring additional insurance with an average cost of \$1,186. This is because the larger the house price decline, and the higher the LTV ratios of these loans. As a result, it will be more likely for the loans to require extra insurance, and the insurance period until the LTV ratios fall below 80% will also be longer. For the same reason, a larger house price decline will make a larger share of the loans ineligible to refinance through the standard conventional program. A 10% decline in house prices could have made 11.09% of the refinance loans from April 2020 to October 2020 ineligible for standard refinancing. If this were to happen, special programs that allow a large number of high LTV refinancing would be necessary, such as the Home Affordable Refinance Program (HARP) put forward during the 2008 financial crisis.

For cash-out refinancing, the amount of home equity that could be cashed out is also highly sensitive to the magnitude of house price declines. As it can be seen from Table 4, if house price declines were to raise from 1% to 10%, the share of cash-out refinance loans that would have been forced to lower their cashed-out equity increases from 16.5% to 35.6%, and the corresponding decrease in equity extraction also climbs from \$3,262 to \$33,364. This is because a lower house price reduces home equity which can be cashed out.

Table 4: This table reports the estimates of the impact of house price declines on refinancing eligibility, refinancing costs, and equity extraction. We consider a variety of assumptions on house price declines in the months from April 2020 through October 2020. The naive house price declines considered are 1%, 2%, 3%, 5%, 8%, 10%, and they are relative to realized house prices in the origination month of each loan. To perform a comparison with naive house price declines, in the first column we also include a baseline estimation of how much refinancing activities would have been impacted without intervention. The sample consists of 30-year, fixed-rate, GSE-backed refinance loans originated from April 2020 till October 2020. To put the numbers in context, the average monthly house price growth rate in 2020 is around 1%.

	<i>House Price Decline:</i>						
	Model Predicted Decline	1%	2%	3%	5%	8%	10%
Share of Non-cashout Loans Needs Additional Insurance	14.8%	7.32%	10.40%	12.77%	14.65%	27.08%	29.67%
Item Counts	267,956	132,670	188,556	231,666	265,761	491,164	538,062
Average Extra Cost	\$3,619	\$1,186	\$1,934	\$2,482	\$4,217	\$4,927	\$6,712
Share of Non-cashout Loans Ineligible for Refinancing	3.34%	0.66%	0.84%	2.57%	4.12%	8.20%	11.09%
Item Counts	60,632	12,029	15,196	46,578	74,729	148,657	201,191
Share of cash-out Loans with Less Equity Extraction	22.47%	16.54%	18.48%	20.19%	21.67%	33.51%	35.56%
Item Counts	145,148	106,853	119,404	130,454	139,989	216,476	229,742
Average Decrease in Equity Extraction	\$15,371	\$3,262	\$6,565	\$9,879	\$16,501	\$26,594	\$33,364
Share of Loans with Higher LLPA Cost	37.01%	19.29%	28.08%	32.10%	38.59%	53.78%	71.16%
Item Counts	910,384	474,441	690,556	789,549	949,237	1,322,802	1,750,306
Avg Extra LLPA Cost as up-front fee	\$1,419	\$1,553	\$1,485	\$1,403	\$1,348	\$1,365	\$1,326
Avg Extra LLPA Cost as Interest Payment	\$5,626	\$6,201	\$5,918	\$5,588	\$5,368	\$5,438	\$5,270

The share of homeowners that would be subject to a higher LLPA fee is sensitive to the magnitude of house price declines. This means that as the hypothetical drop in house prices gets larger, more homeowners would incur a higher refinancing cost, which would then lead to lower refinancing thresholds for homeowners.

This sensitivity analysis indicates that even a slight decline in house prices has a large impact on refinancing activities. More specifically, it suggests that it is crucial to stabilize house prices to increase refinancing activity, reduce refinancing cost, and increase equity extraction. It is only in this way that households can benefit from the stimulative effect of lower interest rate through mortgage refinancing during a crisis period.

5 Conclusion

This paper investigates the impact of mortgage forbearance on the real economy through the housing market and the refinancing channel. We show that mortgage forbearance embedded in the CARES Act not only prevents a large wave of foreclosures that might otherwise have occurred, but also supports refinancing activities by stabilizing house prices. Our analysis implies that the foreclosure moratorium has prevented approximately 900,000 foreclosures in the first seven months of its enactment and a house price decline up to 8% in the period from April to October 2020.

We have quantified how forbearance supports household borrowing through the refinancing channel along three dimensions: relaxing eligibility constraints of mortgagors, increasing their equity extraction, and lowering their refinancing cost. We find that during the first seven months, the foreclosure moratorium allowed more than 60,000 mortgagors (about 3.3% of non-cashout refinancing) to become eligible for refinancing, increased home equity cashed out for around 145,000 households (about 22% of cash-out refinancing) by around \$15,000 on average, and lowered the refinancing cost for at least 900,000 households (about 37% of total refinancing lenders) by around \$5,600 per loan in terms of interest payments. Our

estimation shows that forbearance can increase aggregate consumption by \$6.4 billion.

Unlike policies which disproportionately benefit the least hard-hit households during crisis times, mortgage forbearance greatly helps households who are subject to stricter credit standards and declining home equity. Households with low credit score benefit from a saving in terms of refinancing cost by roughly \$3,700 as up-front fee, or equivalently, \$15,500 in the form of interest payment.

Our results have important implications for the design of effective policy interventions. In crisis times like the COVID-19 pandemic, where a large number of households are simultaneously hit by income shocks, decisive and comprehensive foreclosure-prevention interventions are necessary from the very beginning. Lessons from the 2008 financial crisis indicate that the occurrence of a large wave of foreclosure has a negative long-term impact on economy, which is extremely difficult to counteract even with the aid of massive stimulus and debt relief (see Piskorski and Seru (2020)). Our analysis demonstrates that, by preventing a foreclosure shock from occurring, early intervention through mortgage forbearance avoids its potential amplification through the refinancing channel and raises aggregate consumption. This highlights the importance of implementing foreclosure prevention policies early during a crisis instead of trying to limit the negative consequences afterward, especially given that ex-post relief policies often come with severe frictions (e.g., Piskorski and Seru (2020), Agarwal et al. (2015), Agarwal et al. (2017)). Moreover, our analysis also demonstrates the extent to which forbearance stabilizes house prices and prevents households' leverage from increasing. In this way, income shocks do not spillover to households who are not directly hit by those shocks, and these households benefit from the provision of liquidity and credit through the refinancing channel. Hence, household debt forbearance policies aimed at reducing foreclosures can have a sizeable impact on the pass-through of monetary policy to households. All this suggests that a combined regulatory effort is needed to support the economy during these crisis periods.

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Appendix A Specification of the Markov Transition Model

The transitions of the mortgage delinquency status are modeled via a discrete-time, time-homogeneous Markov chain with a finite state space $S = \{0, D30, D60, D90, F, R, P, L\}$. S represents the set of all possible states, with "0" being performing loans, "D30, D60, D90" being respectively 30-day, 60-day, 90-day delinquencies, "F" being foreclosures, "R" being repurchased, "P" being paid-off, and "L" being loss mitigation. In particular, foreclosures, repurchased, paid-off, and loss mitigation will result in the removal of the loans from the pools, i.e., those states are absorbing states in the Markov chain.

To control for loan-level characteristics, we divide loans in each month into different groups, $g = 1, 2, 3, \dots$, according to their current LTV ratios (30, 60, 80, 100, 120), credit scores (600, 660, 740), Ginnie Mae programs (FHA, VA, PIH, RD), and states (judicial/non-judicial).

For each group g , the discrete-time, finite state, Markov chain is specified by a 8×8 transition matrix $Q(g)$:

$$Q(g) = \begin{pmatrix} p_{(0,0)}(g) & p_{(0,D30)}(g) & p_{(0,D60)}(g) & p_{(0,D90)}(g) & p_{(0,F)}(g) & p_{(0,R)}(g) & p_{(0,P)}(g) & p_{(0,L)}(g) \\ p_{(D30,0)}(g) & p_{(D30,D30)}(g) & p_{(D30,D60)}(g) & p_{(D30,D90)}(g) & p_{(D30,F)}(g) & p_{(D30,R)}(g) & p_{(D30,P)}(g) & p_{(D30,L)}(g) \\ p_{(D60,0)}(g) & p_{(D60,D30)}(g) & p_{(D60,D60)}(g) & p_{(D60,D90)}(g) & p_{(D60,F)}(g) & p_{(D60,R)}(g) & p_{(D60,P)}(g) & p_{(D60,L)}(g) \\ p_{(D90,0)}(g) & p_{(D90,D30)}(g) & p_{(D90,D60)}(g) & p_{(D90,D90)}(g) & p_{(D90,F)}(g) & p_{(D90,R)}(g) & p_{(D90,P)}(g) & p_{(D90,L)}(g) \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

where $p_{(i,j)}(g) \geq 0$ for $i, j \in S$, and $\sum_{j \in S} p_{(i,j)}(g) = 1$. The (i, j) entry, $p_{(i,j)}(g)$, represents the probability of a loan in group g going from state i to state j in one month. Since states F, R, P, L are absorbing states, $p_{(i,j)}(g) = 0$ for $i \neq j, i \in \{F, R, P, L\}$, and the diagonal entries, $p_{(i,i)}(g) = 1$ for $i \in \{F, R, P, L\}$.

For any period $t \in [0, T]$ and any group g , following Jarrow, Lando, and Turnbull (1997), we estimate the transition probability $p_{(i,j)}(T, g)$ using Ginnie Mae loan-level data as follows:

$$p_{(i,j)}(T, g) = \frac{\sum_{t=0}^T N_{(i,j)}(t, g)}{\sum_{t=0}^T N_i(t, g)},$$

where $\sum_{t=0}^T N_{(i,j)}(t, g)$ is the total number of transitions from state i to state j in the period of $t \in [0, T]$ for group g , and $\sum_{t=0}^T N_i(t, g)$ is the total number of loans in state i in the same period of time for group g . In our study, we choose the period $[0, T]$ as the time prior to the implementation of forbearance, since we want to estimate the transition probability in the absence of forbearance.

The expected number of foreclosures for month t , given the number of loans in each state at month $t - 1$, is calculated as:

$$\mathbb{E}_{t-1}[N_F(t)] = \sum_g \sum_i p_{(i,F)}(g) N_i(t - 1, g)$$

where $N_i(t, g)$ is the total number of loans in state i at $t - 1$ for group g , $p_{(i,F)}(g)$ is the probability that a loan in state i transits to state F . In particular, $p_{(i,F)}(g) > 0$ only if $i = D90$ because it is only loans that are more than 90-day delinquent to be foreclosed.

The underlying rationale for the above calculation is: for each month in forbearance and for each group of loans, we first multiply our estimated transition rate from 90-day delinquency to foreclosure with the number of delinquencies identified as non strategic in the previous step. This yields the expected number of foreclosures next month for each group, in the absence of forbearance. After summing up the expected numbers for all groups, for each month we obtain the estimated numbers of Ginnie Mae backed mortgages which would have been foreclosed without forbearance.

Finally, we estimate the number of total US foreclosure filings that would have occurred without intervention as follows. We first calculate the average proportion of Ginnie Mae backed foreclosed loans in the US total foreclosure filings using the pre-COVID sample from March 2019 till March 2020. We then divide the number of Ginnie Mae backed, foreclosed mortgages estimated above by this proportion.

Appendix B Specification of the SVAR Model

In this section, we give the detailed specification of our SVAR model. The vector of the five endogenous variables is given by

$$\mathbf{x}_t = (\Delta une_t, \Delta y_t, f_t, \Delta s_t, \Delta hp_t)',$$

where Δune is the log growth in unemployment rate, Δy denotes the log growth rate of GDP, f denotes the log of the number of foreclosures, Δs represents the log growth rate of new houses for sale, and Δhp is the log growth rate of the house price index. We use monthly data from January 2005 to March 2020 to estimate the SVAR model. A detailed description of the data used in our VAR model and the corresponding plots are given in Appendix D. The structural VAR representation is:

$$\mathbf{A}_0 \mathbf{x}_t = \boldsymbol{\alpha} + \sum_{i=1}^T \mathbf{A}_i \mathbf{x}_{t-i} + \boldsymbol{\epsilon}_t,$$

where $\boldsymbol{\epsilon}_t$ denotes the vector of mutually and serially uncorrelated structural innovations.

Similar to Calomiris, Longhofer, and Miles (2013), we assume that \mathbf{A}_0^{-1} has a recursive structure. The ordering is indicated by the definition of \mathbf{x}_t above. In particular, house prices depend contemporaneously on all other variables. The model also imposes the exclusion restriction that structural shocks specific to the housing market will not immediately affect the real economy, but rather with a delay of at least a month. This restriction is consistent with the fact that information on house prices is not available instantaneously. This is because the data on house prices are released with lags, and there exists large heterogeneity in agent real estate valuations, allowing us to rule out instantaneous feedback. The number of foreclosures depends contemporaneously on unemployment and GDP, since the growth of the real economy and unemployment rate immediately affects how many people will default on their mortgage loans. This ordering emphasizes that (i) real economic activities affect contemporaneously both house prices and the number of foreclosures, (ii) foreclosures can

immediately affect house prices, and (iii) changes in house prices affect future foreclosures.

The reduced-form VAR model is estimated using the least-squares method, and the resulting estimates are used to construct the structural VAR representation of the model. These impulse response is based on wild bootstrap with 1000 replications. Figure B.1 lays out the two estimated impulse response functions (IRFs) of our interest.

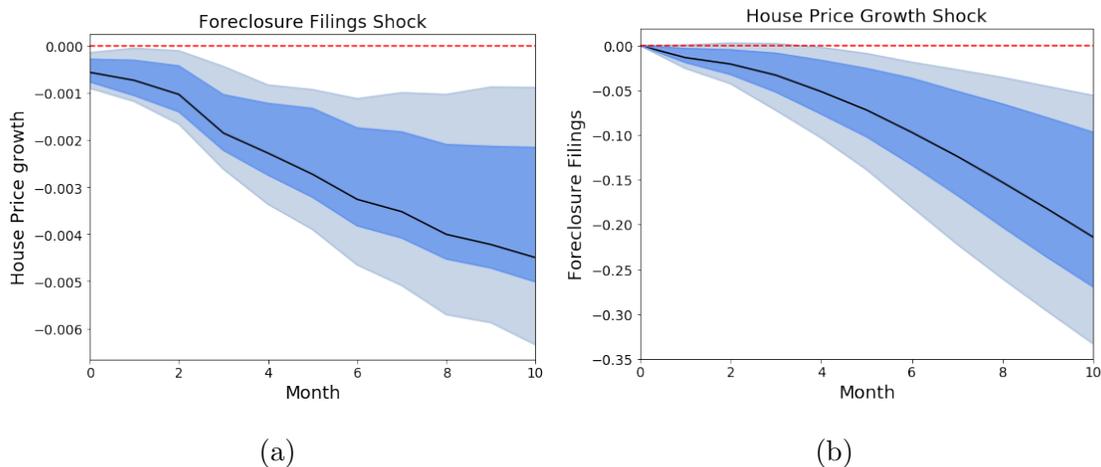


Figure B.1: Impulse responses to one-standard-deviation structural shock over 10 months, with 68% (dark blue) and 90% (light blue) confidence interval. Panel (a) illustrates the responses of the growth rate of house prices to one-standard structural innovation of foreclosure. Panel (b) illustrates the response of foreclosure to one-standard structural innovation of house prices growth.

The impulse responses between foreclosures and house prices are supportive of the existence a self-reinforcing feedback loop between changes in foreclosures and changes in house prices found by Guren and McQuade (2020), Calomiris, Longhofer, and Miles (2013), Arslan, Guler, and Taskin (2015), and Chatterjee and Eyigungor (2009). It can be seen from Figure B.1 that an unexpected surge of foreclosures then causes a very persistent and highly statistically significant decrease in house price growth. Conversely, an unexpected increase in house prices growth triggers a highly persistent decrease in foreclosures. The impulse responses can be explained by the fact that a surge in foreclosures tends to flood the housing market with foreclosed real estate that banks are eager to unload promptly, resulting in lower prices. Moreover, when house prices increase, a homeowner can sell a house at a profit even

if she is unable to make monthly mortgage payments.

Appendix C Calculation of House Price Declines

In this section, we introduce the methodology used to calculate house price declines in the absence of forbearance.

Let $\mathbf{x}_t = (\Delta une_t, \Delta y_t, f_t, \Delta s_t, \Delta hp_t)'$ be the time series of our five endogenous variables. Denote $\mathbf{x}_t^* = (\Delta une_t^*, \Delta y_t^*, f_t^*, \Delta s_t^*, \Delta hp_t^*)'$ to be the counterfactual of the same five variables in the hypothetical scenario without foreclosure forbearance. The two time series should be identical until April 2020 when the foreclosure moratorium is introduced. The structural VAR representation is:

$$\mathbf{A}_0 \mathbf{x}_t = \boldsymbol{\alpha} + \sum_{i=1}^T \mathbf{A}_i \mathbf{x}_{t-i} + \boldsymbol{\epsilon}_t,$$

where $\boldsymbol{\epsilon}_t$ denotes the vector of mutually and serially uncorrelated structural innovations.

Using a moving average representation of the SVAR, we obtain $\mathbf{x}_t = \mathbf{x}_0 + \sum_0^t \Phi_i \boldsymbol{\epsilon}_{t-i}$, and $\mathbf{x}_t^* = \mathbf{x}_0 + \sum_0^t \Phi_i \boldsymbol{\epsilon}_{t-i}^*$. It then follows that

$$\mathbf{x}_t - \mathbf{x}_t^* = \sum_{i=0}^t \Phi_i (\boldsymbol{\epsilon}_{t-i} - \boldsymbol{\epsilon}_{t-i}^*). \quad (1)$$

Assume that the mortgage forbearance only exerts structural shocks on foreclosures, and the structural shocks of other variables will not be affected by mortgage forbearance. We then have

$$\boldsymbol{\epsilon}_t - \boldsymbol{\epsilon}_t^* = [0, 0, \epsilon_{t,f} - \epsilon_{t,f}^*, 0, 0]',$$

where $\epsilon_{t,f} - \epsilon_{t,f}^*$ is the difference of the structural shocks on foreclosures. In particular, we

can write the third component of equation (1) as:

$$f_t - f_t^* = \sum_{i=0}^t [\Phi_i]_{(3,3)} (\epsilon_{t-i,f} - \epsilon_{t-i,f}^*),$$

where $f_t - f_t^*$ is the difference of foreclosures between the two scenarios, and $[\Phi_i]_{(3,3)}$ is the $(3, 3)$ component of the matrix Φ_i . Since we know the actual foreclosure filings f_t and the counterfactual foreclosures estimates f_t^* from Section 4.1, we can calculate the difference $\epsilon_{t,f} - \epsilon_{t,f}^*$ recursively through the above equation. After obtaining $\epsilon_{t,f} - \epsilon_{t,f}^*$, we can use equation (1) to calculate $\Delta hp_t - \Delta hp_t^*$, i.e., the difference of log house price growth in the two scenarios. The ratio between the actual house prices and the counterfactual can then be calculated as

$$\frac{HPI_t}{HPI_t^*} = e^{\sum_{i=0}^t \Delta hp_t - \Delta hp_t^*}$$

.

Appendix D Data for The SVAR Model

In this section, we describe and provide the source of data used to estimate our SVAR model. We also plot all the time series in Figure D.2.

Real GDP and Unemployment Rate: We use monthly data of GDP and unemployment rate. The monthly Real GDP Index is from HIS Markit, and the unemployment rates are from the U.S. Bureau of Labor Statistics. The unemployment rate is defined as the number of unemployed people divided by the size of the labor force.

House Prices: We use the seasonally adjusted House Price Index (HPI) from FHFA. The FHFA HPI is a weighted, repeat-sales index which measures average price changes in repeat sales on the same properties. It covers all single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975. This index is published with a two-month lag. At the time our paper has been released, the last

published date was October 2020.

Foreclosures: We use the U.S. Home Foreclosure Filings Total from Realty Trac Inc. to measure foreclosures. This index counts properties at different stages of the foreclosure process, such as receiving a notice, auction, and actual foreclosure, in each month from 2005-01 till 2020-10.

New Home for Sale: The data for United States New Home Sales are provided monthly by the US Census Bureau. A new home is considered to be offered for sale when it is being built to be sold. In permit-issuing areas of the United States, this is recorded when the permit to build is issued. In non-permit-issuing areas, this is recorded when work has begun on the footings or foundation, and a sales contract has not been signed nor a deposit accepted. The seasonally adjusted monthly data is jointly released by the U.S. Census Bureau and the U.S. Department of Housing and Urban Development (HUD).

Appendix E Robustness Analysis

In this section, we analyze the robustness of our predictions. First, we consider alternative foreclosure measurements and estimate how much foreclosure would be prevented by forbearance. Second, we analyze alternative econometric models and their produced estimates for the spillover effect of foreclosures on house prices. We examine the predictions of these models on the impact of forbearance on house prices.

Our sensitivity analysis of the refinancing activity to hypothetical house price declines should be robust as long as GSEs do not alter their eligibility requirements and standards for charging LLPA fees. This is because (1) our calculation is based on GSE eligibility requirements and LLPA matrices, and (2) our sample covers all GSE refinance loans originated from April 2020 to October 2020.

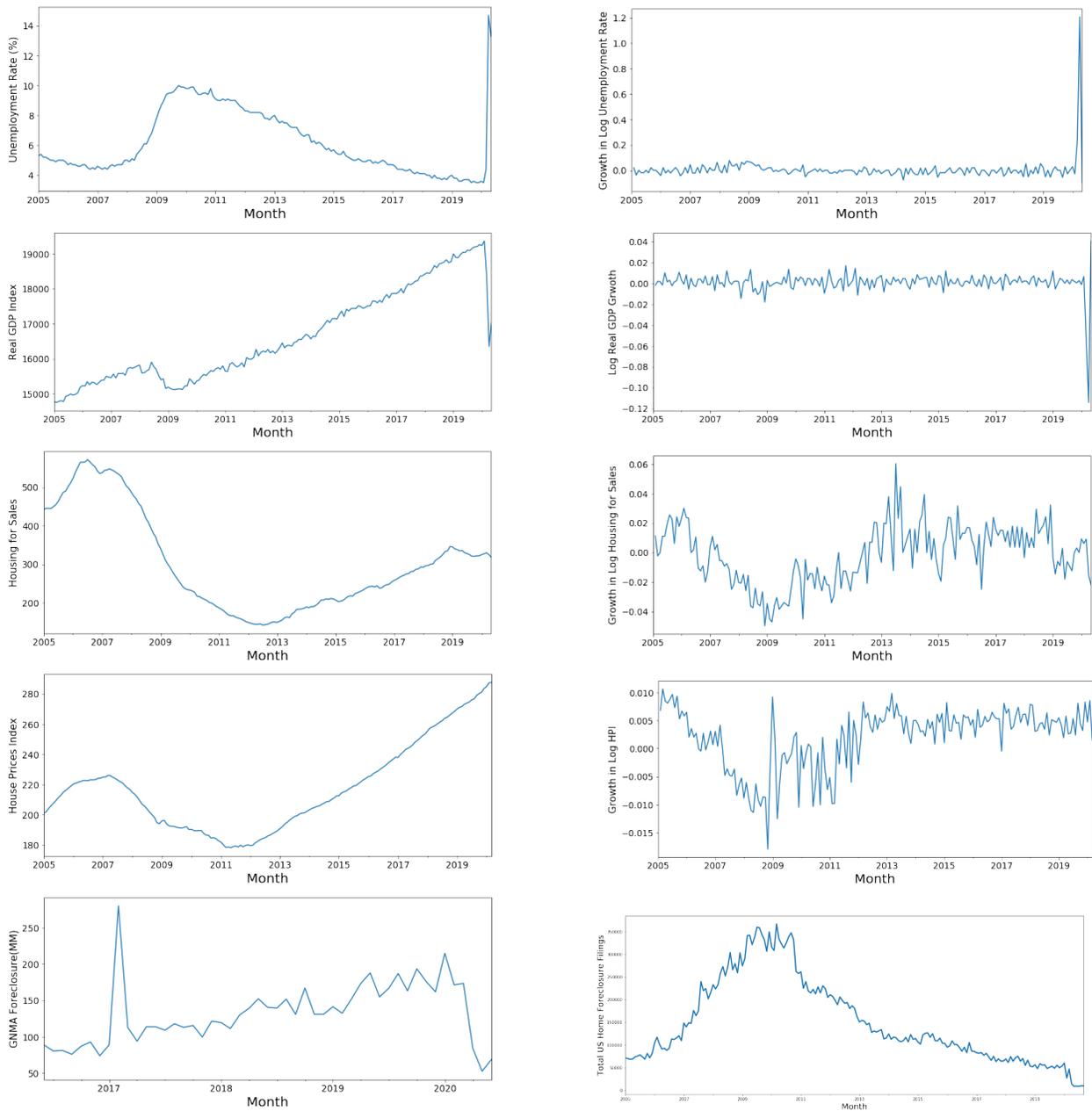


Figure D.2: Data: The figure displays the time series of unemployment rate, real GDP index, new home for sale, House Price Index, foreclosures. It also displays the time series of the log growth rate of unemployment rate, real GDP index, new home for sale, and House Price Index.

E.1 Alternative Measures of Foreclosures and Delinquencies

Our model uses US Home Foreclosure Filings Total to measure foreclosures in each month. The Mortgage Bankers' Association (MBA) also provides data on foreclosure starts, foreclosure inventory, and delinquencies. However, the frequency of their data is at most quarterly, which would be too coarse for our counterfactual analysis on refinancing activities using loan-level data. For example, if we know that the counterfactual cumulative house price declines in July, August, and September are 1%, 2%, 4% respectively, we can correspondingly calculate the counterfactual LTV ratios for all loans originated in each of those months, and analyze the effect on their refinancing cost and eligibility. However, if we only know that the counterfactual average house price decline in Q3 is around 2.3%, it would be hard to accurately calculate the counterfactual LTV ratios in each month. We could overestimate the impact on loans originated in July, and underestimate the impact on loans originated in September.

Even though the MBA data are inappropriate for our analysis on refinancing activity, we can still use them to calculate the counterfactual estimate of foreclosures in the absence of intervention. We use the foreclosure starts rate and serious delinquency rate as our measurement of foreclosure and delinquency. Similar to what we have done in Section 4.1, we calculate the transition rate from serious delinquency to foreclosure start in each quarter from aggregate data, and then estimate what the foreclosure starts rate would have been without intervention. We find that the foreclosure starts rate might have been 0.32% and 0.64%, respectively in Q2 and Q3 2020, in the absence of intervention, whereas the actual foreclosure starts rate is 0.03% in Q2 and Q3 2020 (See Figure E.3). This supports our conclusion that, in the absence of intervention, there would have been many more foreclosures.

E.2 Alternative Estimates of House Prices

In our study, we build a SVAR model to estimate how foreclosure would have impacted house prices in the absence of forbearance. We then use the resulting counterfactual house price

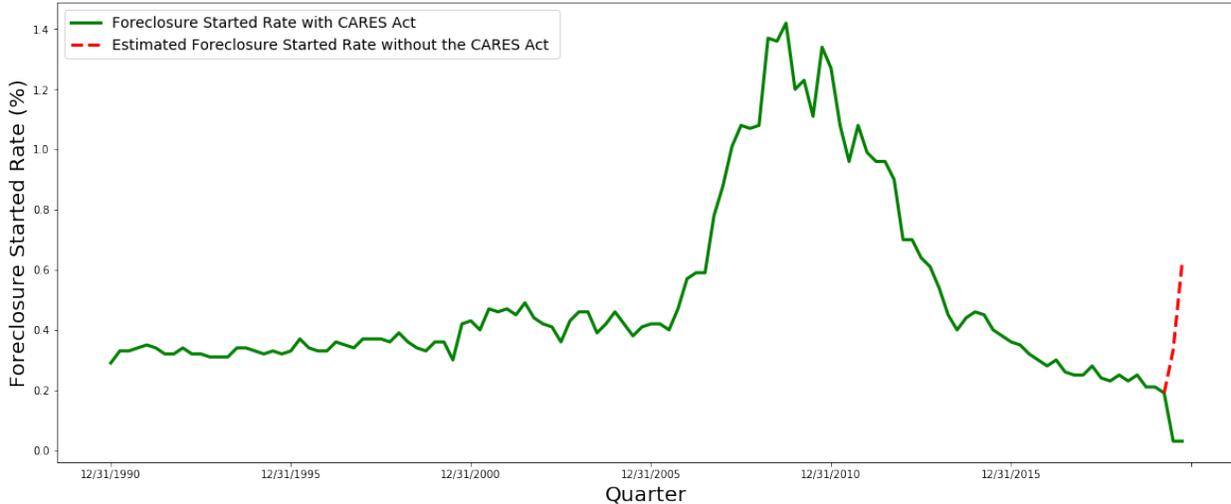


Figure E.3: US Foreclosures Started Rate with the foreclosure moratorium (green solid line) and estimated US Foreclosures Started Rate in the hypothetical scenario of no moratorium (red dotted line).

declines and our loan-level data to estimate the impact of the foreclosure moratorium on refinancing activities. There are alternative econometric models developed in the literature, which estimate the spillover effect of foreclosures on house prices (see, for instance, Calomiris, Longhofer, and Miles (2013) and Mian, Sufi, and Trebbi (2015)). As discussed earlier, we did not directly use the model in Calomiris, Longhofer, and Miles (2013), but rather constructed a similar model fed with data at a monthly, instead of quarterly, frequency for our refinancing analysis. As a robustness check, we compare the magnitude of house price declines implied by their model with ours.¹⁸

Our model estimates that spillover effects from a large wave of foreclosures prevented by the moratorium in Q2 and Q3 2020 could have led to an approximately 5% house price decline in Q3 2020 relative to the realized house price in the same quarter. In Section E.1, we also estimate that without the moratorium, the foreclosure starts rate could have been 0.32% and 0.62% instead of 0.03%, respectively in Q2 and Q3 2020. In Calomiris, Longhofer, and Miles (2013), they use the log foreclosure starts rate from MBA to measure foreclosures,

¹⁸The difference in the estimates may result from the different data size, use of state-level and low-frequency data in their model, different measurement of house prices and foreclosures, and different identification methods.

and their impulse response function indicates that a comparable shock (that is, a quarterly foreclosure shock that increases the log foreclosure starts rate from $\ln(0.03)$ to $\ln(0.32)$ in Q2 2020, and from $\ln(0.03)$ to $\ln(0.62)$ in Q3 2020) in Q2 2020 results in a quarterly house price decline of roughly 2% in Q3 2020. The contemporaneous foreclosure shock¹⁹ in Q3 2020 could lead to an additional 1% house price decline in Q3 2020. All this suggests that the procedure in Calomiris, Longhofer, and Miles (2013) would yield similar, but slightly smaller estimates of house price drops without the moratorium.

It is difficult to generate a shock comparable to the foreclosures shocks in Mian, Sufi, and Trebbi (2015) with our data and compare our estimates with theirs directly. This is because their model considers state-level, cross-section data between 2007 and 2009 whereas ours uses aggregate, time-series data. Therefore, we can only compare the results indirectly and resort to approximations. Calomiris, Longhofer, and Miles (2013) compare their estimates with that of Mian, Sufi, and Trebbi (2015), and show that theirs are more conservative: relative to Mian, Sufi, and Trebbi (2015), a similar magnitude of foreclosure shock would only result in about a third of the house price decline (2.7% compared to 8%) for a nine-quarter horizon in Calomiris, Longhofer, and Miles (2013). A three-time stronger response of the house price log growth rate to foreclosure shocks relative to Calomiris, Longhofer, and Miles (2013) would then suggest a roughly 9% house price decline in Q3 2020, after a comparable foreclosure shock in Q2 and Q3 2020. Compared to ours, their estimates of house price drops in the absence of a moratorium are higher.

¹⁹A contemporaneous foreclosure shock only affects house prices in their identification method that orders foreclosures before house prices.