Forbearance and the Cost of Credit.*

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Abstract

Using novel data from the GSE Credit Risk Transfer (CRT) market and the enactment of the 2020 CARES Act as a natural experiment, we study the ex-ante pricing of mortgage forbearance. We show that private investors demanded higher compensation for bearing mortgage credit risk following the introduction of federal mortgage forbearance. The increase in CRT spreads was larger for securities with greater exposure to judicial foreclosure regimes, lower expected house price growth, higher house price volatility, and riskier borrowers. These patterns suggest that investors priced heightened uncertainty regarding future collateral values and recovery outcomes. We find little evidence that the response was driven by broader financial market conditions, prepayment risk, servicer liquidity concerns, or strategic forbearance take-up. Our findings show how borrower-protection policies are transmitted to mortgage markets through the pricing of mortgage credit risk.

Keywords: Fannie Mae, Freddie Mac, GSEs, Mortgages, Investors, Credit Risk, Forbearance, Delinquencies.

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1 Introduction

Mortgage forbearance policies have become an increasingly important component of housing finance systems around the world. For example, the 2020 Coronavirus Aid, Relief, and Economic Security (CARES) Act in the United States and the 2023 Guideline to Prevent Mortgage Defaults in Canada allowed borrowers facing financial hardship to temporarily suspend mortgage payments without risking foreclosure. A growing literature highlights the benefits of such policies for household balance sheets and aggregate demand during economic downturns (see, e.g., Agarwal et al. 2017; Gabriel, Iacoviello and Lutz 2021; Gete and Zecchetto 2024). Yet we know considerably less about how borrower-protection policies affect the valuation of mortgage credit risk and, more broadly, the willingness of private capital to bear that risk.

In this paper, we study how private investors responded to the federal mortgage forbearance provisions introduced under the 2020 CARES Act. The Act allowed borrowers with federally backed mortgages to suspend payments for up to 12 months, later extended to 18 months, upon request and without documentation of hardship. Studying how forbearance affects the cost of mortgage credit is challenging because conventional mortgage markets provide little information about how private capital values the policy. During the pandemic, the Government-Sponsored Enterprises (GSEs) continued to guarantee conforming mortgages and did not pass increases in mortgage credit risk directly to borrowers. As a result, primary mortgage rates largely reflected policy choices made by government-controlled entities rather than the pricing of mortgage credit risk by private investors.

To overcome this challenge, we turn to the market for Credit Risk Transfer (CRT) securities. Introduced by Fannie Mae and Freddie Mac after the Global Financial Crisis, CRTs transfer a portion of the credit risk on conforming mortgages from taxpayers to private investors. Because CRT investors directly absorb mortgage credit losses and trade in a competitive market, CRT spreads provide a direct measure of how private capital prices mortgage credit risk and responds to borrower-protection policies such as mortgage forbearance.

We assemble a comprehensive dataset of the CRT market. Our novel dataset focuses on the two largest CRT programs: Connecticut Avenue Securities (CAS) issued by Fannie Mae and Structured Agency Credit Risk (STACR) securities issued by Freddie Mac, both launched in 2013. We analyze daily secondary-market trading data around the enactment of the 2020 CARES Act forbearance program and its subsequent extension in 2021. In addition, we assemble detailed information on borrower characteristics, including FICO scores, debt-to-income and loan-to-value ratios, as well as servicer composition and the geographic distribution of each CRT pool across U.S. states. We further merge these data with local house prices and COVID-

19 case counts, as well as financial market indicators, including risky corporate bond spreads, S&P 500 returns, and REIT pricing. In the CRT market, private investors bear the credit risk that would otherwise remain on the GSEs' balance sheets, along with prepayment and liquidity risk. CRT spreads over LIBOR (now SOFR) reflect their pricing of these risks.

The effect of mortgage forbearance on the pricing of mortgage credit risk is theoretically ambiguous. On the one hand, forbearance provides temporary payment relief to borrowers facing financial distress and may reduce mortgage losses by preventing avoidable defaults. On the other hand, it delays the resolution of distressed loans and postpones the normal loss-mitigation process. Under standard servicing practices, delinquent borrowers may enter repayment plans, receive loan modifications, or ultimately proceed through foreclosure. By replacing this process with a broad forbearance regime and foreclosure moratoria, the CARES Act extends the horizon over which borrower circumstances, collateral values, and recovery conditions can evolve before losses are realized. Delaying foreclosure and other loss-mitigation actions increases investors' exposure to future house price movements and can reduce expected recovery values, particularly when house prices are falling or expected to fall. Importantly, the CARES Act did not interrupt cash flows to CRT investors. Servicers continued to advance scheduled principal and interest payments, while the GSEs guaranteed timely remittances. Consequently, the repricing of CRT securities reflects changes in the compensation required by private investors to bear mortgage credit risk and investors' expectations regarding the future performance of the underlying mortgage pools. Some mechanisms may operate through changes in expected mortgage losses and recoveries, whereas others may affect CRT valuations without necessarily changing expected mortgage losses.

Whether investors viewed the CARES Act's forbearance provisions as reducing or increasing mortgage credit risk, or as affecting CRT valuations through alternative mechanisms, is therefore an empirical question. We begin by examining the response of junior CRT spreads to the enactment of the CARES Act using high-frequency event-study methods. We then exploit cross-sectional variation in borrower characteristics, foreclosure regimes, local housing market conditions, and servicer composition to identify the economic mechanisms underlying the market response, while separately evaluating alternative explanations based on prepayment risk, forbearance participation, and cash-flow timing.

Using an event-study framework, we document a sharp increase in CRT spreads following the enactment of the CARES Act. The increase is economically large, averaging approximately 10 percentage points, and remains highly elevated for more than 40 trading days and above pre-COVID levels for months. The timing of the response coincides precisely with the enactment of the CARES Act rather than with the declaration of a global pandemic or other major COVID-

19-related news. It also does not coincide with the dynamics of risky corporate bond spreads, equity prices, or REIT valuations. We also find a smaller but statistically significant increase in spreads following the subsequent extension of the maximum forbearance period from 12 to 18 months. These responses are robust to controls for local COVID-19 conditions and are difficult to reconcile with broader movements in credit, equity, or real estate markets.

We develop three complementary theoretical channels through which mortgage forbearance may affect the pricing of mortgage credit risk. The first operates through delayed loan resolution. By delaying foreclosure and other loss-mitigation actions, forbearance extends the period over which borrower circumstances, collateral values, and recovery conditions can evolve before losses are realized, thereby increasing expected loss given default. While forbearance helps some liquidity-constrained borrowers avoid default, it also exposes investors to greater uncertainty regarding borrower repayment capacity, house prices, and eventual recovery values. This uncertainty is heightened because the loss-mitigation protocols typically used to resolve mortgage distress, including foreclosure and loan modifications, are precluded during the forbearance period. The second operates by extending the borrower's option to default, allowing borrowers to condition repayment decisions on a longer horizon of future economic outcomes and increasing the sensitivity of both expected default probabilities and loss given default to the duration of forbearance, future house prices, and borrower conditions. The third operates through regulatory uncertainty, as the unprecedented federal intervention in mortgage contracts may have altered investors' expectations regarding the future mortgage resolution process, increasing uncertainty surrounding both future default probabilities and recovery values.

These economic arguments yield several testable implications. First, if investors are concerned about future recovery values, the response should be stronger for CRT securities with greater exposure to judicial foreclosure states. Judicial states involve longer and more uncertain foreclosure processes and lower expected recoveries conditional on default. By extending the period before distressed loans are resolved through foreclosure or other loss-mitigation actions, delayed loan resolution should have a larger effect on expected losses in these markets. We test this prediction using a difference-in-differences design that exploits variation in judicial-state exposure across CRT pools.

Second, if investors viewed forbearance as increasing exposure to collateral-value risk, the response should be strongest in areas where future house prices are expected to be weaker or more uncertain. Delaying the resolution of distressed loans extends the period over which collateral values can fluctuate before liquidation occurs, making expected mortgage losses more sensitive to local housing-market conditions. We test this implication by examining whether spread responses vary with expected house price growth and house price downside volatility

across CRT pools.

Third, the effect of prolonged exposure to collateral-value risk should be amplified for borrowers who are closer to the margin of default. Standard models of mortgage default emphasize the interaction between adverse income shocks and home equity. As borrower equity declines, income shocks become more likely to trigger default and generate credit losses. By extending the horizon over which borrower equity positions can evolve, forbearance increases investors' exposure to this double-trigger risk. Consequently, CRT pools with greater concentrations of marginal borrowers, such as those with lower FICO scores or higher debt-to-income ratios, should exhibit larger spread increases following the introduction of forbearance. We test this prediction using cross-sectional variation in borrower credit characteristics across CRT securities.

A related implication concerns loan-to-value ratios. Because missed mortgage payments under the CARES Act were deferred, forbearance mechanically increased borrowers' loan-to-value ratios. The resulting reduction in borrower equity reinforces the delayed resolution and borrower's option channels by increasing the sensitivity of both default probabilities and recovery values to future economic conditions. Although investors' expectations regarding future loan-to-value ratios are not directly observable at the time of the policy announcement, we provide ex post evidence consistent with this mechanism, highlighting the role of borrower equity in linking collateral-value risk, borrower credit risk, and expected recovery values.

Taken together, these tests provide consistent support for the delayed resolution, borrower's option, and regulatory uncertainty channels. Across the different empirical tests, CRT spreads responded more strongly for securities with greater exposure to foreclosure frictions, adverse collateral-value dynamics, and borrower credit risk, precisely where these mechanisms predict the largest effects. The evidence indicates that investors revised their expectations regarding both future default probabilities and recovery values following the CARES Act.

We next evaluate several competing explanations for the observed increase in CRT spreads and find little evidence supporting these alternative channels. The market response is not concentrated in the tranches most exposed to prepayment risk, indicating that changes in expected prepayments were not driving the repricing. Similarly, securities with greater exposure to nonbank mortgage servicers did not experience larger spread increases, suggesting that servicer liquidity concerns were not driving the market response. We also find little indication that investors were mainly worried about widespread participation by borrowers with limited need for payment relief. Finally, the persistence of elevated CRT spreads despite the uninterrupted remittance of scheduled principal and interest payments is inconsistent with a cash-flow timing

explanation. We further show that the timing of the response is difficult to reconcile with broader movements in financial markets or changing perceptions of the pandemic: corporate bond spreads, equity prices, and REIT valuations had already experienced their largest adjustments before the enactment of the CARES Act, whereas CRT spreads increased sharply immediately after the policy announcement. Taken together, these results support the interpretation that the increase in CRT spreads reflected investors' reassessment of future mortgage losses and recoveries associated with the forbearance program.

Our findings have important implications for the design of borrower-relief policies and for ongoing debates in the United States regarding the future structure of housing finance. These considerations are particularly relevant given recurring proposals to reduce the role of the federal government in mortgage markets, reform or privatize Fannie Mae and Freddie Mac, and expand the role of private capital through CRTs and other forms of risk transfer. Under the current system, increases in mortgage credit risk associated with borrower-relief policies are largely absorbed by the GSEs and, ultimately, taxpayers. In a more privatized housing finance system, however, these costs would be reflected more directly in market prices. Our findings therefore suggest that the effects of forbearance policies depend not only on their consequences for borrowers but also on how mortgage credit risk is allocated across the financial system. Importantly, the relatively favorable mortgage outcomes observed during the pandemic occurred alongside unprecedented fiscal, monetary, and housing-market support. The extent to which similar outcomes would arise in the absence of such interventions remains uncertain. More broadly, the results highlight that the design of borrower-protection policies and the structure of housing finance cannot be considered independently. In a market-based system, higher risk premia would likely be borne disproportionately by borrowers with limited equity or weaker credit profiles, potentially restricting access to refinancing or new mortgage credit precisely when liquidity is most valuable.

The remainder of the paper proceeds as follows. Section 2 reviews the related literature. Section 3 provides institutional background on CRT securities and the CARES Act forbearance provisions, and Section 4 describes the data. Section 5 presents the main event-study evidence. Section 6 develops the theoretical channels through which mortgage forbearance may affect CRT valuations. Section 7 evaluates the empirical implications of these channels using a series of cross-sectional analyses, examines competing explanations for the observed increase in CRT spreads, and conducts a range of robustness and falsification tests. Section 8 presents evidence on forbearance participation and ex post loan outcomes. Section 9 concludes.

2 Related Literature

This paper contributes to several strands of research. First, we extend the growing literature on the effects of COVID-19 and the 2020 CARES Act on mortgage performance. Kim et al. (2024) find that access to forbearance provided substantial liquidity support to households, significantly reducing delinquencies outside of formal forbearance. Gerardi, Lambie-Hanson, and Willen (2022) show that the forbearance provisions enacted during the pandemic were highly beneficial to borrowers. Analyzing seriously delinquent loans at the onset of COVID-19, Goodman and Zhu (2024) document that loans granted forbearance had foreclosure rates five times lower than comparable loans without forbearance. Capponi et al. (2021) develop a reduced-form framework to study how mortgage forbearance affects refinancing behavior, showing that exposure to unemployment risk plays an important role in driving default-related prepayment decisions. This literature emphasizes the borrower-side benefits of forbearance and highlights the role of federal stimulus policies and Federal Reserve interventions in facilitating repayment of suspended debt. In contrast, we contribute new evidence on the investor-side response by examining how the CRT market priced these policies, providing a complementary perspective on the broader potential equilibrium effects of mortgage forbearance in a market-based system.

Second, our study contributes to the literature on the heterogeneous effects of the CARES Act forbearance program. An et al. (2022) find that, while forbearance offered temporary relief, minority and lower-income borrowers were more likely to enter delinquency or default after exiting the program. Similarly, Gerardi, Lambie-Hanson, and Willen (2021) show that minority borrowers were significantly less likely than White borrowers to exit forbearance and resume making payments. In contrast, Goodman and Zhu (2023) document that the policy had a more positive effect on helping single borrowers resolve delinquency and return to current status compared to households with multiple borrowers. Contat et al. (2026) further show that uncertainty regarding repayment resolution and limited financial understanding make it more difficult for borrowers to resume payments after forbearance ends, highlighting the importance of borrower expectations and information in shaping post-forbearance outcomes. We extend this literature by identifying the economic channels through which large-scale mortgage forbearance is transmitted to financial markets. Our results contribute to understanding how institutional foreclosure regimes, expected house price dynamics, and borrower credit risk jointly shape the pricing of mortgage credit risk, highlighting the importance of legal institutions, collateral-value risk, and borrower fundamentals in the transmission of borrower relief policies to financial markets.

Third, our study makes a novel contribution to the broader literature on debt relief programs by offering new evidence on how financial markets *ex-ante* priced the risks associated with large-scale forbearance. While much of the existing work focuses on ex-post borrower outcomes, we highlight how investors in the CRT market reassessed and repriced credit risk in real time following the enactment of the CARES Act. For example, Dinerstein, Yannelis, and Chen (2024) show that the federal student loan payment pause during COVID-19 boosted consumption as borrowers redirected liquidity toward mortgages, auto loans, and credit cards. They attribute these effects primarily to increased credit demand. Similarly, Mian, Sufi, and Trebbi (2014) find that judicial foreclosure rules mitigated house price declines but heightened moral hazard during the Global Financial Crisis, resulting in no net improvement in default outcomes. Gabriel, Iacoviello and Lutz (2021) find that the California Foreclosure Prevention Laws (CFPL) generated a 20% reduction in foreclosures during the 2008 financial crisis, with minimal adverse side effects on the availability of mortgage credit for new borrowers. Fout et al. (2017) document no effect of forbearance on subsequent loan outcomes. However, the previous studies assess the consequences of debt relief *ex-post*, which is particularly problematic for investigations of the CARES forbearance program because the economy benefited from unprecedented stimulus and property price increases (Goodman and Zhu 2024). In contrast, we show that CRT investors, as forward-looking and risk-sensitive market participants, immediately priced in the anticipated costs of the CARES Act's forbearance provisions into prices on a well-identified policy date, rather than over an extended period. By documenting sharp and heterogeneous responses in spreads, we provide direct evidence on how capital markets anticipate and internalize the trade-offs of borrower relief policies in real time, free from look-ahead bias.

Fourth, our analysis is grounded in the literature linking foreclosure risk to income shocks, house price dynamics, and broader macro-financial outcomes, particularly in the context of the U.S. subprime mortgage crisis (Gerardi et al., 2008; Mian and Sufi, 2009; Davis and Van Nieuwerburgh, 2015; Favilukis et al., 2017). It is also informed by the literature showing that mortgage distress arises from the interaction of adverse income shocks and low or negative home equity (Fuster and Willen, 2017; Ganong and Noel, 2023). We build on these insights by examining how private investors priced these risks *ex ante* following the introduction of mortgage forbearance. By studying the response of CRT spreads, we provide evidence on how capital markets incorporated expectations about future mortgage losses and recoveries in real time, before the ultimate outcomes of the program were known.

Fifth, our study contributes to the emerging literature on the Credit Risk Transfer (CRT) market, a key innovation in housing finance that allows private investors to bear mortgage credit

risk previously held by the federal government. Capponi et al. (2026) develop an asset-pricing model of CRT securities that links mortgage default to the joint occurrence of a liquidity shock and negative home equity. Related work, such as Finkelstein, Strzodka, and Vickery (2018) and Golding and Lucas (2022), assess the effectiveness of CRTs in transferring risk away from taxpayers. Gete, Tsouderou, and Wachter (2024) show that CRT spreads respond sharply to catastrophic hurricanes, quantifying the impact of natural disasters on credit risk pricing. Compared to markets like CDS, the CRT market offers a cleaner setting to study the pricing of mortgage credit risk, free of counterparty concerns and more transparently linked to credit risk. We build on this literature by documenting how CRT investors reacted in real time to the borrower forbearance provisions of the CARES Act, extending our understanding of how this market prices policy-driven credit risk.

Finally, this paper contributes to the broader literature on housing finance and the role of Government-Sponsored Enterprises (GSEs). Prior studies have examined various aspects of the GSEs' function and risk exposure, including pricing guarantees (Lucas and McDonald 2010), macroeconomic implications (Jeske, Krueger, and Mitman 2013), regulatory challenges (Frame, Wall, and White 2013), and the effects of reform proposals (Elenev, Landvoigt, and Van Nieuwerburgh 2016; Hurst et al. 2016; Gete and Zecchetto 2018). Notably, Pavlov, Schwartz, and Wachter (2021) and Stanton and Wallace (2011) demonstrate that traditional credit risk transfer instruments like credit default swaps failed to adequately reflect mortgage risk during the 2008 financial crisis, limiting the effectiveness of risk transfer to private markets. By showing how policy-induced changes in mortgage credit risk were immediately reflected in CRT prices, our study sheds light on the role of CRTs in sharing mortgage credit risk between the GSEs and private investors. More broadly, our findings highlight how the current GSE structure absorbs increases in mortgage credit risk during periods of economic distress and inform ongoing discussions about the implications of a more privatized housing finance system.

3 The CRT Market and the CARES Act

3.1 CRT Market Background and Pricing

The GSEs began issuing Credit Risk Transfer (CRT) securities in July 2013; by 2022, they had transferred risk on about $6.2 trillion in mortgages (FHFA 2023). CRTs are 10–12.5 year notes that pass through principal and interest from a reference pool of recently securitized agency mortgages. Pools span all U.S. states and are grouped by loan-to-value (LTV) ratios into high (80–97%) and low (60–80%) LTV categories. CRTs pay a floating rate based on

LIBOR (now SOFR) plus a spread reflecting the market price of bearing GSE credit risk (Wachter 2018).

Mortgage pools are tranched by seniority. The GSEs retain the most senior tranche, while mezzanine and junior tranches are sold to investors, including first-loss tranches since 2016. Cash flows follow a waterfall: senior tranches are paid first, while losses are absorbed from the most junior tranches upward; prepayments are first applied to senior tranches.

CRT prices reflect investors' expectations of future mortgage cash flows, which depend on default, recovery, and prepayment outcomes. For the junior tranches that we study, expected credit losses are the primary determinant of value because these securities absorb mortgage losses first. Prior research shows that increases in expected default rates or loss severity reduce CRT prices and raise yields (Zandi et al. 2017; Golding and Lucas 2022). Thus, movements in junior CRT spreads provide a direct measure of how investors revise their expectations of future mortgage credit losses.

3.2 The 2020 CARES Act

The Coronavirus Aid, Relief, and Economic Security (CARES) Act, signed into law on March 27, 2020, allowed borrowers with federally backed mortgages to enter forbearance for up to 12 months (later extended to 18) without penalties or additional interest. Missed payments could be repaid through several options, including deferral until the end of the loan term. Take-up was widespread due to minimal eligibility requirements. By early 2021, $16.6 billion in GSE-backed and $10.2 billion in FHA-backed mortgage balances were in forbearance (Cherry et al. 2022). Loans exit forbearance when they become current, are modified or liquidated, or reach the time limit, whichever occurs first.

An important feature of the CARES Act forbearance program is that it did not immediately interrupt cash flows to CRT investors. For loans guaranteed by Fannie Mae and Freddie Mac, mortgage servicers were contractually required to continue advancing scheduled principal and interest payments to mortgage-backed securities investors and, consequently, to CRT investors, even when borrowers entered forbearance and temporarily stopped making payments (see, for example, Golding et al. 2021). As a result, the underlying loans did not generate immediate losses due to missed payments, and CRT investors were not required to absorb losses simply because borrowers entered forbearance. Had these advances not been made, widespread payment suspensions would have accelerated the recognition of mortgage credit losses. Instead, servicer advances effectively kept the loans current from the perspective of the securitization

structure, shielding CRT investors from immediate losses associated with borrower payment interruptions. In April 2020, the FHFA capped servicers' advance obligations at four months, after which the GSEs assumed responsibility for ensuring that scheduled payments continued to reach investors. Consequently, borrowers in forbearance remained in the securitized mortgage pools, and investors continued to receive scheduled principal and interest under the GSE guarantee despite the absence of borrower payments.

4 Data

We assemble a comprehensive database by combining information on CRT securities, underlying mortgage pools, financial markets, and local economic conditions from multiple sources. We begin with data on Credit Risk Transfer (CRT) securities obtained from the GSEs (Fannie Mae 2026, Freddie Mac 2026). The two main CRT programs are Connecticut Avenue Securities (CAS), issued by Fannie Mae, and Structured Agency Credit Risk (STACR) securities, issued by Freddie Mac. For all CRT deals issued between 2017 and 2019, we collect information on deal characteristics, including issuance dates and tranche structure.

We supplement these data with detailed information on the underlying mortgage pools from the GSEs. Specifically, we collect loan-level information on borrower and loan characteristics, including loan-to-value (LTV) ratios, FICO scores, debt-to-income (DTI) ratios, and mortgage servicer identities. We aggregate these data to the CRT-pool level to construct measures of borrower risk, collateral risk, and servicer composition.

Our primary outcome variable is the secondary-market yield spread of CRT securities. We obtain the complete history of CRT yields from Refinitiv Eikon (now part of LSEG Workspace) and merge these data with CRT characteristics using deal and tranche identifiers. CRT spreads are calculated as the yield to maturity minus the 1-month U.S. dollar LIBOR rate, the benchmark reference rate specified in CRT contracts during our sample period. The resulting panel of daily CRT spreads forms the basis of our event-study and difference-in-differences analyses. We also merge daily data on the 10-year Treasury yield from FRED to control for changes in broader interest-rate conditions.

To capture local housing market conditions, we merge monthly state-level house price data from Zillow's Home Value Index (ZHVI) for single-family homes. We also collect monthly state-level unemployment rates from the Bureau of Labor Statistics and weekly state-level COVID-19 case counts from the Centers for Disease Control and Prevention. Finally, we obtain BBB corporate bond spreads from FRED as a measure of broader credit-market conditions.

Our baseline analysis focuses on junior CRT tranches. These securities are the first to absorb realized mortgage credit losses from defaults and foreclosures, while senior tranches are initially more exposed to prepayment risk. We restrict the sample to securities issued between January 2017 and December 2019 for two reasons. First, at the onset of the CARES Act, these securities still had substantial principal outstanding and therefore meaningful exposure to future mortgage credit losses. Second, unlike some pre-2016 CRT issuances that relied on modeled credit-loss measures ("fixed severity" CRTs), the securities in our sample are linked directly to realized mortgage losses, making them particularly well suited for studying how investors priced the introduction of mortgage forbearance.

Table 1 reports summary statistics for the main variables used in the analysis. The baseline sample consists of 55 CRT securities and 2,088 security-day observations within a 30-day window before and after the introduction of the CARES Act. The underlying mortgage pools have an average LTV ratio of 83 percent and an average FICO score of 741.

5 Novel Fact

This section establishes the paper's central empirical finding. We document a sharp increase in CRT spreads following the introduction of the CARES Act. We first present graphical evidence and then quantify the market response using an event-study specification. We then examine the robustness of the results to contemporaneous shocks and alternative specifications before turning to the market response to the February 2021 extension of the maximum forbearance period.

Figure 1 plots the evolution of CRT spreads around the introduction of the CARES Act. In the months leading up to the policy announcement, spreads were relatively stable and exhibited a slight downward trend. On the first trading day following the enactment of the Act, however, spreads increased sharply, indicating that private investors demanded substantially higher compensation for bearing mortgage credit risk. Elevated spreads persisted for approximately two months before moderating, but remained well above pre-CARES Act levels for more than a year.[1] Appendix Figure A1 corroborates these findings using aggregate CRT spread data from the Federal Reserve Bank of St. Louis.

[1]Figure 1 also shows that the First-Loss (B2) tranche experienced a substantially larger increase in spreads than the more senior B1 tranche. Section 7.5 examines the differential response across CRT tranches.

5.1 Event Study

We formally quantify the market response to the introduction of the CARES Act using an event-study design. The specification traces the evolution of CRT spreads around the policy announcement and allows us to estimate the magnitude and persistence of the repricing. We estimate the following:

$$Spread_{i,t} = \sum_{\substack{k=-40 \\ k\neq -1}}^{40} \beta_k \mathbf{1}_{\{t-E=k\}} + \alpha_i + \epsilon_{i,t}, \tag{1}$$

where $Spread_{i,t}$ denotes the yield spread of CRT tranche i on day t, measured as the yield to maturity minus the 1-month LIBOR rate. The coefficients of interest, β_k, capture the evolution of spreads at each event time k relative to the omitted day immediately preceding the event ($k = -1$). The variable E denotes the event date, March 30, 2020, the first trading day after the CARES Act was enacted, and α_i are security fixed effects.

Estimating a separate coefficient for each day allows us to examine the timing, magnitude, and persistence of the market response, while also testing for pre-existing trends. Standard errors are clustered at the security level to account for serial correlation in spreads.

Figure 2 presents the estimated event-study coefficients. Prior to the enactment of the CARES Act, the coefficients are economically small and statistically indistinguishable from zero, providing no evidence of pre-trends. Following the policy announcement, CRT spreads increase sharply and remain elevated throughout the post-event period. The estimated effect reaches approximately 10 percentage points on average and persists for the subsequent 40 trading days, although its magnitude moderates over time. While confidence intervals widen in the post-event period, the estimated coefficients remain far from zero, highlighting the magnitude and persistence of the effect.

5.2 Robustness

Identification of the event-study estimates requires that no other contemporaneous shocks systematically affected CRT spreads around the enactment of the CARES Act. We evaluate this assumption using two complementary exercises.

First, we augment the baseline event-study specification with controls capturing each CRT pool's exposure to local COVID-19 conditions. Specifically, we construct a CRT-level measure of weekly confirmed COVID-19 cases as a weighted average across states, where the weights

correspond to each state's share of unpaid principal balance in the underlying mortgage pool. Figure A2 reports the resulting estimates. Consistent with the baseline specification, the estimated coefficients are close to zero prior to the enactment of the CARES Act, providing no evidence of pre-trends. Following the policy announcement, CRT spreads increase sharply and remain elevated throughout the subsequent 40 trading days. The similarity of the estimates suggests that differential exposure to local COVID-19 conditions does not explain the observed response.

Second, we examine whether the timing of the CRT response reflects broader movements in financial markets or a deterioration in economic expectations associated with the pandemic rather than the forbearance provisions of the CARES Act. Because corporate bond spreads, equity indices, and REIT prices exhibit only time-series variation, they are absorbed by the event-time indicators and therefore cannot be included separately in the event-study regression. Instead, we examine their behavior around the enactment of the CARES Act. Figure 3 plots BBB- and B-rated corporate bond spreads, while Figure A3 presents the S&P 500 index and the NAREIT real estate index.

The evidence indicates that these markets did not exhibit a discrete response around March 30, 2020. Corporate bond spreads increased sharply throughout March as financial markets reacted to the rapidly deteriorating economic outlook associated with the pandemic and peaked around March 23, more than a week before the enactment of the CARES Act. Similarly, both the S&P 500 and NAREIT indices declined substantially beginning in mid-February and reached their lowest levels around March 23. It is also notable that the World Health Organization declared COVID-19 a global pandemic on March 11, more than two weeks before the CARES Act was signed, yet CRT spreads did not increase materially until the policy enactment. In contrast, CRT spreads increased sharply on the first trading day following the signing of the CARES Act. Taken together, these patterns suggest that the response documented in the CRT market was distinct from the broader movements observed in financial markets during March 2020 and coincided closely with the enactment of the CARES Act.

5.3 The 2021 Extension of CARES Act Forbearance

In February 2021, federal housing authorities expanded the forbearance protections introduced under the CARES Act. Specifically, the White House announced that borrowers who had entered forbearance by June 30, 2020 could obtain up to two additional three-month extensions, effectively increasing the maximum allowable forbearance period from 12 to 18 months for eligible loans. This policy change, implemented through guidance from agencies overseeing

federally backed mortgages, extended pandemic mortgage relief and delayed the resolution of distressed loans.[2]

This policy extension provides a second event with which to examine how CRT investors also responded to subsequent expansions of mortgage forbearance protections. To do so, we estimate the event-study specification in equation (1) around the announcement date of February 16, 2021.

Figure 4 presents the estimated coefficients. Prior to the announcement, the coefficients are statistically indistinguishable from zero, providing no evidence of pre-trends. Following the announcement, CRT spreads increase. The magnitude of the response is smaller than that observed around the initial introduction of the CARES Act forbearance program, but spreads rise gradually over the subsequent 30 trading days, with the estimated effect reaching approximately 0.3 percentage points. The confidence intervals remain above zero, highlighting the significance and persistence of the effect.

The results are robust to alternative specifications, including controls for CRT-specific exposure to local COVID-19 conditions. Taken together, the evidence indicates that CRT spreads responded not only to the introduction of mortgage forbearance but also to subsequent expansions of the program. The following section develops theoretical arguments that rationalize these findings and explains why extending the maximum duration of forbearance should reinforce the effects of the initial policy.

6 Economic Channels

The increase in CRT spreads following the introduction of the CARES Act can arise through several economic channels. Because servicers continued to advance scheduled principal and interest payments and the GSEs guaranteed cash flows during the forbearance period, CRT investors were not exposed to immediate losses arising from missed borrower payments. The market response therefore reflects changes in the compensation required by private investors to bear mortgage credit risk and incorporates investors' expectations regarding the future performance of the underlying mortgage pools. Some channels operate through changes in expected mortgage losses and recoveries, whereas others affect the valuation of CRT securities without necessarily changing expected mortgage losses.

The channels operating through expected mortgage losses are theoretically ambiguous. On

[2]https://www.presidency.ucsb.edu/documents/fact-sheet-biden-administration-announces-extension-covid-19-forbearance-and-foreclosure

the one hand, forbearance provides temporary payment relief to borrowers experiencing financial distress. If borrowers are primarily illiquid rather than fundamentally unable to repay, forbearance may allow them to remain current and ultimately reduce mortgage losses. On the other hand, forbearance delays the resolution of distressed mortgages and extends the period over which borrower circumstances, collateral values, and recovery conditions can evolve before losses are realized. For borrowers whose future repayment capacity remains uncertain, longer resolution horizons increase investors' exposure to adverse outcomes. By extending the period during which foreclosure and other loss-mitigation actions are unavailable, delayed resolution also increases investors' exposure to future house price declines, reducing expected recovery values and increasing expected losses conditional on default.

The remainder of this section develops the economic intuition underlying the channels that could explain the observed increase in CRT spreads and derives the corresponding empirical predictions.

6.1 Delayed Loan Resolution and Recovery Values

One channel through which mortgage forbearance may affect CRT valuations is delayed loan resolution. Under standard servicing practices, delinquent borrowers may enter repayment plans, receive loan modifications, or ultimately proceed through foreclosure. By replacing this process with a mandatory forbearance regime and foreclosure moratoria, the CARES Act delayed the resolution of distressed mortgages and extended the period over which borrower circumstances, collateral values, and recovery conditions could evolve before losses were realized.

For borrowers who ultimately default, delayed resolution increases the period over which collateral values and property conditions may deteriorate before liquidation occurs. Recovery values become more uncertain because foreclosure and other loss-mitigation actions are postponed while house prices, borrower equity, and repayment prospects continue to evolve. Consequently, delayed resolution can increase expected loss given default (LGD), particularly when house prices are expected to decline or become more volatile.

This channel gives rise to several testable implications. First, the effect should be stronger in judicial foreclosure regimes, where longer foreclosure timelines increase the uncertainty surrounding recovery values and, consequently, expected LGD. Second, the increase in CRT spreads following the CARES Act should be larger for securities with greater exposure to areas where house price appreciation is expected to be weaker. Third, the response should be stronger for securities exposed to areas with higher house price volatility, particularly downside volatil-

ity, where adverse collateral-value realizations are more likely. Fourth, it should be amplified for borrowers with weaker balance sheets because prolonged exposure to collateral value risk increases the importance of future borrower equity positions and repayment capacity.

6.2 Extending the Borrower's Option to Default

The borrower's decision to continue repayment or default can be viewed as a put option on the underlying property. Mortgage forbearance extends the period before this decision must be made, allowing borrowers additional time to observe future house price realizations before resolving mortgage distress. If house prices recover sufficiently, borrowers have a stronger incentive to resume repayment and retain the property. If house prices deteriorate further, they can instead choose to default. By expanding the set of future states over which this decision is made, forbearance increases the value of the borrower's option.

The increase in the borrower's option value comes at the expense of CRT investors. Lenders do not participate in the upside associated with favorable future realizations beyond receiving the promised mortgage balance, but they remain fully exposed to adverse realizations that reduce collateral values and increase credit losses. Extending the forbearance horizon therefore increases lenders' downside risk without creating corresponding upside gains. As a result, private investors require higher compensation for bearing mortgage credit risk.

We formalize this intuition in the option-theoretic model presented in the Appendix. Together with illustrative simulations, the model demonstrates how extending the forbearance horizon increases the value of the borrower's option and provides a theoretical foundation for the empirical predictions developed in this section.

The model predicts that the increase in CRT spreads should be strongest when extending the forbearance horizon generates the greatest increase in the value of the borrower's default option. This occurs when the effective time before liquidation is longest, making judicial foreclosure regimes particularly sensitive to the introduction of forbearance. The effect should also be stronger when future house prices are more uncertain, since additional time allows borrowers to condition repayment decisions on a wider range of future house price realizations. Finally, the option becomes more valuable for borrowers with limited home equity who are closer to the default boundary, where relatively small changes in collateral values can alter the optimal repayment decision.

An immediate implication of these mechanisms is that subsequent extensions of the maximum duration of forbearance should further increase the compensation required to bear mort-

gage credit risk. By further delaying the resolution of distressed mortgages, such policies reinforce both the delayed resolution and borrower option mechanisms. A longer forbearance horizon increases investors' exposure to future collateral values and recovery outcomes while simultaneously increasing the value of the borrower's option to default.

6.3 Regulatory Uncertainty

The introduction of the CARES Act may also have affected CRT valuations by increasing regulatory uncertainty surrounding mortgage resolution. In particular, the Act represented an unprecedented federal intervention into mortgage contracts that may have signaled a broader shift in the policy environment governing mortgage resolution and foreclosure. A similar mechanism has been proposed in the housing literature. Rent control and eviction moratoria affect landlords' investment and supply decisions not only through their direct economic effects, but also because they may reveal a government's willingness to intervene in existing contractual arrangements, thereby increasing the perceived likelihood of future policy intervention (Diamond, McQuade and Qian 2019, Arefeva et al. 2019). Similarly, Corbae, Glover and Nattinger (2024) show that eviction moratoria alter landlords' investment and screening incentives beyond the moratorium's immediate cash-flow effects. This is consistent with a broader literature showing that policy uncertainty can reduce investment and risk-taking independently of the specific policy being implemented (Baker, Bloom and Davis 2016).

Although the institutional setting differs, a similar mechanism may operate in mortgage markets. By introducing federal intervention into the enforcement of mortgage contracts, the CARES Act may have increased uncertainty regarding the future rules governing mortgage resolution. If investors assigned positive probability to further policy interventions affecting the resolution of distressed mortgages, they would require higher compensation for bearing mortgage credit risk. Such interventions could also increase expected default probabilities by raising uncertainty about future repayment incentives, with the effect being strongest for securities backed by borrowers with greater underlying credit risk. A testable implication is that any increase in expected mortgage losses associated with delayed resolution should be amplified for pools containing borrowers with weaker credit profiles.

The same reasoning also applies to subsequent policy interventions. If the initial introduction of the CARES Act caused investors to revise their beliefs about the government's willingness to intervene in mortgage contracts, then later expansions of the program provide additional evidence that such interventions may continue. By reinforcing expectations of future changes to the mortgage resolution process, subsequent policy extensions should further

increase the compensation investors require for bearing mortgage credit risk.

6.4 Prepayment Risk

An alternative explanation for the increase in CRT spreads is that investors revised their expectations regarding future mortgage prepayments rather than expected mortgage credit losses. The sharp decline in interest rates during March 2020 increased refinancing incentives, potentially affecting the valuation of CRT securities through changes in expected prepayments. Because mezzanine CRT tranches are more exposed to prepayment risk than junior tranches, the prepayment channel predicts a larger increase in spreads for the mezzanine tranches following the CARES Act. A larger response among the junior tranches would instead be consistent with investors pricing higher expected mortgage credit losses.

6.5 Servicer Liquidity

Mortgage forbearance also raised concerns about the financial resilience of mortgage servicers. Under the CARES Act, borrowers could suspend mortgage payments while servicers remained responsible for advancing scheduled principal and interest payments to the securitization trust. If forbearance participation became sufficiently widespread, these advance obligations could generate substantial liquidity pressures for mortgage servicers.

These concern would have been particularly salient for nonbank mortgage companies, which rely more heavily on short-term funding and are generally viewed as more vulnerable to liquidity shocks than traditional bank servicers (Kaul, 2020; Gerardi, Lambie-Hanson and Willen 2022; Jiang et al., 2024). If servicer liquidity risk were an important driver of the market response, CRT securities with greater exposure to nonbank servicers should exhibit larger spread increases following the enactment of the CARES Act.

6.6 Forbearance Participation

Another concern raised at the time of the CARES Act was that the program's minimal documentation requirements could lead to widespread forbearance participation, creating liquidity pressures for all servicers and increasing the program's fiscal cost. Reflecting these concerns, press coverage shortly after the announcement emphasized the scale of take-up and the strain on the mortgage industry, with headlines such as "Nearly 3 million borrowers have been granted

mortgage relief, and the industry is crying for help" (Olick 2020).

If expectations of widespread forbearance participation drove the repricing of CRT securities, the increase in spreads should primarily reflect expected program take-up rather than underlying borrower risk. Accordingly, this mechanism predicts that the response should not be systematically stronger for securities backed by riskier borrowers.

6.7 Cash-Flow Timing

Another potential explanation for the increase in CRT spreads is that investors expected mortgage forbearance to delay the timing of cash flows rather than increase expected mortgage losses. At the time the CARES Act was enacted, investors may have been uncertain whether widespread payment deferrals would disrupt the timing of principal and interest remittances to CRT investors. Even if borrowers ultimately resumed repayment, a temporary interruption in cash flows could reduce the present value of CRT securities and therefore increase required spreads. If this mechanism were important, the increase in CRT spreads should primarily reflect concerns regarding the timing of cash flows. Once investors observed that scheduled principal and interest remittances continued without interruption, these concerns should dissipate and CRT spreads should return toward their pre-policy levels.

7 Empirical Evidence

The proposed mechanisms generate distinct cross-sectional predictions for the response of CRT spreads to the CARES Act. This section evaluates these predictions to identify the economic mechanisms underlying the observed increase in CRT spreads.

7.1 Judicial Foreclosure Regimes

The institutional variation in foreclosure regimes provides a natural setting to evaluate both the delayed resolution and borrower's option channels. The key distinction between between judicial and non-judicial regimes lies in the foreclosure process: judicial states require court approval throughout the resolution process, resulting in substantially longer liquidation timelines and lower expected recovery values than non-judicial states, where lenders can initiate and complete foreclosure without court involvement. Delinquent borrowers in judicial states remain in their homes for longer periods, increasing the likelihood of property deterioration before liq-

uidation. Recovery values also tend to be lower, while legal and administrative foreclosure costs are higher. As a consequence, LGD is systematically higher in judicial states, even when the likelihood of foreclosure is similar across regimes (e.g., Ghent 2011; Gerardi, Lambie-Hanson, and Willen 2013; McGowan and Nguyen 2023).

By delaying the resolution of distressed mortgages, the CARES Act further lengthened an already protracted foreclosure process in judicial states, increasing investors' exposure to future collateral values, recovery values, and foreclosure costs. At the same time, the longer resolution horizon increased the value of the borrower's option to default by allowing repayment decisions to depend on a wider range of future house price realizations and financial conditions. These effects were likely reinforced by the greater backlog accumulation and court congestion expected in judicial states following the expiration of forbearance. If investors interpreted forbearance as affecting expected mortgage losses through higher LGD, CRT securities with greater exposure to judicial states should exhibit a larger increase in spreads following the introduction of the policy.

To implement the above test we measure each CRT pool's judicial exposure as the share of unpaid principal balance as of March 2020 secured by properties located in judicial states, using loan-level geographic data from the GSEs.[3] Judicial exposure ranges from 26 to 41 percent across pools, providing meaningful cross-sectional variation.

We compare spread dynamics across securities with different levels of judicial exposure around the introduction of the CARES Act. Figure 5 plots average spreads for securities above the median and below the median of judicial exposure. Prior to the policy announcement, high-exposure securities trade at slightly higher spreads. Following the CARES Act, spreads rise sharply across all securities, with a markedly stronger response for those with higher judicial exposure, consistent with investors anticipating higher LGD as forbearance increased uncertainty surrounding the resolution and recovery of distressed loans especially in markets where foreclosure is more costly and time-consuming. Although spreads decline after several months, they remain persistently above pre-policy levels.

Figure A5 shows that average house prices and unemployment rates evolved similarly in judicial and non-judicial states, providing no evidence that mortgage default expectations were driven by these economic factors. Focusing on the largest states to which CRT mortgage pools are exposed, Figure A6 reveals no meaningful differences attributable to judicial foreclosure requirements, suggesting that these requirements did not drive CRT investors' reactions. Moreover, Figure A7 indicates that the number of confirmed COVID-19 cases eventually be-

[3]Figure A4 displays a map of the U.S., showing each state classified as either judicial or non-judicial based on its foreclosure process.

came larger in non-judicial states, implying that this too was not a driving factor behind CRT spreads.

We conduct a differences-in-differences analysis using panel data of daily CRT spreads. The treatment period begins on the first trading day after the introduction of the CARES Act. The treatment group consists of CRTs with high geographical exposure to judicial states, while the control group includes CRTs with low geographical exposure to judicial states. By comparing the changes in CRT spreads between these two groups, we can isolate the effect of the CARES Act on spreads, accounting for pre-existing differences in exposure to judicial state dynamics.

The identification assumption underlying our differences-in-differences analysis is that, in the absence of the treatment (i.e., the forbearance program introduced with the 2020 CARES Act), the treatment and control groups would have followed parallel trends in their CRT spreads. This parallel trends assumption implies that any differential change in CRT spreads between the two groups after the introduction of the CARES Act can be attributed to the effect of the Act itself, rather than to other factors. We perform tests for parallel trends and introduce alternative specifications with controls that capture the exposure of each CRT to other economic shocks that validate the assumption. We estimate the following regression:

$$\begin{aligned} Spread_{i,t} = \beta_1 + \beta_2 PostCARES_t + \beta_3 \left(Judicial_i \times PostCARES_t\right) \\ + \beta_4 \left(Issuer_i \times PostCARES_t\right) + \beta_5 Treasury_t + \alpha_i + \epsilon_{i,t}, \end{aligned} \tag{2}$$

where $Spread_{i,t}$ denotes the spread of CRT tranche i at time t. $PostCARES_t$ is an indicator equal to 1 on March 30, 2020 and thereafter, and 0 otherwise. $Judicial_i$ measures the share of the underlying mortgage balance in judicial states for security i, based on data as of the end of March 2020. The variable $Judicial_i$ is demeaned in the regressions. The interaction term $Judicial_i \times PostCARES_t$ captures differential spread responses based on judicial state exposure following the policy announcement. $Issuer_i$ is an indicator variable for each issuer (Fannie Mae or Freddie Mac). The interaction term $Issuer_i \times PostCARES_t$ captures potential differences in how issuers implemented the forbearance program, following the policy announcement. The variable $Treasury_t$ is the 10-year Treasury rate on each date.

We cluster standard errors at the CRT security level to account for potential serial correlation in the residuals. In our setting, this clustering is applied to the full population of outstanding CRT securities rather than a sample drawn from a larger universe. As noted by Abadie et al. (2023, p. 1-2), "when the number of clusters in the sample is a non negligible fraction of the number of clusters in the population, conventional clustered standard errors can be severely inflated." Furthermore, Cameron and Miller (2015) show that within-cluster serial

correlation can be captured by explanatory variables. Our specifications include security and time fixed effects, as well as security characteristics, which capture potential serial correlation. We therefore report clustered standard errors as a conservative benchmark.

The coefficients of primary interest are β_2 and β_3. The coefficient β_2 captures the average increase in spreads at the introduction of the CARES Act, while β_3 captures the increase of the judicial-exposed spreads relative to the rest at the CARES Act introduction.

Table 2 reports the estimated coefficients from equation (2), for different windows of 14, 30, 60, and 90 days around the CARES Act enactment. The results show that the interaction between judicial exposure and post-CARES remain positive and robust across all event windows. For each additional one percentage point increase in judicial exposure, spreads increased by approximately 0.52 percentage points at the time of the CARES Act introduction, based on the 30-day event window results. Both the post-CARES base effect and the interaction effect decrease in magnitude while remaining statistically significant over longer event windows. This pattern reflects the sharp increase in CRT spreads on the event date followed by a gradual decline over time.

To ensure that the results are not driven by a small number of large judicial states, we repeatedly re-estimate the baseline difference-in-differences specification, excluding one judicial state at a time from the construction of the judicial-exposure measure. Figure 6 plots the resulting interaction coefficients. The estimates remain tightly clustered around the baseline coefficient and retain their sign, magnitude, and statistical significance across specifications. These results indicate that the judicial-exposure effect reflects a broad pattern across judicial foreclosure regimes rather than the influence of any individual state.

Taken together, the evidence indicates that CRT spreads reacted more strongly in securities with greater exposure to judicial foreclosure states following the CARES Act. This pattern is consistent with investors updating expectations about LGD and the associated uncertainty regarding the timing and value of mortgage recoveries in environments with more costly and lengthy foreclosure processes. The precise timing of the response and its systematic heterogeneity across CRT exposures strengthen the interpretation that the observed pricing effects are driven by the CARES Act rather than by contemporaneous confounding events. We further support this interpretation with a series of falsification and robustness tests showing that alternative explanations are unlikely to account for the observed heterogeneity.

7.2 House Price Expectations and Volatility

We examine whether the market response to the CARES Act was stronger for CRT securities exposed to areas with lower expected house price growth and greater downside house price volatility. These variables capture the evolution of collateral values over the extended resolution period created by mortgage forbearance. By delaying the resolution of distressed mortgages, forbearance increases investors' exposure to future collateral values and recovery outcomes, while also increasing the value of the borrower's option to default by allowing repayment decisions to depend on future house price realizations. In March 2020, market participants faced substantial uncertainty regarding the economic consequences of the pandemic and had reason to anticipate weaker labor market conditions, lower household income, and weaker housing demand. Lower or more uncertain future house prices reduce expected recovery values in the event of foreclosure, increasing expected loss given default, while also influencing borrowers' equity positions and repayment incentives, affecting the probability of default through the borrower's option to default.

Accordingly, we modify our differences-in-differences specification as follows:

$$\begin{aligned} Spread_{i,t} = \beta_1 + \beta_2 PostCARES_t + \beta_3 \left(\Delta Ph_i \times PostCARES_t\right) \\ + \beta_4 \left(Issuer_i \times PostCARES_t\right) + \beta_5 Treasury_t + \alpha_i + \epsilon_{i,t}, \end{aligned} \tag{3}$$

ΔPh_i captures expected house price growth in the locations underlying the mortgages in CRT pool i. We construct this measure as the weighted average of state-level house price growth, where the weights correspond to each state's share of unpaid principal balance within the mortgage pool. As a proxy for expectations, we rely on recent price trends, including the early housing market dynamics associated with the onset of COVID-19 in the one to three months preceding the CARES Act announcement. State-level house price growth is computed using monthly data from Zillow. Our baseline measure uses house price growth from January to March 2020, while alternative specifications, such as December 2019 to March 2020, serve as robustness checks. All other variables are defined as in the baseline specification in equation (2).

To isolate the house price channel, we augment the baseline difference-in-differences specification with interactions between the post-CARES indicator and weighted-average borrower credit risk, an indicator for the B2 tranche, and an indicator for high-LTV securities. These additional controls account for heterogeneity in the post-policy response across borrower and security characteristics, allowing the coefficient of interest to capture the differential sensitivity

of CRT spreads to local house price conditions.

Table 3 reports estimates of equation (3) using windows of 14, 30, 60, and 90 days around the CARES Act enactment. The coefficients of the interaction term $\Delta Ph_i \times PostCARES_t$ are negative, as expected, and statistically significant across specifications. This suggests that the cross-sectional variation in expected house price growth and in anticipated collateral values amplifies the prolonged exposure to home prices and the uncertainty about the foreclosure process introduced in the CARES Act.

Next, we estimate equation (3) but replace the house price growth with a measure of downside house price volatility exposure. House price volatility exposure is the weighted average downside house price volatility across the states in which the loans underlying each CRT pool are located. The downside volatility is measured for the interval of two years up to March 2020, that is, this is the latest volatility estimates the the investors had available at the time of the CARES Act enactment. State-level house price growth is computed using monthly data from Zillow. The weights correspond to each state's share of the unpaid principal balance in the CRT pool as of March 30, 2020.

Table 4 shows the results using 5 to 8-month windows around the CARES Act enactment. The coefficients of the interaction term $SD(\Delta Ph_i) \times PostCARES_t$ are positive and statistically significant across estimation windows. Exposure to higher downside volatility increases the CRT spreads after the CARES Act.

7.3 Borrower Credit Risk

We examine whether the market response to the CARES Act was stronger for CRT securities backed by borrowers with greater underlying credit risk. This analysis evaluates the delayed resolution, borrower's option, and regulatory uncertainty channels by asking whether policies that increased the expected time to resolution and uncertainty about the mortgage resolution process had a larger effect when borrowers were more exposed to adverse future outcomes. Under all three mechanisms, extending the resolution horizon or increasing uncertainty about future policy raises the importance of borrowers' future repayment decisions, implying a stronger repricing of mortgage credit risk for securities backed by riskier borrowers.

Standard models of mortgage default emphasize the interaction between adverse income shocks and borrower equity (Fuster and Willen, 2017; Ganong and Noel, 2023). Mortgage credit losses are particularly likely when borrowers experience financial distress while holding little or negative equity, the so-called double-trigger mechanism. Recent work on CRT valu-

ation similarly highlights the joint role of liquidity shocks and collateral values in generating mortgage losses (Capponi et al., 2026). The double-trigger mechanism implies that prolonged exposure to house price risk and foreclosure uncertainty should be particularly important for marginal borrowers. By extending the period before distressed loans are resolved, forbearance increases the likelihood that borrower circumstances and equity positions evolve adversely before repayment decisions are made. Moreover, uncertainty regarding repayment resolution after the forbearance period may further complicate borrowers' ability to return to current status (Contat et al., 2026).

To examine this prediction, we exploit cross-sectional variation in borrower characteristics across CRT pools. Although each CRT references a large and geographically diversified set of mortgages, meaningful differences remain across pools in weighted-average borrower characteristics, including FICO scores and debt-to-income (DTI) ratios. Lower FICO scores and higher DTI ratios are associated with greater financial vulnerability and a reduced capacity to absorb adverse shocks. If investors viewed forbearance as increasing exposure to future mortgage losses through the interaction of borrower distress and collateral-value risk, the repricing of CRT securities should be stronger for pools backed by riskier borrowers.

Figure 7 plots average CRT spreads for securities sorted by whether the weighted average FICO score of the underlying mortgage pool is above or below the median. Before the policy announcement, lower-FICO securities trade at slightly higher spreads, consistent with their greater underlying credit risk. In the aftermath of the CARES Act, spreads increase sharply across all securities, with a more pronounced widening for those backed by lower-FICO loans. Although spreads partially retrace after several months, they remain persistently above their pre-policy levels.

Figure 8 presents the analogous comparison based on the weighted average debt-to-income ratio of the reference pool. Securities backed by higher-DTI loans carry slightly higher spreads prior to the policy announcement, reflecting their greater financial vulnerability. Following the CARES Act, spreads rise across the board, with a stronger response for securities exposed to higher-DTI borrowers. Overall, the cross-sectional pattern in spread changes aligns with differences in underlying credit risk as captured by borrower characteristics in the CRT pools.

To test this mechanism, we estimate the following difference-in-differences specification:

$$\begin{aligned} Spread_{i,t} = \beta_1 + \beta_2 PostCARES_t + \beta_3 \left(Risk_i \times PostCARES_t\right) \\ + \beta_4 \left(Issuer_i \times PostCARES_t\right) + \beta_5 Treasury_t + \alpha_i + \epsilon_{i,t}, \end{aligned} \tag{4}$$

where $Risk_i$ captures the risk composition of security i, measured using weighted-average FICO

scores or debt-to-income (DTI) ratios, based on data as of the end of March 2020. All risk measures are standardized prior to estimation. The interaction term $Risk_i \times PostCARES_t$ captures differential spread responses based on the risk composition following the policy announcement. The rest of the variables are as in equation (2). Standard errors are clustered by CRT security.

Tables 5 and 6 report the estimated coefficients from equation (4) for a 14, 30, 60 and 90-day window around the introduction of the CARES Act. Table 5 measures risk using the weighted-average FICO score. The coefficients β_3 of the interaction term are negative and statistically significant for the different windows, indicating that CRTs backed by loans with higher FICO scores experienced a smaller spread increase following the CARES Act. Table 6 measures risk using the DTI ratio. The interaction coefficients are positive and statistically significant, indicating that CRTs backed by loans with higher weighted-average DTI ratios experienced a larger spread increase after the introduction of the CARES Act.

Consistent with our predictions, CRT spreads increased significantly more for securities with lower average FICO scores and higher DTI ratios following the introduction of the CARES Act. The results indicate that investors were particularly concerned about mortgage exposures for which future borrower outcomes were more sensitive to adverse income shocks and changes in home equity. Together with the evidence on judicial foreclosure exposure and expected house price dynamics, these findings support the view that delayed resolution, the borrower's option to default, and regulatory uncertainty increased expected mortgage credit losses by raising uncertainty about both future default probabilities and recovery values.

7.4 Loan-to-Value Dynamics

A closely related mechanism operates through borrower leverage. Under the CARES Act, missed mortgage payments were not forgiven but instead accumulated and were repaid later through various loss-mitigation options. As a result, forbearance mechanically increased the outstanding balance of participating mortgages and, therefore, their loan-to-value (LTV) ratios. By reducing borrowers' equity cushions, higher leverage reinforces the delayed resolution and borrower's option channels, increasing the sensitivity of both repayment decisions and recovery values to future house price realizations. Consequently, higher LTV ratios increase expected mortgage losses through both the probability-of-default and loss-given-default margins.

Unlike the previous mechanisms, this channel does not generate meaningful cross-sectional variation across CRT securities because the mechanical increase in leverage applies broadly to all loans entering forbearance. We therefore provide ex-post evidence consistent with this

mechanism using loan-level data on Fannie Mae mortgages originated in 2019. Figure 9 plots the distribution of one-year changes in LTV between April 2020 and April 2021 for loans that entered forbearance and loans that did not. We identify forborne loans using the COVID-19 Alternative Delinquency Resolution (ADR) designation, a loan-level loss-mitigation category that includes COVID-19 payment deferrals and allows borrowers to defer pandemic-related missed payments while remaining current within the mortgage-backed security. To isolate the mechanical effect of forbearance, the calculation focuses solely on the mechanical increase in LTV arising from changes in outstanding loan balances.

The figure reveals a pronounced rightward shift in the distribution of LTV changes for loans in forbearance relative to non-forborne loans. While non-forborne mortgages exhibit declining LTV ratios due to normal amortization, forborne mortgages experience increases in leverage, with many displaying LTV increases of up to 5 percent and some reaching 10 percent in the upper tail. These patterns are consistent with the accumulation of missed payments during the forbearance period. Although the evidence is necessarily ex post, the underlying increase in leverage followed mechanically from the design of the program and was therefore foreseeable at the time of the CARES Act. CRT investors thus had a clear basis for incorporating the implied increase in borrower leverage into their expectations of future default probabilities and recovery values.

7.5 Prepayment Risk

The structure of CRT securities provides a natural empirical setting to distinguish between the credit-risk and prepayment channels. Credit losses are allocated sequentially, with the First-Loss (B2) tranche absorbing losses first, followed by B1 and then the mezzanine tranches. By contrast, principal payments, including prepayments, are allocated from the most senior tranche downward. Consequently, credit risk is concentrated in the most junior tranches, whereas prepayment risk is greatest for the most senior tranches.

The evidence does not support a prepayment-risk explanation. Figure 1 shows that the First-Loss (B2) tranche experienced the largest increase in spreads, while the more senior B1 tranche exhibited a smaller response. Appendix Figure A8 reveals a similar pattern within the mezzanine segment: the most junior tranche (M3) exhibits the largest increase in spreads, while the most senior tranche (M1) exhibits the smallest response. Thus, spread increases decline monotonically with tranche seniority. If the prepayment channel were an important driver of the market response, the opposite pattern would be expected, with larger spread increases among the more senior tranches that bear greater exposure to early principal repayment. Instead, the

response is concentrated in the tranches most exposed to mortgage credit losses.

We formalize this analysis by estimating the following difference-in-differences specification:

$$\begin{aligned} Spread_{i,t} = \beta_1 + \beta_2 PostCARES_t + \sum_k \beta_k \left(Tranche_k \times PostCARES_t\right) \\ + \beta_3 \left(Issuer_i \times PostCARES_t\right) + \beta_4 Treasury_t + \alpha_i + \epsilon_{i,t}, \end{aligned} \tag{5}$$

where k indexes tranches B2, B1, M3, and M2, with the most senior tranche sold to investors (M1) omitted and serving as the baseline category.

Table 7 reports estimates of equation (5). The interaction coefficients β_k are positive and statistically significant across all tranches, with magnitudes declining monotonically with tranche seniority. These results reinforce the earlier evidence and point to mortgage credit risk, rather than prepayment risk, as the relevant channel.

7.6 Servicer Liquidity

We evaluate the servicer liquidity channel by exploiting differences in the servicing composition of CRT pools. To do so, we collect information on the mortgage servicer associated with each underlying loan and measure each security's exposure to nonbank servicers. We classify servicers as banks or nonbanks using servicer names and publicly available information on their regulatory status and business structure, and construct $NonbankShare_i$, defined as the share of outstanding principal balance serviced by nonbank institutions as of March 30, 2020.[4]

To test whether exposure to nonbank servicers amplified the market response to the CARES Act, we estimate the following difference-in-differences specification:

$$\begin{aligned} Spread_{i,t} = \beta_1 + \beta_2 PostCARES_t + \beta_3 \left(NonbankShare_i \times PostCARES_t\right) \\ + \beta_4 \left(Issuer_i \times PostCARES_t\right) + \beta_5 Treasury_t + \alpha_i + \epsilon_{i,t}. \end{aligned} \tag{6}$$

Table 8 reports the estimates of equation (6). The interaction coefficient, β_3, is economically small and statistically insignificant across all event windows. Thus, CRT securities with greater exposure to nonbank servicers did not experience larger spread increases following the CARES Act. These findings provide little support for a servicer-liquidity explanation of the market response and suggest that concerns about intermediary funding risk were not a primary driver

[4]Loans serviced by smaller institutions are grouped by the GSEs under the category "other servicers". We exclude these loans from the baseline analysis. The results are unchanged when these loans are classified as nonbank-serviced instead.

of the increase in CRT spreads.

7.7 Forbearance Participation

The forbearance participation channel yields the opposite prediction to the borrower risk analysis. Section 7.3 shows that the increase in CRT spreads was concentrated among securities backed by riskier borrowers, as measured by lower FICO scores and higher debt-to-income ratios. Rather than repricing all mortgage pools in response to concerns about indiscriminate program participation, investors continued to differentiate across pools based on conventional measures of mortgage credit risk.[5]

7.8 Cash-Flow Timing

We evaluate the cash-flow timing channel by examining whether the increase in CRT spreads can be explained by anticipated delays in mortgage cash flows rather than changes in expected mortgage losses and recoveries. Several features of the institutional setting make this explanation unlikely. First, the CARES Act forbearance provisions did not alter the contractual obligation of servicers and the GSEs to ensure the timely remittance of scheduled principal and interest payments to investors. Second, if the increase in CRT spreads reflected concerns about payment timing, the uncertainty should have been resolved once investors observed that scheduled remittances continued to be made on time following the introduction of the CARES Act. The GSEs and the FHFA explicitly maintained the timing of monthly principal and interest remittances despite widespread forbearance participation. We do not observe a corresponding decline in CRT spreads following these remittances. Instead, CRT spreads remained elevated well beyond the first post-CARES Act remittance cycles, consistent with the view that investors repriced mortgage credit risk through changes in expected default probabilities and recovery values rather than through temporary cash-flow disruptions.

7.9 Parallel Trends and Robustness Checks

To strengthen the identification of the mechanisms supported in Sections 7.1–7.3, we conduct additional robustness tests. We include controls for local COVID-19 conditions and broader

[5]Ex post participation patterns are also inconsistent with widespread take-up by financially secure households. Participation rates were disproportionately higher among low-income households and racial and ethnic minority borrowers, groups that were particularly exposed to the economic consequences of the pandemic (Akana et al. 2021; An et al. 2022; Cherry et al. 2021; Loewenstein and Njinju 2022).

credit market developments in the difference-in-differences specifications and implement placebo tests using alternative event dates. Together, these exercises show that the results are specific to the CARES Act announcement and are not driven by confounding factors.

Table 9 reports estimates of equations (2)–(4) for the 30-day event window after including additional controls. First, we control for weekly confirmed COVID-19 cases, measured as weighted averages across states based on each CRT pool's geographic composition. Second, we include BBB corporate bond spreads to account for broader conditions in credit markets. The estimated interaction effects remain economically and statistically similar across specifications, indicating that the baseline results are robust to these additional controls.

Table 10 presents placebo tests of the baseline difference-in-differences specifications. Specifically, we re-estimate the models using placebo event dates set two and four months before the introduction of the CARES Act. Across all specifications, the interaction terms are statistically insignificant around the placebo dates. Similar results obtain for additional placebo dates. These findings provide no evidence of differential pre-trends and support the interpretation that the estimated effects are tied to the introduction of the CARES Act rather than to pre-existing differences across CRT pools.

8 Ex-Post Outcomes and Policy Intervention

Although CRT investors required higher compensation for bearing mortgage credit risk following the introduction of the CARES Act, realized mortgage outcomes ultimately proved more favorable than initially expected. This reflected, in part, the unprecedented fiscal and monetary policy response, as well as the strength of the housing market, which improved borrower outcomes and limited realized credit losses. Enhanced unemployment benefits, direct fiscal transfers, and other relief measures helped stabilize household finances, while the Federal Reserve implemented a series of interventions to increase liquidity and reduce both interest rates and mortgage rates, lowering borrowing costs and supporting mortgage markets (Gerardi, Lambie-Hanson, and Willen 2022). At the same time, the GSEs maintained stable guarantee fees rather than passing the increase in CRT spreads through to primary mortgage rates, helping preserve access to mortgage credit during the crisis. Together, these interventions reduced the likelihood that temporary payment interruptions would evolve into persistent mortgage distress and foreclosure.

Tables A1–A3 examine the subsequent performance of mortgages originated in 2019 using the Fannie Mae Single-Family Historical Loan Performance Dataset through June 2025. A

large number of borrowers entered forbearance and became seriously delinquent during the initial months following the introduction of the CARES Act. However, delinquency and foreclosure rates declined substantially as fiscal support reached households and labor-market conditions improved. Figure A9 reports the share of mortgages that transitioned from 90-day delinquency to foreclosure through June 2025. Across all delinquency cohorts between 2020 and 2023, mortgages that entered forbearance were significantly less likely to proceed to foreclosure. By the end of 2020, many borrowers in forbearance had resumed repayment, and mortgage outcomes ultimately proved far more favorable than investors initially anticipated. More broadly, these outcomes highlight the importance of the extraordinary policy support provided during the pandemic. In a more privatized housing finance system, the GSEs would have been less able to absorb increases in mortgage credit risk, and higher guarantee fees or tighter credit conditions may have amplified mortgage market stress before fiscal support reached households.

9 Conclusion

This paper studies how private investors priced the federal mortgage forbearance provisions introduced under the CARES Act. Using the market for GSE Credit Risk Transfer securities, we show that the introduction and subsequent extension of mortgage forbearance were associated with a substantial increase in the ex ante compensation required by private investors to bear mortgage credit risk. The response was strongest for securities with greater exposure to judicial foreclosure regimes, weaker or more uncertain house price expectations, and riskier borrowers, consistent with investors pricing heightened uncertainty regarding future borrower outcomes and recovery values.

Our economic arguments emphasize that forbearance changes the timing and uncertainty surrounding the resolution of distressed mortgages. By delaying foreclosure and other loss-mitigation actions, forbearance extends the period over which borrower circumstances, collateral values, and recovery conditions can evolve before losses are realized. These mechanisms link foreclosure frictions, collateral-value risk, borrower credit risk, and leverage dynamics by increasing investors' exposure to future borrower outcomes and recovery values over a longer resolution horizon. The empirical evidence supports this interpretation.

The CRT response was tightly timed to the enactment of the CARES Act and is difficult to reconcile with broader movements in credit, equity, or real estate markets. Across a range of tests, we find little support for alternative explanations based on prepayment risk, servicer liquidity concerns, payment timing, or widespread forbearance participation. Taken together,

these findings point to a repricing of mortgage credit risk associated with investors' reassessment of mortgage credit risk following the introduction of the forbearance provisions rather than to broader market developments occurring during the pandemic.

Ex post loan outcomes ultimately proved more favorable than investors initially feared, but these outcomes occurred in an environment of unprecedented fiscal, monetary, and housing-market support. Enhanced unemployment benefits, direct fiscal transfers, Federal Reserve interventions, and continued support from the GSEs all contributed to stabilizing household finances and mortgage markets. The divergence between ex ante pricing and ex post outcomes therefore highlights the importance of the subsequent policy response in shaping the realized path of mortgage distress during the pandemic.

Our findings have broader implications for the design of borrower-relief policies and the future structure of housing finance in the United States. Borrower-relief policies alter not only borrower outcomes but also the distribution and pricing of mortgage credit risk. In market-based systems, these changes are reflected in credit prices and lending conditions, with the largest effects borne by borrowers with limited equity or weaker credit profiles. Under the current GSE structure, a substantial share of this risk is instead absorbed by government-controlled entities and, ultimately, taxpayers. Our findings identify the mechanisms through which borrower-protection policies are transmitted to mortgage credit markets, highlighting that borrower-protection policies and the institutional allocation of mortgage credit risk cannot be evaluated independently of one another.

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Figures

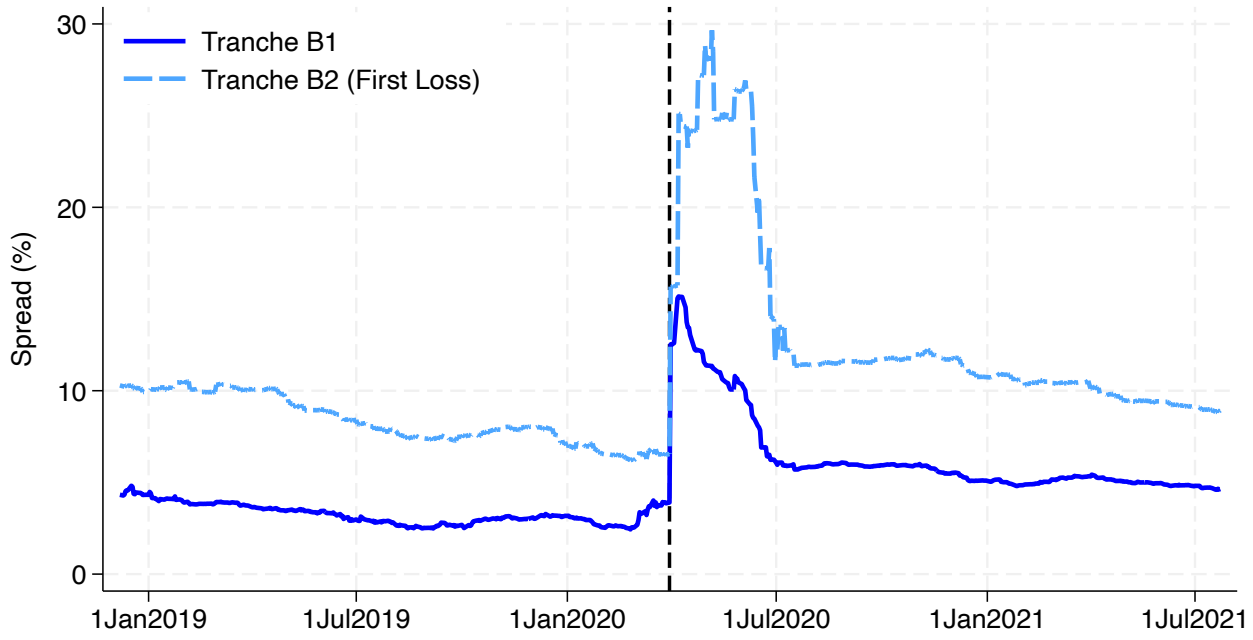


Figure 1. CRT Spreads and the CARES Act. The figure plots the average daily spread (yield to maturity minus 1-month US Dollar LIBOR) in the secondary market of junior tranches of CRT securities. B2 is the *First Loss* most junior tranche, and B1 is the junior tranche with seniority just above B2. The 1-month LIBOR rate is the reference rate used in the CRT documentation at the time. These CRTs were issued between January 2017 and December 2019 by Fannie Mae and Freddie Mac. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Sections 5 and 7.5 discuss the response of junior CRT tranches to the CARES Act forbearance policy illustrated in this figure. Figure A8 in the Appendix shows a more moderate reaction of the CRT mezzanine tranches.

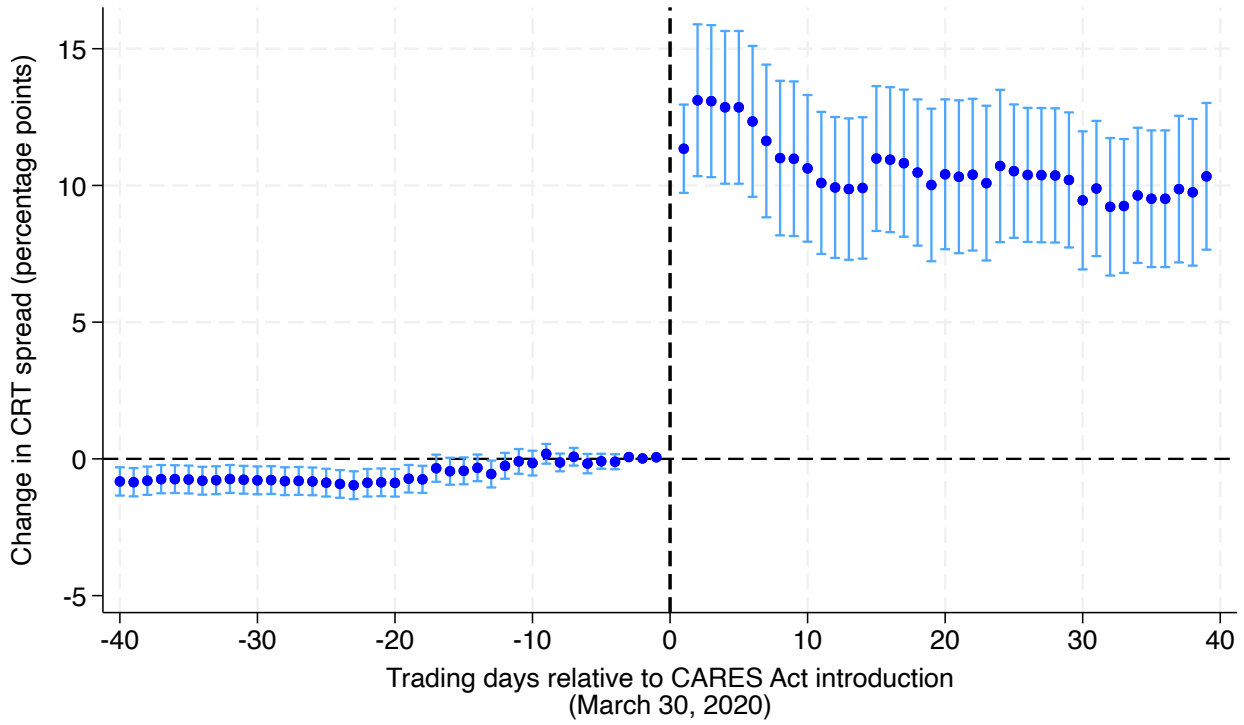


Figure 2. Event Study Coefficients. This figure plots coefficients and 95% confidence intervals from the event-study regression of CRT spreads on daily indicators. The specification follows equation (1) and includes security fixed effects. Observations are at the CRT-day level, with spreads measured in percentage points. Robust standard errors are clustered at the security level. The solid vertical line at $t = 0$ denotes March 30, 2020, the first trading day after the CARES Act was introduced. Section 5.1 provides further details on the regression specification.

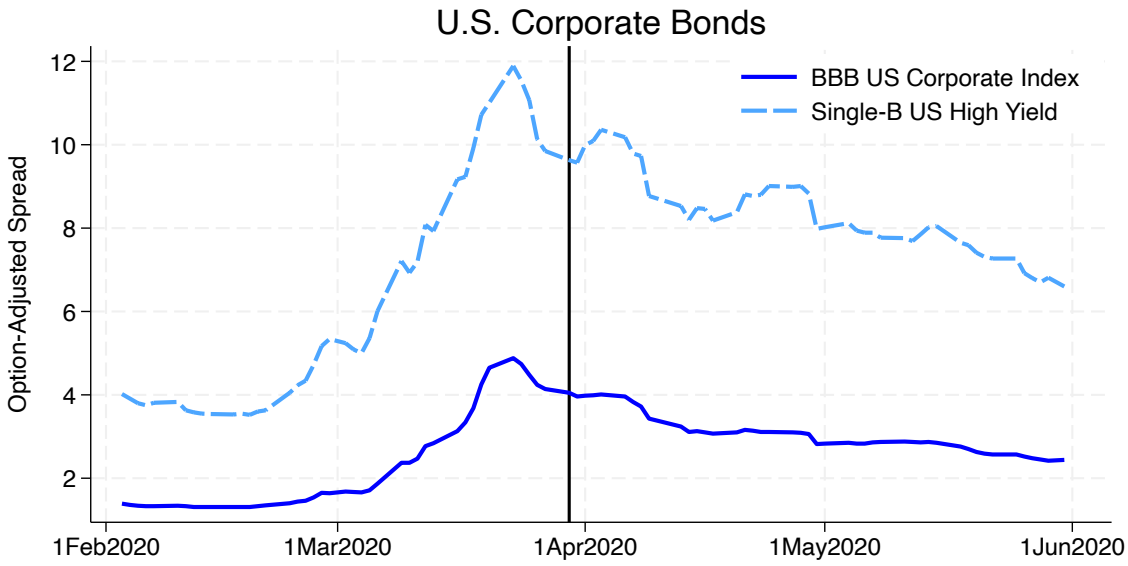


Figure 3. Corporate Bond Spreads. This figure plots the spreads on BBB and B-rated corporate bonds around the CARES Act introduction. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Section 5.2 contrasts the response of the CRT market with the absence of a corresponding response in the corporate bond market following the enactment of the CARES Act. Source: Ice Data Indices, LLC via FRED.

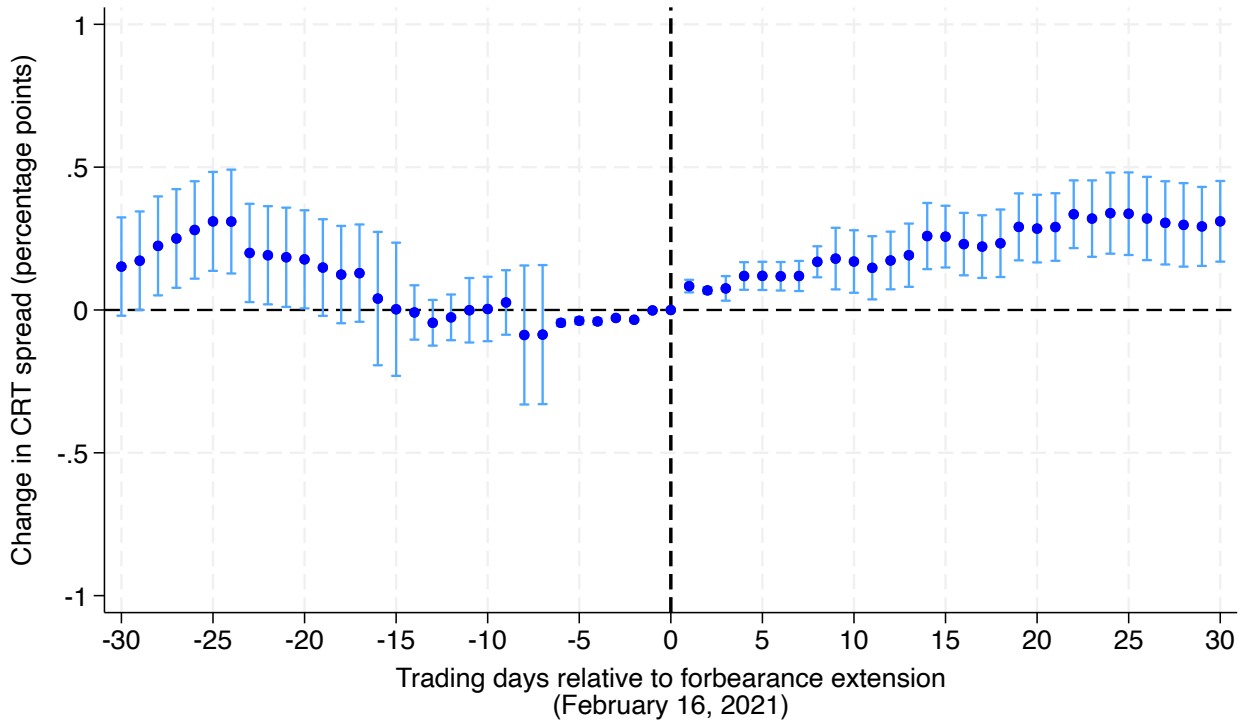


Figure 4. Event Study Coefficients for Forbearance Extension. This figure plots the coefficients and 95% confidence intervals from an event-study regression of CRT spreads on daily event-time indicators. The specification follows equation (1), with February 16, 2021 as the event date. The regression includes security fixed effects. Observations are at the CRT–day level, and spreads are measured in percentage points. Robust standard errors are clustered at the security level. The solid vertical line at $t = 0$ marks February 16, 2021, the announcement of the extension of forbearance provisions from 12 to 18 months. Section 5.3 provides additional details on the analysis.

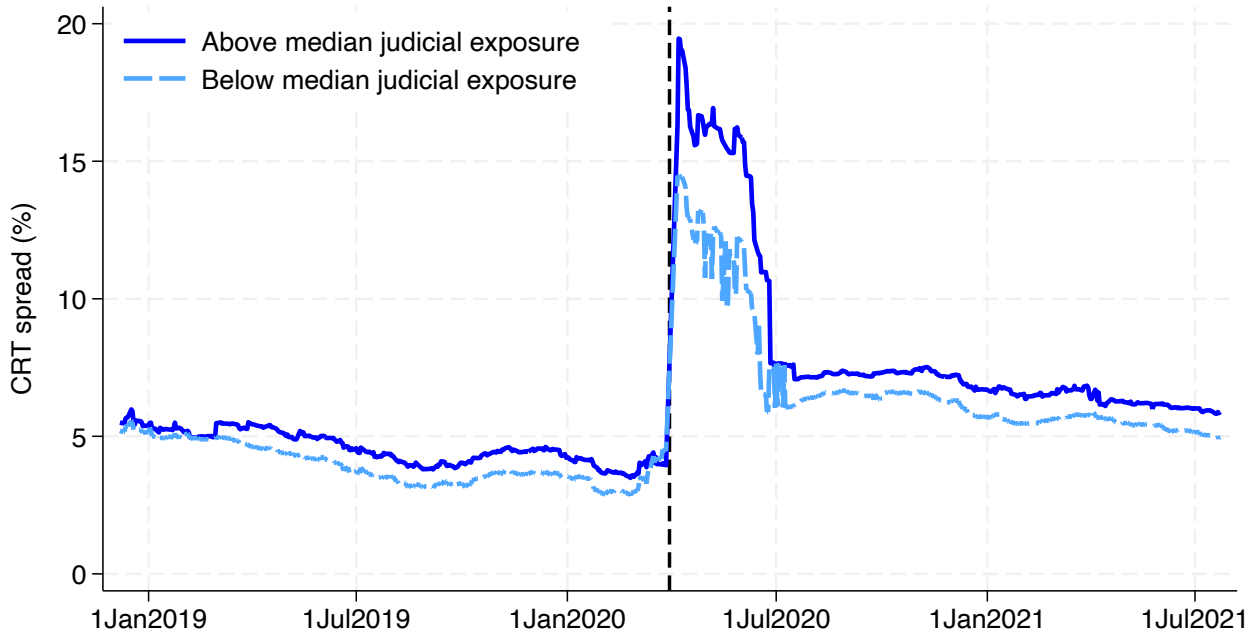


Figure 5. CRT Spreads by Exposure to Judicial States. The figure plots the average daily spread (yield to maturity minus 1-month US Dollar LIBOR) in the secondary market of junior tranches of CRT securities, with mortgage pools that have above median and below median geographical exposure to judicial states. The 1-month LIBOR rate is the reference rate used in the CRT documentation at the time. These CRTs were issued between January 2017 and December 2019 by Fannie Mae and Freddie Mac. The judicial exposure is measured as the percentage of unpaid principal balance within each CRT mortgage pool that is located in judicial states. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Section 7.1 examines the role of judicial foreclosure requirements in the private market response and develops the corresponding difference-in-differences specification.

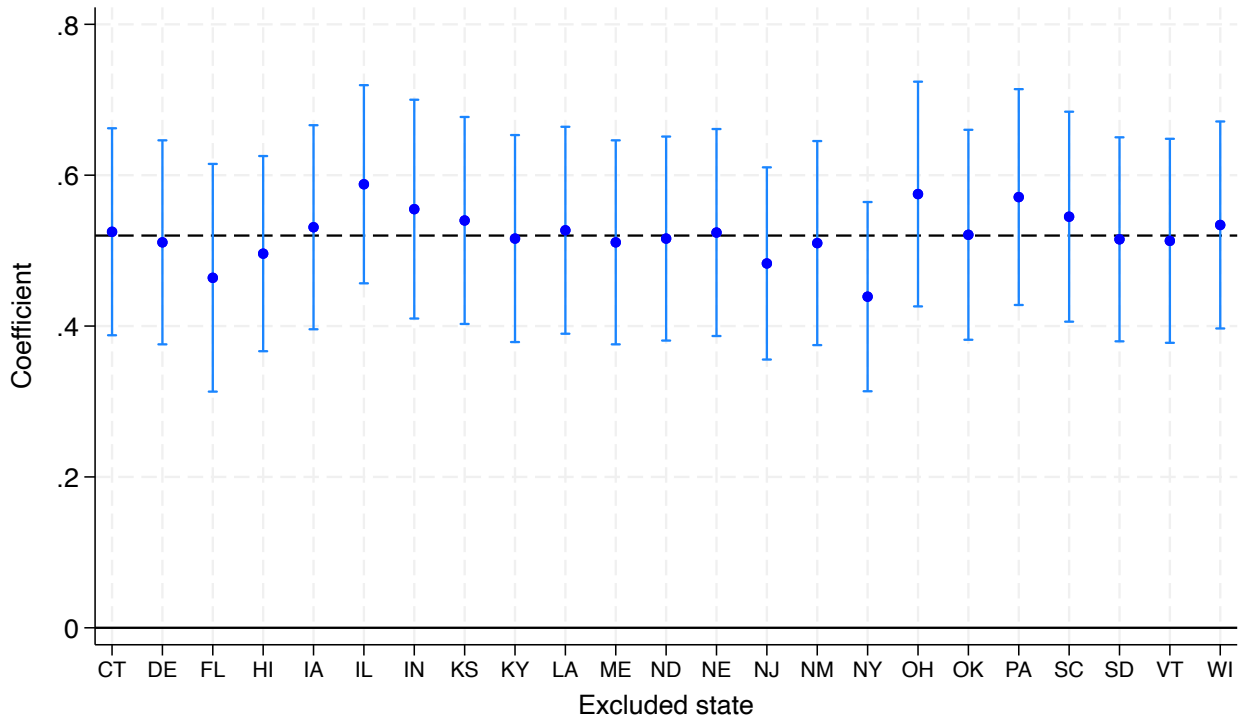


Figure 6. Results Excluding One Judicial State at a Time. This figure plots the estimated coefficients from re-estimating the main specification in equation (2) for the 30-day window while excluding one judicial state at a time. It reports the coefficient on the interaction term Judicial × Post-CARES along with 95% confidence intervals. All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. In each iteration, we exclude the unpaid principal balance of loans from a given judicial state when constructing CRT pool exposure, which yields a new judicial exposure measure each time. The x-axis indicates the state excluded in the corresponding estimation. The dotted vertical line at 0.52 denotes the interaction coefficient from our baseline difference-in-differences specification for the 30-day window, reported in Table 2, Model (2).

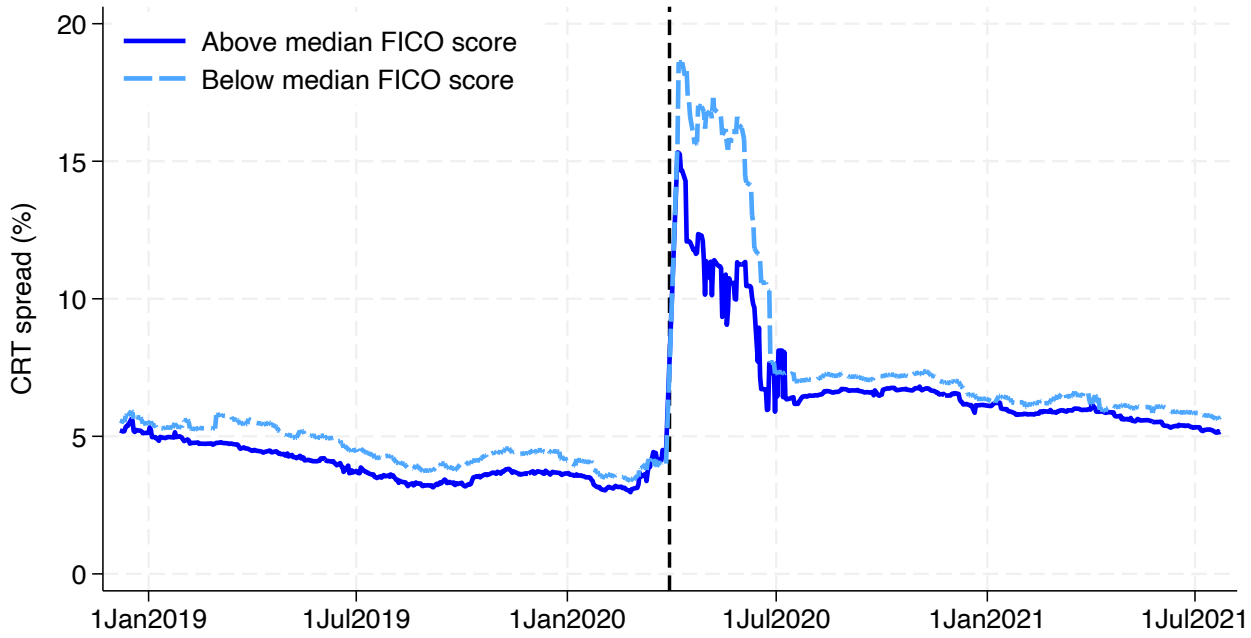


Figure 7. CRT Spreads by FICO score. The figure plots the average daily spread (yield to maturity minus 1-month US Dollar LIBOR) in the secondary market of junior tranches of CRT securities, with mortgage pools that have above median and below median weighted average FICO credit score. The 1-month LIBOR rate is the reference rate used in the CRT documentation at the time. These CRTs were issued between January 2017 and December 2019 by Fannie Mae and Freddie Mac. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Section 7.3 examines the role of borrower risk characteristics in the private market response and develops the corresponding difference-in-differences specification.

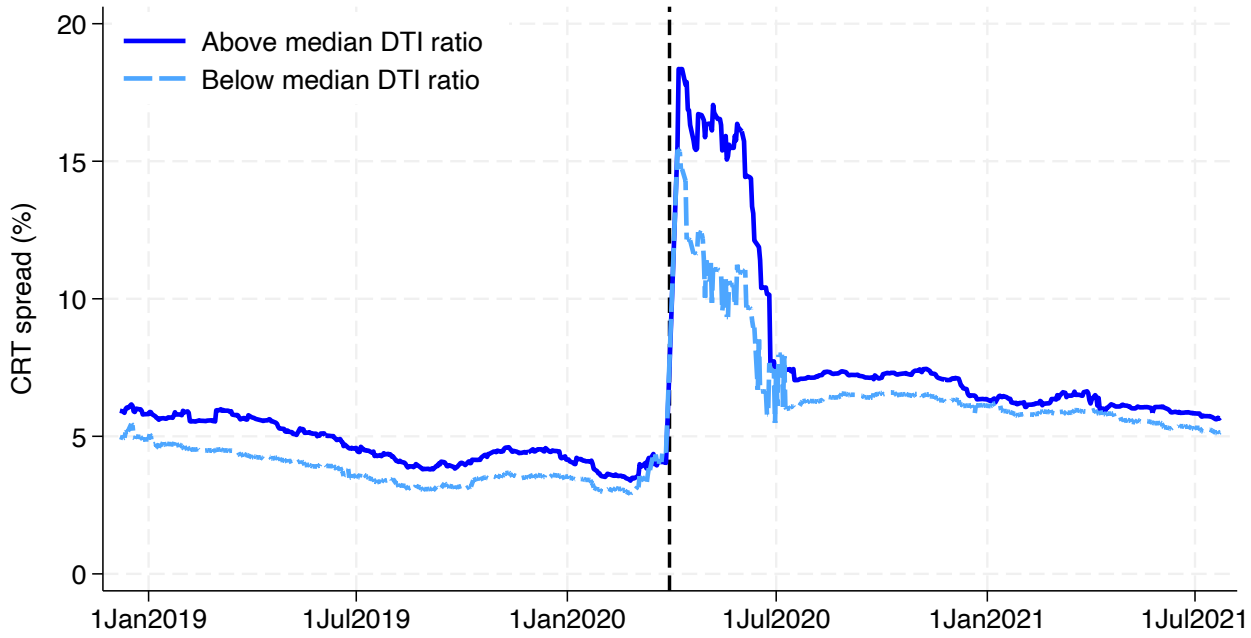


Figure 8. CRT Spreads by Debt-to-Income. The figure plots the average daily spread (yield to maturity minus 1-month US Dollar LIBOR) in the secondary market of junior tranches of CRT securities, with mortgage pools that have above median and below median weighted average debt-to-income (DTI) ratio. The 1-month LIBOR rate is the reference rate used in the CRT documentation at the time. These CRTs were issued between January 2017 and December 2019 by Fannie Mae and Freddie Mac. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Section 7.3 examines the role of borrower risk characteristics in the private market response and develops the corresponding difference-in-differences specification.

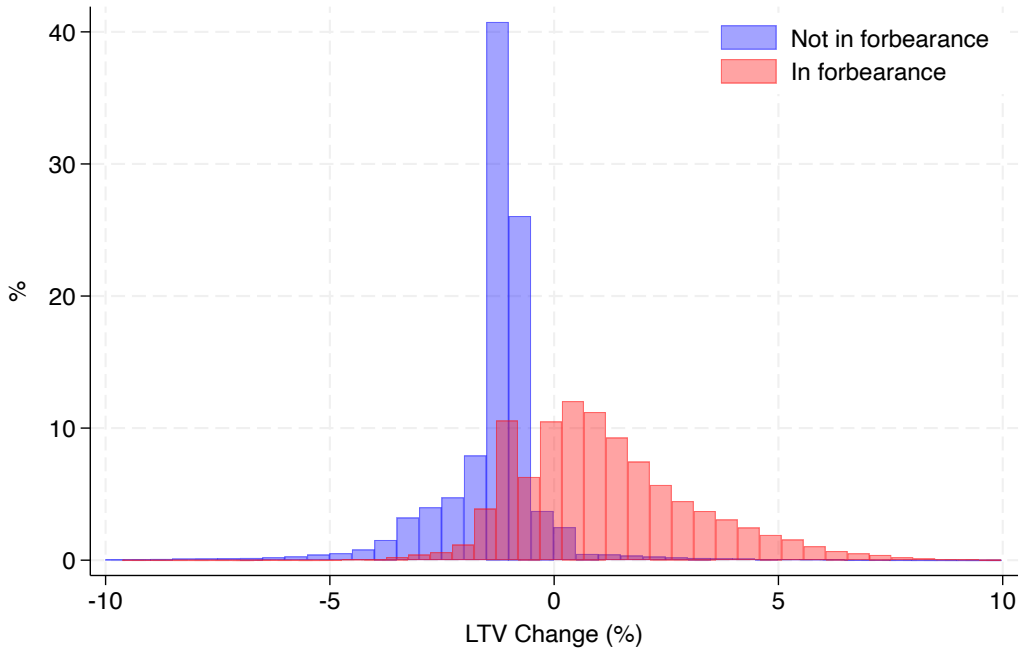


Figure 9. Loan-to-Value Ratio (LTV) Under Forbearance and Non-forbearance. The figure presents the distribution of percentage changes in loan-to-value (LTV) ratios between April 2020 and April 2021 for mortgages that entered forbearance (participating in the COVID-19 Alternative Delinquency Resolution program) and for comparable mortgages that did not enter forbearance. Section 7.4 provides additional details.

Tables

Table 1. Descriptive Statistics

	Observations	Mean	Std. Dev.	Min	Max
CRT Spread (%)	2,088	9.399	8.946	2.055	62.18
Post CARES Indicator	2,088	0.474	0.499	0	1
FICO Credit Score	2,088	741.2	5.742	728.6	753.8
Debt-to-Income Ratio	2,088	0.367	0.014	0.336	0.389
Loan-to-Value Ratio	2,088	0.832	0.086	0.747	0.933
First Loss Indicator	2,088	0.236	0.425	0	1
Judicial Exposure (%)	2,088	35.04	3.622	25.82	41.19
Issuer (1 = Fannie)	2,088	0.418	0.493	0	1
10-Year Treasury Rate (%)	2,088	0.783	0.162	0.540	1.180

This table reports summary statistics for the key variables in the study. The sample includes the junior tranches of 55 securities issued between 2017 and 2019. The daily observations for the CRT spreads in the secondary market (on trading dates) are within a window of 30 days before and after March 30, 2020. The CRT spread is calculated as the yield to maturity minus the 1-month US Dollar LIBOR. The post CARES indicator is a dummy variable that takes the value of one on and after March 30, 2020, the first trading day after the 2020 Coronavirus Aid, Relief, and Economic Security (CARES) Act was signed into law, and zero otherwise. The judicial exposure is the percentage of unpaid principal balance within each CRT mortgage pool, in March 2020, that is located in judicial states. The FICO score, debt-to-income (DTI) ratio and loan-to-value (LTV) ratio are the weighted average measures of the loans in the CRT reference pools. Section 4 describes the variables and datasets.

Table 2. CARES Act Impact on CRT Spreads and Judicial Exposure

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	14.512***	12.517***	10.053***	8.303***
	(1.524)	(0.992)	(0.630)	(0.462)
Judicial × Post-CARES	0.612**	0.520**	0.471**	0.362*
	(0.272)	(0.243)	(0.192)	(0.183)
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	880	2,088	4,451	6,724
Adj R Squared	0.691	0.679	0.679	0.637
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports the results from the estimation of equation (2), for event windows of 14, 30, 60, and 90 days. Spread and judicial exposure are measured in percentage points. Post-CARES is the treatment variable that takes the value of one from the first trading date after the CARES Act was signed into law, zero otherwise. The variable Judicial is the percentage of unpaid principal balance within each CRT pool located in judicial states. All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. The event window shows the number of days before and after March 30, 2020. The sample consists of the junior tranches of CRT securities issued between 2017 and 2019. Section 7.1 describes the empirical specification in detail. ***p<0.01; **p<0.05; *p<0.10.

Table 3. CARES Act Impact On CRT Spreads and House Price Growth Exposure

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	9.368***	8.382***	7.285***	6.319***
	(1.898)	(1.731)	(1.234)	(1.051)
ΔHouse Price Exposure× Post-CARES	-3.438***	-3.263***	-2.310***	-2.059***
	(0.629)	(0.412)	(0.268)	(0.225)
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	880	2,088	4,451	6,724
Adj R Squared	0.715	0.714	0.738	0.700
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports estimates of equation (3), for event windows of 14, 30, 60, and 90 days. House price growth exposure is the weighted average 1-month house price growth across the states in which the loans underlying each CRT pool are located, lagged by one month. This variable is standardized to have a mean of zero and a standard deviation of one. State-level house price growth is computed using monthly data from Zillow. The weights correspond to each state's share of the unpaid principal balance in the CRT pool as of March 30, 2020. The spread is measured in percentage points. The sample, control variables, and fixed effects follow those in Table 2. Standard errors are clustered at the security level. Section 7.2 describes the empirical specification in detail. ***p<0.01.

Table 4. CARES Act Impact On CRT Spreads and House Price Volatility Exposure

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	9.026***	8.421***	7.460***	6.646***
	(1.883)	(1.717)	(1.377)	(1.280)
House Price Volatility × Post-CARES	3.156***	2.602***	1.617***	1.199***
	(0.741)	(0.488)	(0.315)	(0.264)
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	880	2,088	4,451	6,724
Adj R Squared	0.714	0.710	0.735	0.697
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports estimates of equation (3) using 5 to 8-month event windows. House price volatility exposure is the weighted average downside house price volatility across the states in which the loans underlying each CRT pool are located. The downside volatility is measured for the interval of two years up to March 2020. This variable is standardized to have a mean of zero and a standard deviation of one. State-level house price growth is computed using monthly data from Zillow. The weights correspond to each state's share of the unpaid principal balance in the CRT pool as of March 30, 2020. The spread is measured in percentage points. The sample, control variables, and fixed effects follow those in Table 2. Standard errors are clustered at the security level. Section 7.2 describes the empirical specification in detail. ***p<0.01.

Table 5. CARES Act Impact On CRT Spreads and Borrower FICO Score

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	12.986***	11.173***	8.826***	7.354***
	(1.274)	(0.867)	(0.584)	(0.455)
FICO × Post-CARES	-2.463**	-2.245**	-2.090***	-1.631**
	(1.005)	(0.910)	(0.731)	(0.687)
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	880	2,088	4,451	6,724
Adj R Squared	0.695	0.684	0.684	0.641
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports the results from estimating equation (4) for event windows of 14, 30, 60 and 90 days. The spread is measured in percentage points. FICO measures the weighted average FICO score of the underlying loans in each CRT pool and is standardized to have a mean of zero and a standard deviation of one. All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. The event window shows the number of days before and after March 30, 2020. The sample consists of junior tranches of CRT securities issued between 2017 and 2019. Standard errors are clustered at the security level. Section 7.3 describes the empirical specification in detail. ***p<0.01; **p<0.05.

Table 6. CARES Act Impact On CRT Spreads and Borrower Debt-to-Income (DTI)

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	13.721***	11.842***	9.442***	7.836***
	(1.400)	(0.900)	(0.592)	(0.422)
DTI × Post-CARES	2.152*	2.031**	1.794**	1.348**
	(1.077)	(0.993)	(0.720)	(0.620)
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	880	2,088	4,451	6,724
Adj R Squared	0.691	0.682	0.681	0.638
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports the results from estimating equation (4) for event windows of 14, 30, 60 and 90 days. The spread is measured in percentage points. DTI measures the weighted average debt-to-income ratio of the underlying loans in each CRT pool and is standardized to have a mean of zero and a standard deviation of one. All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. The event window shows the number of days before and after March 30, 2020. The sample consists of junior tranches of CRT securities issued between 2017 and 2019. Standard errors are clustered at the security level. Section 7.3 describes the empirical specification in detail. ***p<0.01; **p<0.05; *p<0.10.

Table 7. CARES Act Impact On CRT Spreads and Tranche Seniority

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	0.920	1.557***	1.190**	0.981**
	(0.780)	(0.560)	(0.504)	(0.486)
Tranche B2 × Post-CARES	11.368***	14.259***	15.627***	14.658***
	(2.122)	(3.240)	(2.850)	(2.643)
Tranche B1 × Post-CARES	8.094***	7.654***	7.091***	6.127***
	(0.723)	(0.510)	(0.388)	(0.357)
Tranche M3 × Post-CARES	5.456***	4.433**	5.082***	4.991***
	(0.868)	(1.789)	(1.024)	(0.603)
Tranche M2 × Post-CARES	3.763***	3.794***	3.573***	3.204***
	(0.666)	(0.454)	(0.436)	(0.447)
Adj R Squared	0.537	0.627	0.677	0.663
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	3,066	6,276	12,628	18,671
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports estimates of equation (5) for event windows of 14, 30, 60, and 90 days. The dependent variable is the CRT spread, measured in percentage points. Tranche indicators are included as dummy variables for each tranche category. The omitted category is the most senior tranche (M1). All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. The event window shows the number of days before and after March 30, 2020. The sample consists of junior and mezzanine tranches of CRT securities issued between 2017 and 2019. Standard errors are clustered at the security level. Section 7.5 describes the empirical specification in detail. ***p<0.01; **p<0.05.

Table 8. CARES Act Impact On CRT Spreads and Exposure to Nonbank Servicers

	CRT Spread			
	(1)	(2)	(3)	(4)
Post-CARES	12.357***	9.917***	7.729***	6.451***
	(2.286)	(2.175)	(1.544)	(1.319)
Nonbank share × Post-CARES	0.368	0.519	0.466	0.376
	(0.472)	(0.524)	(0.378)	(0.329)
Treasury Rate	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes
Observations	880	2,088	4,451	6,724
Adj R Squared	0.681	0.679	0.680	0.638
Event Window	14 Days	30 Days	60 Days	90 Days

This table reports the results from estimating equation (4) for event windows of 14, 30, 60 and 90 days, replacing the risk measure with with nonbank exposure. The spread is measured in percentage points. Nonbank share is defined as the share of the unpaid principal balance in each CRT pool serviced by nonbank servicers as of March 30, 2020. This measure ranges from 47% to 64% and is demeaned in all specifications. All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. The event window shows the number of days before and after March 30, 2020. The sample consists of junior tranches of CRT securities issued between 2017 and 2019. Standard errors are clustered at the security level. Section 7.6 describes the empirical specification in detail. ***p<0.01.

Table 9. Robustness: CARES Act Impact On CRT Spreads and Default Risk

	CRT Spread									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post-CARES	10.537***	7.422***	7.043***	9.806***	10.635***	10.881***	7.854***	7.463***	10.174***	11.006***
	(2.728)	(1.043)	(1.085)	(2.873)	(2.695)	(2.887)	(1.058)	(1.101)	(3.027)	(2.843)
Judicial × Post-CARES	0.546**					0.541**				
	(0.258)					(0.259)				
ΔHouse Price× Post-CARES		-3.241***					-3.251***			
		(0.413)					(0.413)			
SD(House Price) × Post-CARES			2.590***					2.594***		
			(0.488)					(0.488)		
FICO × Post-CARES				-2.275**					-2.266**	
				(0.935)					(0.937)	
DTI × Post-CARES					2.054**					2.046**
					(0.999)					(0.999)
Treasury Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COVID-19 Cases	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BBB Corporate Bond Spread	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	2,088	2,088	2,088	2,088	2,088	2,088	2,088	2,088	2,088	2,088
Adj R Squared	0.679	0.714	0.710	0.684	0.682	0.680	0.714	0.710	0.684	0.682

This table reports the results from estimating equations (2)–(4) for a 30-day event window and with additional controls. Models (1) to (5) include the weekly confirmed COVID-19 cases as a weighted average across states, where the weights correspond to each state's share of unpaid principal balance in the underlying mortgage pool. Models (6) to (10) include in addition the daily BBB corporate bond spreads. The CRT spread is measured in percentage points. All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. Standard errors are clustered at the security level. Section 7.9 provides further details. ***p<0.01; **p<0.05.

Table 10. Parallel Trends: Alternative Event Dates Impact on CRT Spreads

	CRT Spread									
Event Date:	November 30, 2019					January 31, 2020				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post-Event	-0.008	-0.025	-0.013	-0.015	-0.012	-0.159***	-0.193**	-0.166*	-0.122***	-0.141***
	(0.012)	(0.022)	(0.025)	(0.011)	(0.010)	(0.054)	(0.084)	(0.093)	(0.042)	(0.044)
Judicial × Post-Event	0.003					-0.014				
	(0.005)					(0.017)				
ΔHouse Price× Post-Event		-0.011					-0.120			
		(0.027)					(0.103)			
SD(House Price) × Post-Event			-0.010					0.071		
			(0.032)					(0.112)		
FICO × Post-Event				-0.010					0.065	
				(0.015)					(0.056)	
DTI × Post-Event					0.004					-0.051
					(0.013)					(0.048)
Treasury Rate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CRT Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,313	2,313	2,313	2,313	2,313	2,365	2,365	2,365	2,365	2,365
Adj R Squared	0.992	0.992	0.992	0.992	0.992	0.965	0.966	0.966	0.965	0.965

This table reports the results from estimating equations (2)–(4) for alternative event dates and for a 30-day event window around those dates. Post-Event is the placebo treatment variable that takes the value of one on or after the event date, and zero otherwise. The event dates are November 30, 2019 in Models (1) to (5) and January 31, 2020 in Models (6) to (10). All models include CRT security fixed effects, the 10-year Treasury rate, and issuer interaction with the post-CARES indicator. Standard errors are clustered at the security level. Section 7.9 provides further details. ***p<0.01; **p<0.05; *p<0.10.

ONLINE APPENDIX

Option-Theoretic Model

This appendix presents a simple option-theoretic model that links mortgage forbearance to expected mortgage losses. We build on a standard binomial option-pricing model in which the borrower's decision to continue repayment or default is represented as an American put option written on the underlying property, with the outstanding mortgage balance serving as the strike price. Upon default, the borrower's payoff is normalized to zero, while the lender incurs a loss equal to the shortfall between the outstanding mortgage balance and the property value. Within the model, default is optimal only when the borrower has negative equity. Otherwise, the borrower either continues to repay the mortgage or sells the property and retains the remaining equity.

The timing of default is governed by the mortgage resolution process rather than occurring immediately following financial distress. After missing mortgage payments, borrowers enter a finite delinquency period during which mortgage payments may be suspended before foreclosure proceedings begin. At the end of this period, the borrower either cures the delinquency by paying a fixed cost and resuming mortgage payments or defaults and surrenders the property.

We introduce mortgage forbearance into the model to capture the institutional features of the CARES Act. Relative to the standard mortgage resolution process, forbearance affects the borrower's repayment decision in two ways. First, it extends the period during which the borrower may remain delinquent before mortgage resolution. Second, it reduces or eliminates the financial and reputational costs of curing the delinquency and resuming mortgage payments. Under standard servicing practices, borrowers typically have approximately six months to cure arrears before foreclosure proceedings are initiated, although this period is generally longer in judicial foreclosure states. The CARES Act extended the maximum forbearance period by up to twelve months, and subsequently by an additional six months, while allowing borrowers to return to current status without the financial and reputational penalties that would otherwise accompany delinquency.

These changes did not replace the standard delinquency process. Instead, the CARES Act added a formal forbearance period before the existing foreclosure timeline began. Following the expiration of the forbearance period, borrowers continued to receive the standard delinquency period before liquidation, during which they could still cure arrears and resume

mortgage payments, albeit subject to the usual financial and reputational costs. Consequently, the CARES Act both increased the effective time available before liquidation and reduced the cost of curing delinquency.

Time before liquidation

The delinquency and foreclosure process typically spans several months following the first missed mortgage payment. During this period, the lender's financial position resembles a short position in an American put option written on the underlying property. If the property's market value falls below the outstanding mortgage balance, including accrued interest and any penalties, the lender bears losses dollar for dollar. Conversely, if the property's market value increases, the lender does not participate in the upside because borrowers are more likely to continue making payments or sell the property and repay the loan.

The key implication of introducing mortgage forbearance into the model is that it increases the effective maturity of the borrower's American put option on the underlying property. Because the lender is effectively short this option, a longer time before liquidation increases its value and correspondingly reduces the value of the lender's position. Additional time allows borrowers to condition their repayment decision on a broader range of future house price realizations. If house prices recover, borrowers continue to repay the mortgage. If house prices deteriorate further, they exercise the option by defaulting. Consequently, extending the time before liquidation increases the value of the borrower's option while increasing the lender's exposure to downside risk.

Ex-ante option to default

The option value associated with forbearance extends beyond borrowers already in forbearance. *Before* entering forbearance, borrowers decide whether to continue making mortgage payments or to exercise the option to enter forbearance. Conditional on entering forbearance, they subsequently choose whether to cure the delinquency or default. These sequential decisions constitute a compound option, in which the decision to enter forbearance creates a second option over the subsequent repayment decision.

Model setup

The borrower holds a mortgage secured by a home with market value P_t. The home value follows a standard geometric Brownian motion:

$$dP = \mu P dt + \sigma P dZ. \tag{7}$$

The mortgage is interest-only with a fixed contractual payment m and a constant mortgage rate r. Valuation is conducted under the risk-neutral measure. In the baseline parameterization, we set the expected house price appreciation rate μ equal to the mortgage rate, r. Allowing for a different risk-free rate is straightforward and does not affect the model's implications.

We use a binomial pricing method to value the option. At each time step, t, the borrower chooses one of four mutually exclusive actions: (1) remain current, (2) enter forbearance, (3) exit forbearance (if applicable), or (4) default.

Borrower's per-period choices

Let $V_t(P_t, s_t)$ denote the borrower's value function, where s_t captures the state of the loan (current, in forbearance, or post-forbearance). Let h_t denote the flow utility (or implicit rental value) from housing consumption. For simplicity, we assume $h_t = h$ is constant over time and independent of P_t, so that housing services do not directly affect the default boundary beyond their role in the intertemporal budget constraint. The borrower's choices are:

1. Remain current. The borrower pays the mortgage interest m, receives the flow utility from housing services (normalized to h_t), and continues in the current state:

$$V_t^C = h_t - m + \beta \mathbb{E}_t \left[V_{t+1}(P_{t+1}, s_{t+1} = \text{current}) \right]. \tag{8}$$

2. Enter or remain in forbearance. During forbearance, the borrower suspends payments but continues to receive housing services:

$$V_t^F = h_t + \beta \mathbb{E}_t \left[V_{t+1}(P_{t+1}, s_{t+1} = \text{forbearance}) \right]. \tag{9}$$

No interest is paid during this period.

3. Exit forbearance. Upon exit, the borrower pays a fixed penalty $\phi \geq 0$ (which may include missed payments or fees), after which the loan returns to current status:

$$V_t^E = h_t - \phi - m + \beta \mathbb{E}_t \left[V_{t+1}(P_{t+1}, s_{t+1} = \text{current}) \right]. \tag{10}$$

4. Default. Default delivers the value of the property net of debt obligations. Let L denote the outstanding loan balance. The default payoff is:

$$V_t^D = \max\{P_t - L, 0\}. \tag{11}$$

This captures the standard limited-liability structure: the borrower retains positive equity if available and otherwise walks away with zero payoff.

At maturity T, the borrower chooses between repayment and default. The terminal value is:

$$V_T(P_T) = \max\{P_T - L, 0\}. \tag{12}$$

At each $t < T$, the borrower solves:

$$V_t(P_t, s_t) = \max\left\{V_t^C, V_t^F, V_t^E, V_t^D\right\}. \tag{13}$$

The optimal policy is therefore characterized by endogenous thresholds in P_t, which determine default and forbearance decisions.

Mortgage and interest rate assumptions

We assume an interest-only mortgage with constant contractual rate r, so that the payment $m = rL$ remains fixed over time. This assumption simplifies the valuation problem without affecting the qualitative comparative statics of interest, since amortization would gradually reduce the outstanding balance without altering the option value structure. Interest rates are assumed constant, consistent with the prevalence of fixed-rate mortgages in the data.

Within a risk-neutral pricing framework, the borrower's option value resulting from mortgage forbearance has a natural interpretation in terms of expected default losses. In particular, the value of this option to the borrower is equal to the present value of the losses expected

to be borne by the lender:

$$\text{Option Value} = \mathbb{E}^{Q}\left[\sum_{t} \beta^{t} \mathbf{1}_{\{\text{default at } t\}} \cdot \text{LGD}_{t}\right], \tag{14}$$

where LGD_t denotes the loss given default at time t. An increase in option value therefore corresponds to an increase in expected discounted losses.

Figure A10 plots the value of the borrower's option to enter forbearance and, subsequently, to default, expressed as a percentage of the outstanding loan balance. The figure shows that the option value increases with the length of the forbearance period and decreases with the cost of curing mortgage delinquency. These comparative statics capture the central economic intuition of the model: extending the time available before loan resolution increases the value of the borrower's option by allowing repayment decisions to depend on a broader range of future house price realizations and economic conditions. Because mortgage investors are effectively short the borrower's option, increases in the duration of forbearance or reductions in the cost of curing mortgage delinquency increase the value of the borrower's option while reducing the value of the lender's position. As a result, investors require greater compensation for bearing mortgage credit risk.

Consistent with standard option theory, the option value declines monotonically over the life of the mortgage and converges to zero as maturity approaches, reflecting the diminishing value of delaying the repayment decision. Consequently, extending the resolution horizon through mortgage forbearance has its largest effect when substantial time remains before mortgage maturity, increasing the value of the borrower's option at the onset of the forbearance program.

The option value is economically significant. For a mortgage with ten years remaining to maturity, it can reach approximately 15 percent of the outstanding loan balance. Although the precise magnitude depends on model parameters, particularly house price volatility and initial borrower equity, the central implication is robust: the option to enter forbearance and potentially default is quantitatively important.

The model also highlights the importance of institutional design. The option value is lowest when the forbearance period is short and the cost of curing delinquency (exit penalty) is high. Extending the duration of forbearance, reducing the cost of curing delinquency, or both, increases the option value by expanding the set of states in which delaying default is optimal.

The model provides a simple mechanism linking mortgage forbearance to expected mort-

gage losses. By extending the forbearance period and reducing the cost of curing delinquency, the CARES Act increases the value of the borrower's option and, correspondingly, the expected losses borne by lenders. For mortgages securitized through the CRT program, these expected losses are ultimately borne by CRT investors, implying higher required compensation and, therefore, higher CRT spreads.

Importantly, a higher option value does not necessarily imply higher realized default rates. Favorable future house price realizations may lead borrowers to resume mortgage payments rather than default. However, because these future outcomes are uncertain at the time of the policy intervention, expected mortgage losses, and the compensation required by investors, can increase even if ex post defaults ultimately do not.

Figures for the Online Appendix

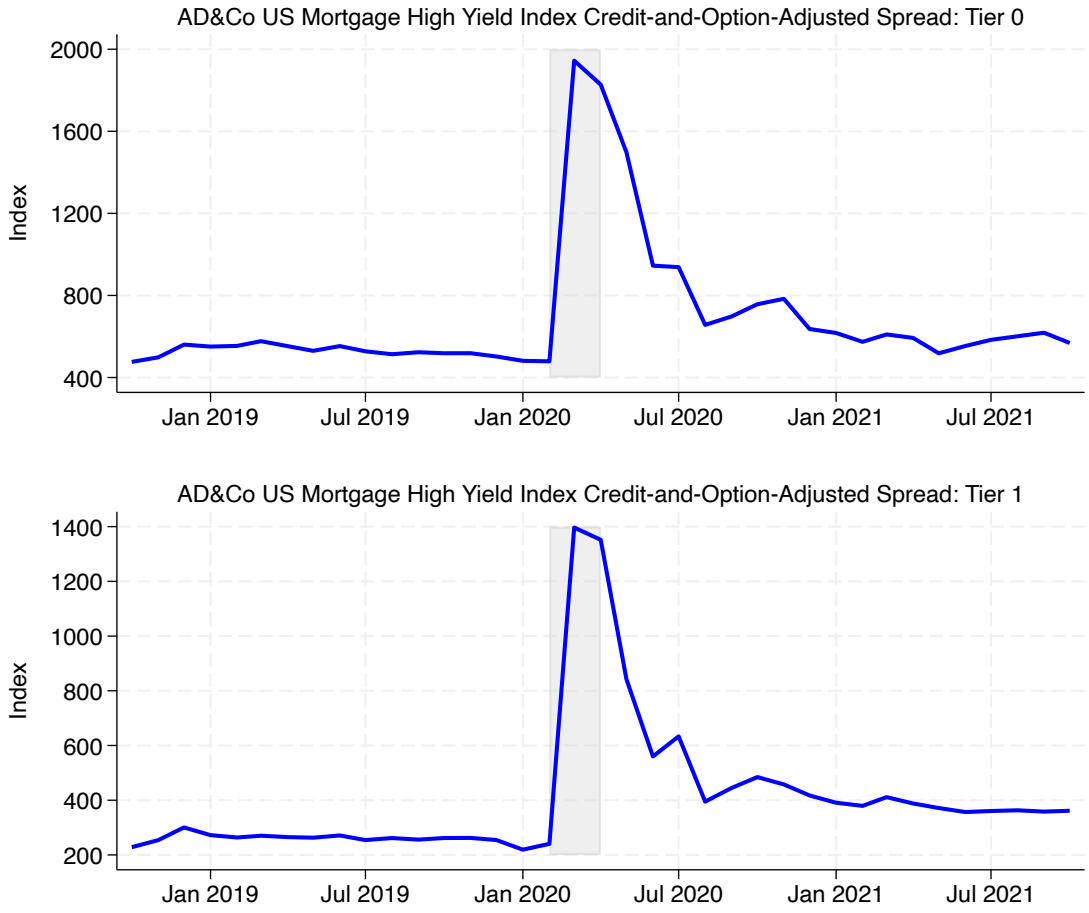


Figure A1. CRT Spreads. The figures plot the AD&Co US Mortgage High Yield Index credit-and-option-adjusted spread. The indices include CRT bonds CAS from Fannie Mae and STACR from Freddie Mac offered to the public, whether they are exchangeable or not, that have or have had IDC prices. To be included in the index the bond factor should be >= 0.25, bonds should be floating rate and have 30-year residential mortgage collateral. Tier 0 (top panel) plots CRT junior tranches B and B2. Tier 1 (bottom panel) plots CRT junior tranche B1. On a set of 20 standardized, probabilistically weighted, market-and-model stress scenarios, AD&Co computes a discount rate that equates expected present value of tranche's cash flows to the observed market price; the cash flows are loss-adjusted using AD&Co's LoanDynamics Model (LDM). Investors and fund managers can use the index to assess the broad market returns, risks and opportunities available through investing in a market-weighted, passive portfolio of US mortgage credit risk transfer instruments. Until February of 2022, AD&Co has been computing crOAS relative to the LIBOR-swap rate curve before it was set to retire in 2023. Source: Andrew Davidson & Co., Inc., AD&Co US Mortgage High Yield Index, Credit-and-Option-Adjusted Spread: Tier 0 [CROASTIER0] and Tier 1 [CROASTIER1], retrieved from FRED, Federal Reserve Bank of St. Louis.

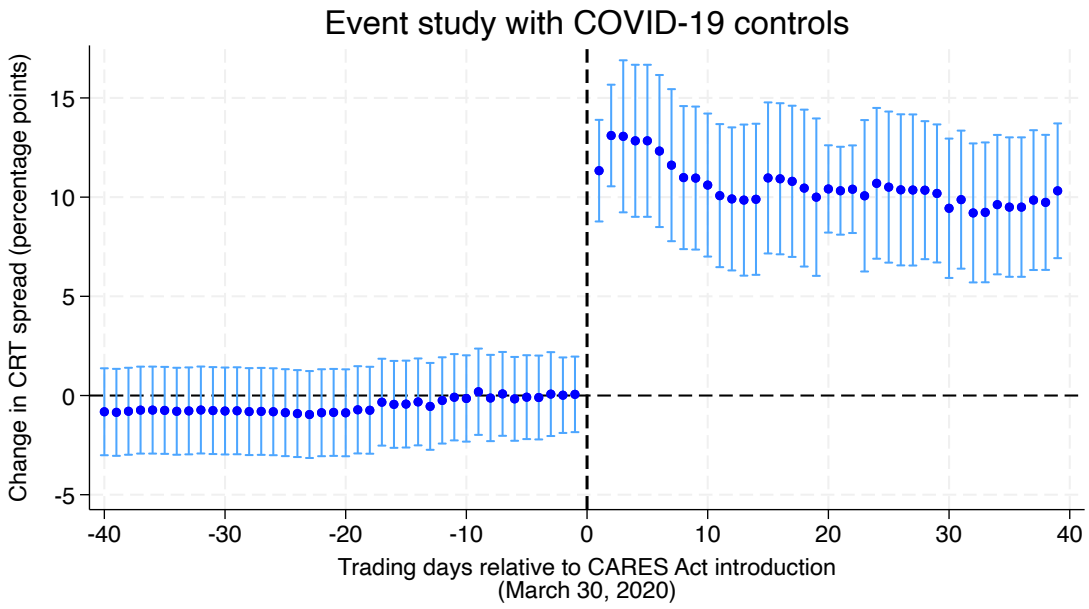


Figure A2. Event-Study Coefficients with COVID-19 Controls. The figure plots the estimated coefficients and 95% confidence intervals from the event-study specification in equation (1). The specification augments the baseline model with controls for CRT-specific exposure to local COVID-19 conditions. Weekly confirmed COVID-19 cases are measured as weighted averages across states, where the weights correspond to each state's share of unpaid principal balance in the underlying mortgage pool referenced by the CRT. The specification includes security fixed effects. Observations are at the CRT–day level, and spreads are measured in percentage points. The vertical line at $t = 0$ denotes March 30, 2020, the first trading day after the enactment of the CARES Act. Section 5.2 provides additional details.

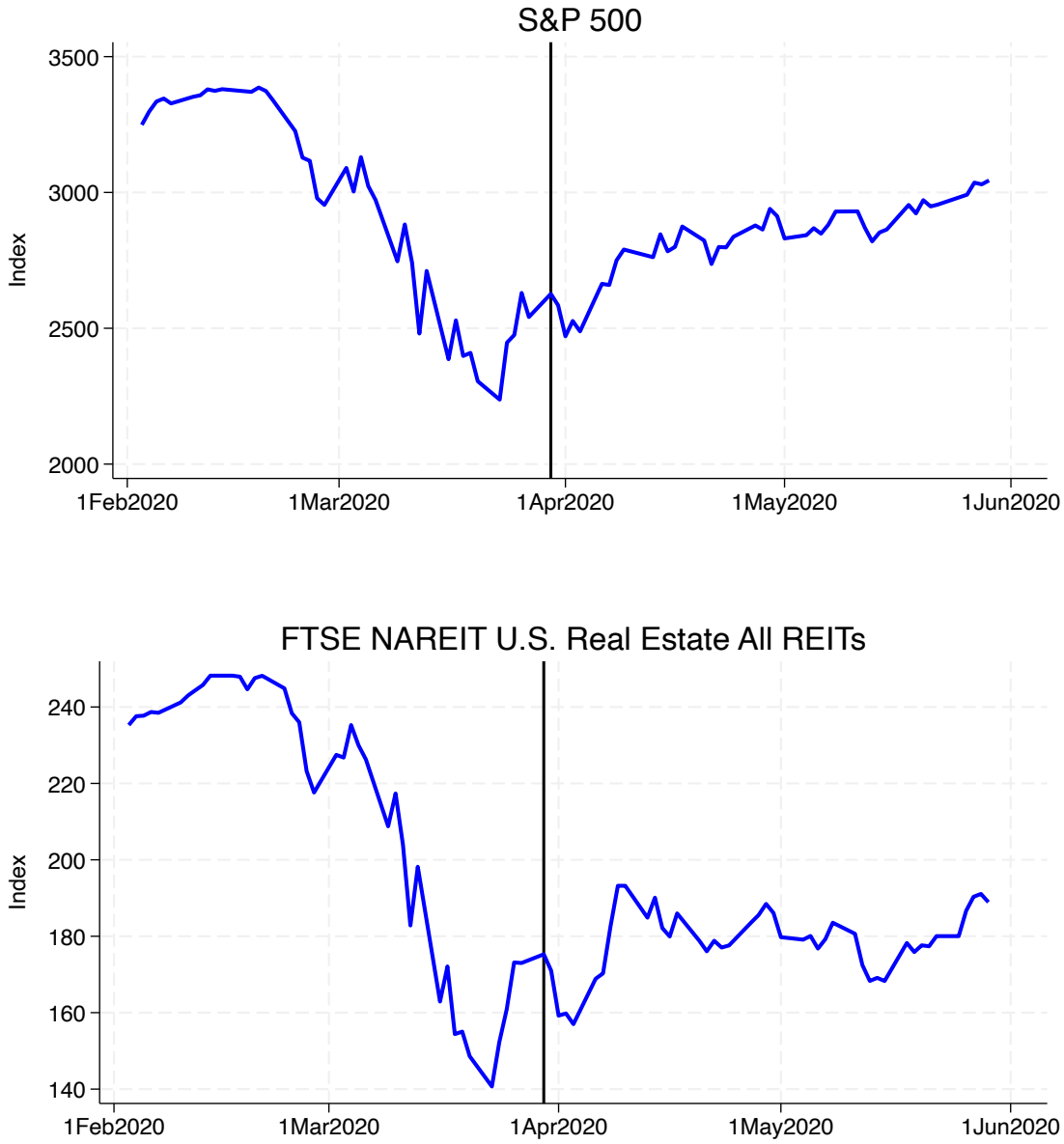


Figure A3. Equity Market and Real Estate Investment Trust (REIT) Performance Around Federal Pandemic Relief. This figure plots the evolution of the S&P 500 index (top figure) and the NAREIT index (bottom figure) around the CARES Act introduction. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Section 5.2 contrasts the response of the CRT market with the lack of a comparable response in the equity market and the NAREIT Real Estate Index following the enactment of the CARES Act.

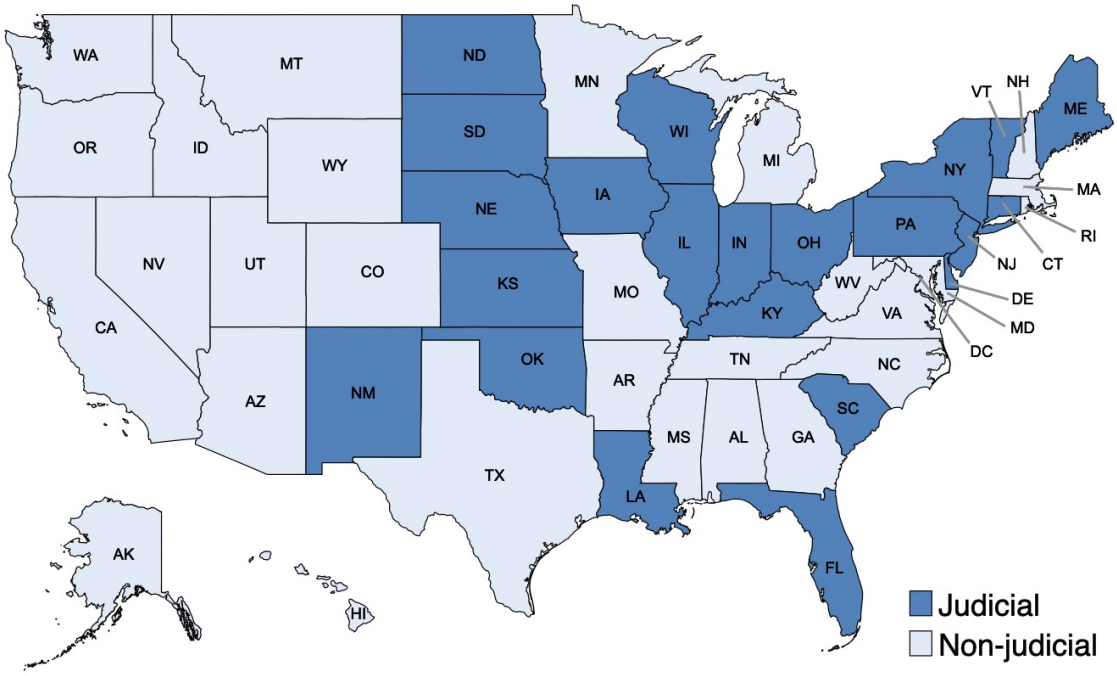


Figure A4. States With Judicial and Non-Judicial Foreclosure Requirements. The map show the states with judicial and non-judicial foreclosure requirements. Our classification of the states follows Fout et al. (2017).

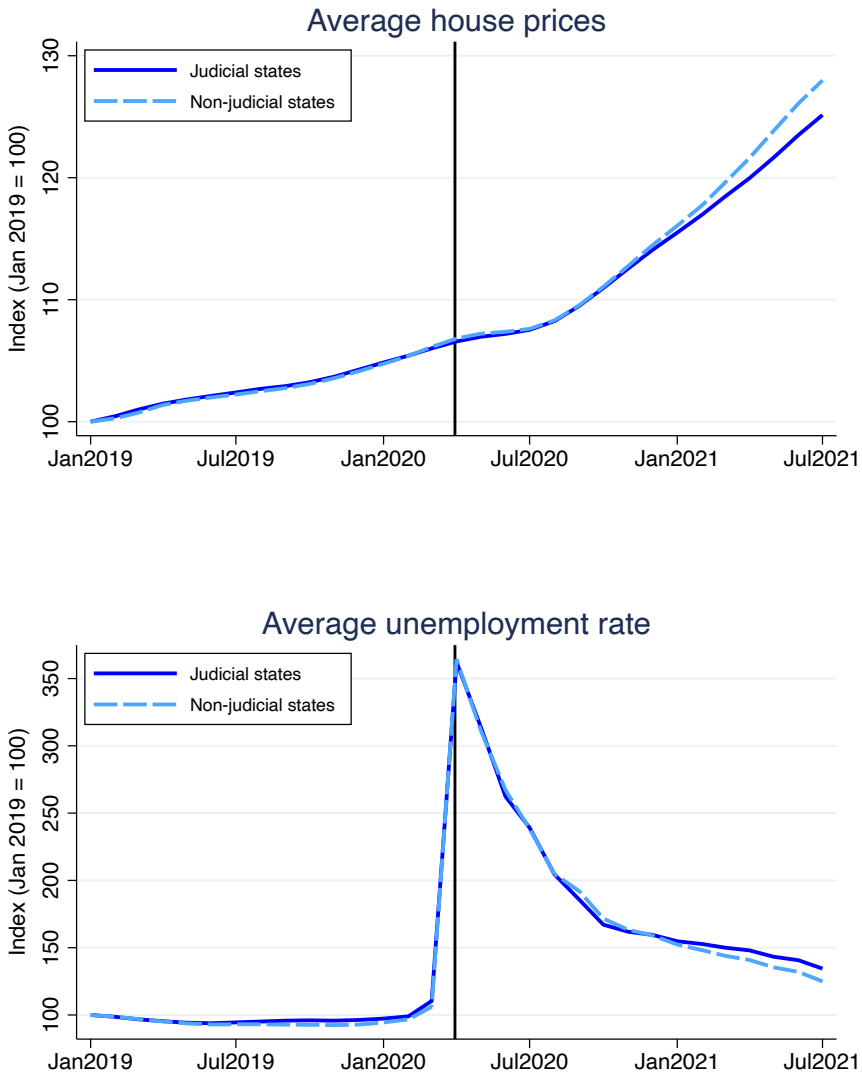


Figure A5. House Prices and Unemployment in Judicial vs. Non-Judicial States. The top panel shows the trends in average prices of median single-family homes in judicial and non-judicial states. The bottom panel displays the dynamics of the average unemployment rate in these states. Both the house price index and the unemployment rate index are normalized to 100 in January 2019 and are measured monthly through July 2021. Source: Zillow Home Value Index (ZHVI) for single-family homes, Bureau of Labor Statistics, and authors' calculations.

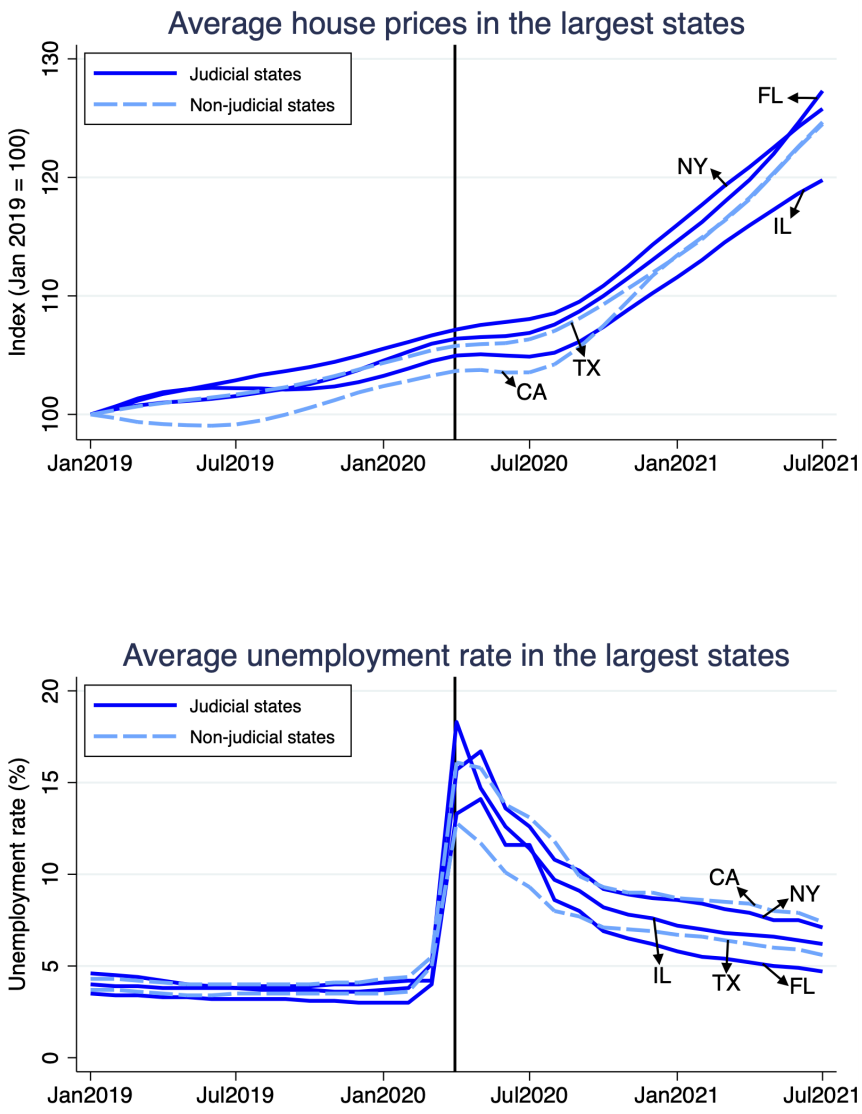


Figure A6. House Prices and Unemployment in the Largest States by CRT Principal Balance Share. The top panel shows the median single-family home price index in New York, Florida, and Illinois (judicial states, solid lines) and California and Texas (non-judicial states, dashed lines). The index is normalized to 100 in January 2019. CRT mortgage pools have the largest exposure in these states. The bottom panel displays the unemployment rate in the same states. Both the house price index and the unemployment rate are measured monthly from January 2019 through July 2021. Source: Zillow Home Value Index (ZHVI) for single-family homes, Bureau of Labor Statistics, and authors' calculations.

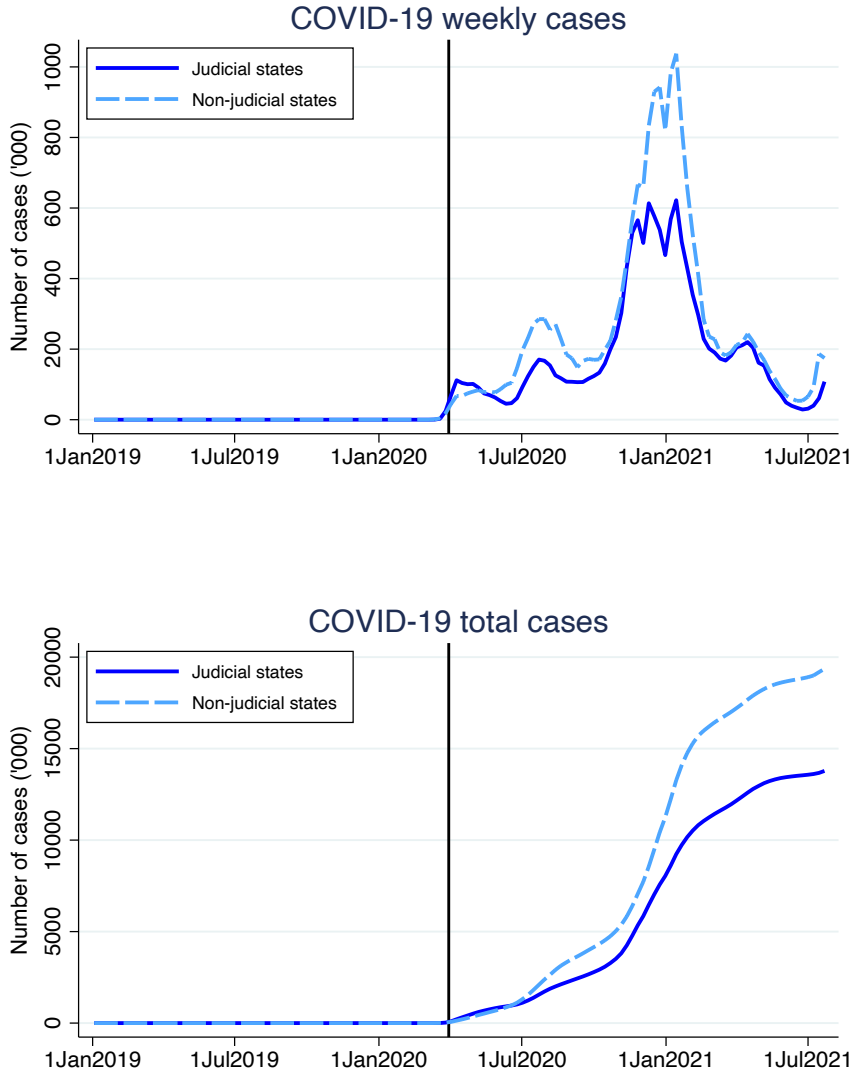


Figure A7. COVID-19 Cases in Judicial vs. Non-Judicial States. The top panel plots the weekly number of confirmed COVID-19 cases in judicial and non-judicial states from January 2019 to July 2021. The bottom panel shows the cumulative weekly number of cases in judicial versus non-judicial states. Source: Centers for Disease Control and Prevention (CDC) and authors' calculations.

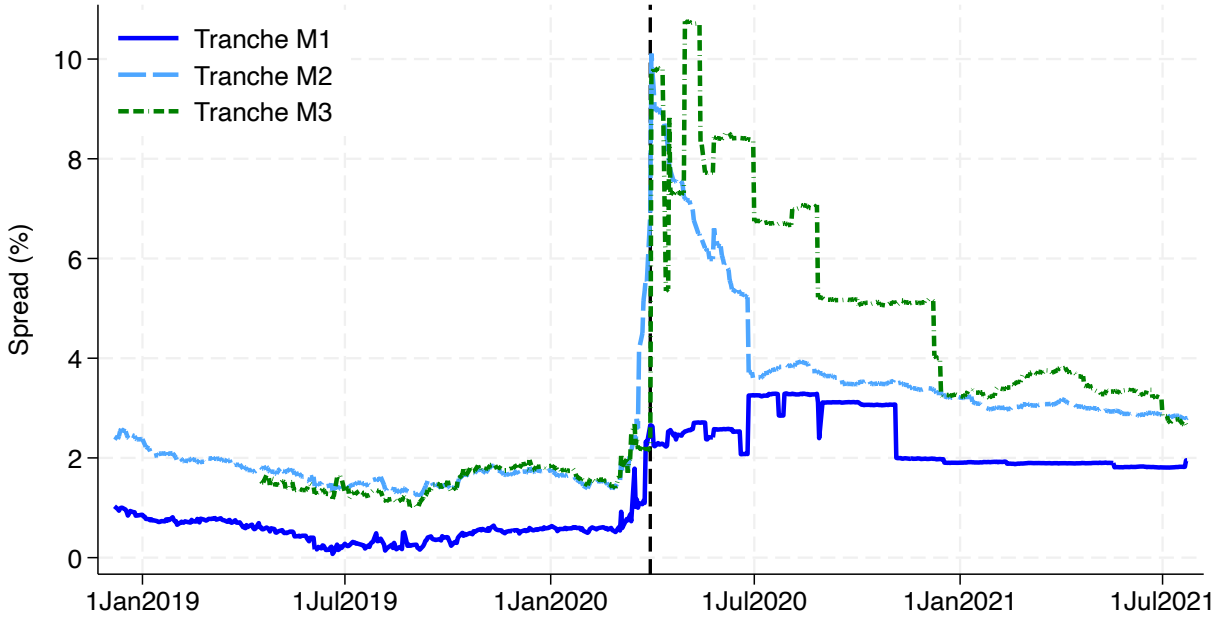


Figure A8. CRT Spreads and the CARES Act: Mezzanine Tranches. The figure plots the average daily spread (yield to maturity minus 1-month US Dollar LIBOR) in the secondary market of mezzanine tranches of CRT securities. M1 is the upper mezzanine, M2 the middle mezzanine and M3 the lower mezzanine tranche. The 1-month LIBOR rate is the reference rate used in the CRT documentation at the time. These CRTs were issued between January 2017 and December 2019 by Fannie Mae and Freddie Mac. The vertical line indicates March 30, 2020, the first trading day following the CARES Act introduction. Section 7.5 examines the differential response of junior and mezzanine CRT tranches and presents the corresponding difference-in-differences specification.

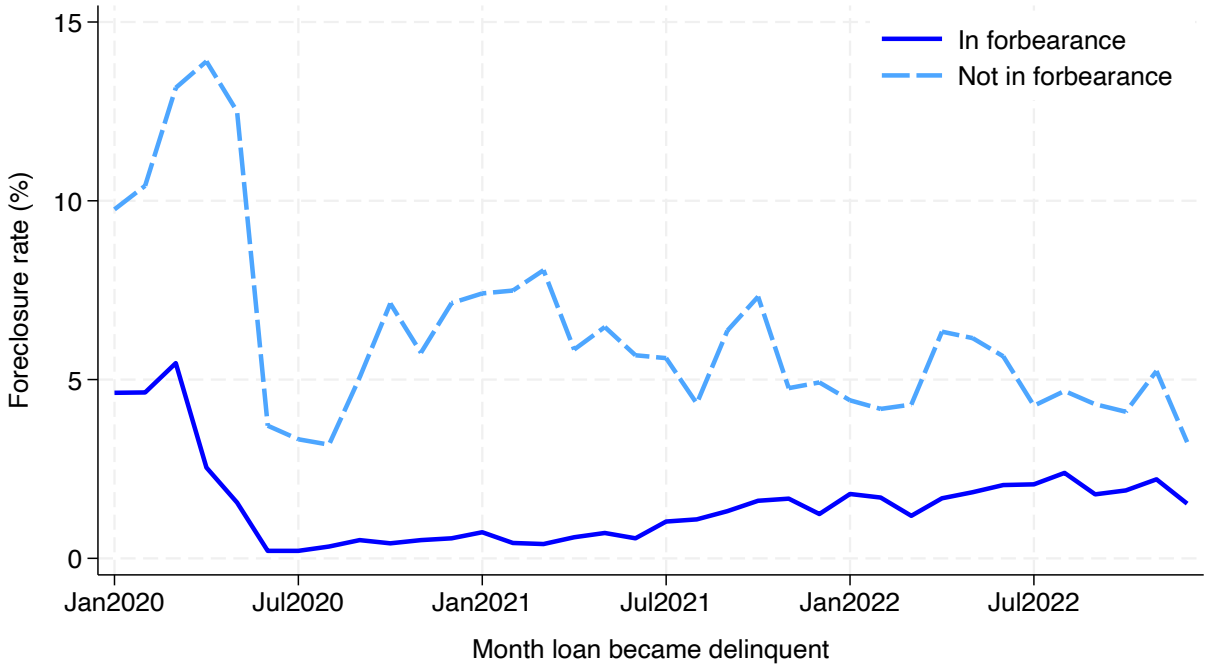


Figure A9. Ex-post Foreclosure Rate. The figure plots the share of Fannie Mae mortgages that transitioned from 90-day delinquent into foreclosure or liquidation. Each loan is tracked from the month that it becomes 90-day delinquent until it exits the dataset or until June 2025, whichever occurs first. The data are presented in Tables A1–A3. Section 8 provides further details on the mortgage outcomes. Source: Fannie Mae Data Dynamics.

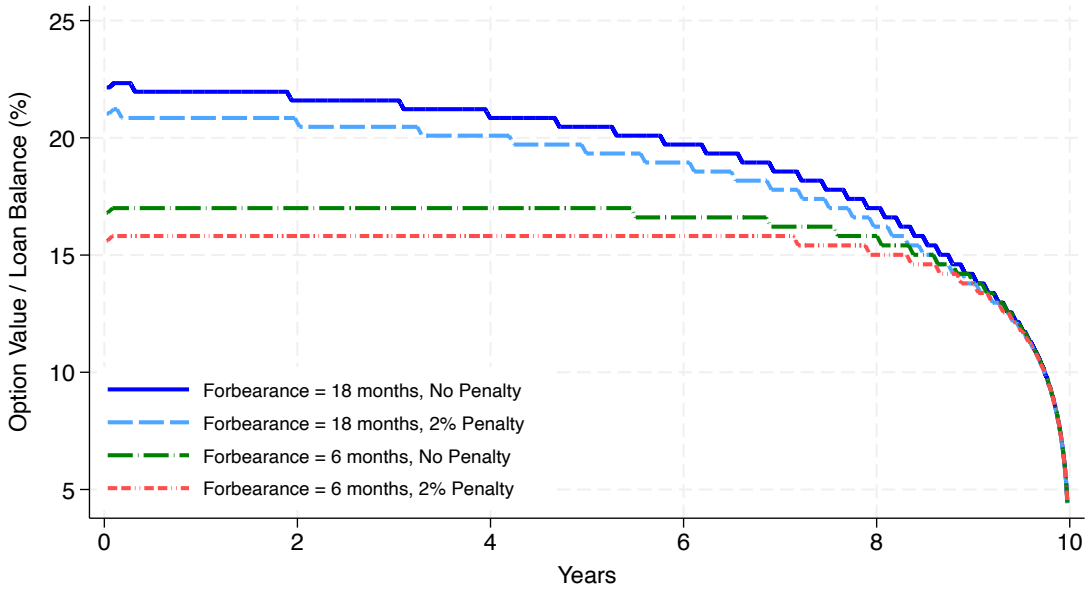


Figure A10. Value of Option to Enter Forbearance. This figure depicts the value of the option to enter forbearance, and potentially default, with forbearance of 6 or 18 months and with and without penalty to exit forbearance.

Tables for the Online Appendix

Table A1. Monthly Mortgage Outcomes (2020)

	Month in 2020:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	**Total**
Loans in Forbearance	Number of loans 90-day delinquent	259	304	366	591	2761	41130	26267	12350	8013	6671	5452	4627	**108,791**
	Foreclosure rate (%)	4.63	4.64	5.46	2.54	1.56	0.21	0.21	0.33	0.51	0.42	0.51	0.56	**0.38**
	Removal rate (%)	10.04	11.26	11.48	9.48	4.14	0.74	0.52	0.72	0.79	0.76	0.74	0.63	**0.91**
	Still delinquent (June 2025, %)	8.88	12.91	10.93	9.81	6.17	0.75	0.73	1.12	1.61	1.38	2.02	1.87	**1.27**
Loans not in Forbearance	Number of loans 90-day delinquent	246	305	266	223	185	241	195	182	190	215	187	224	**2,659**
	Foreclosure rate (%)	9.76	10.42	13.16	13.9	12.5	3.71	3.33	3.18	5.06	7.13	5.75	7.14	**8.19**
	Removal rate (%)	5.69	7.17	10.15	7.17	8.33	2.15	1.85	1.24	1.01	0.95	3.74	1.72	**4.52**
	Still delinquent (June 2025, %)	4.07	2.28	2.26	3.59	4.17	0.59	0.93	0.53	1.82	1.43	2.3	3.94	**2.35**

This table presents the outcomes of loans that became exactly 90 days delinquent in each month of 2020, categorized by forbearance status. Each loan is tracked until it exits the dataset or until June 2025, whichever occurs first. The foreclosure rate represents the percentage of delinquent loans that transitioned into foreclosure or liquidation. The removal rate indicates the percentage of delinquent loans removed from the dataset due to repurchase or sale. The "still delinquent" category reflects the share of loans remaining delinquent as of June 2025. The final column summarizes the outcomes for the entire cohort of loans that became 90 days delinquent in 2020. Section 8 provides further details on the mortgage outcomes.

Table A2. Monthly Mortgage Outcomes (2021)

	Month in 2021:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	**Total**
Loans in Forbearance	Number of loans 90-day delinquent	4,122	4,102	3,362	2,653	2,052	1,858	1,714	1,538	1,361	1,392	1,414	1,306	**26,874**
	Foreclosure rate (%)	0.73	0.43	0.4	0.59	0.71	0.56	1.03	1.09	1.32	1.61	1.67	1.24	**0.8**
	Removal rate (%)	0.78	1.23	0.68	0.74	0.96	1.45	0.85	1.7	1.87	1.23	1.98	1.91	**1.15**
	Still delinquent (June 2025, %)	2.25	2.32	3.24	3.13	3.13	4.18	4.84	6.25	8.32	8.46	8.75	9.86	**4.41**
Loans not in Forbearance	Number of loans 90-day delinquent	197	206	188	164	162	199	171	187	192	223	237	226	**2,352**
	Foreclosure rate (%)	7.41	7.49	8.06	5.84	6.47	5.68	5.6	4.33	6.37	7.32	4.76	4.92	**6.17**
	Removal rate (%)	2.78	3.29	3.55	2.72	3.45	1.89	3.45	3.15	3.00	3.82	3.57	1.54	**3.01**
	Still delinquent (June 2025, %)	4.01	4.49	4.19	4.67	5.17	8.71	6.9	7.09	8.99	12.1	9.82	9.85	**7.37**

This table presents the outcomes of loans that became exactly 90 days delinquent in each month of 2021, categorized by forbearance status. Each loan is tracked until it exits the dataset or until June 2025, whichever occurs first. The foreclosure rate represents the percentage of delinquent loans that transitioned into foreclosure or liquidation. The removal rate indicates the percentage of delinquent loans removed from the dataset due to repurchase or sale. The "still delinquent" category reflects the share of loans remaining delinquent as of June 2025. The final column summarizes the outcomes for the entire cohort of loans that became 90 days delinquent in 2020. Section 8 provides further details on the mortgage outcomes.

Table A3. Monthly Mortgage Outcomes (2022)

	Month in 2022:	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	**Total**
Loans in Forbearance	Number of loans 90-day delinquent	1,158	1,133	1,074	1,037	944	918	864	902	892	886	841	986	**11,635**
	Foreclosure rate (%)	1.80	1.70	1.19	1.68	1.85	2.05	2.07	2.39	1.79	1.90	2.21	1.53	**1.83**
	Removal rate (%)	2.09	2.27	1.98	2.41	2.20	1.81	2.59	1.88	2.31	2.79	2.76	1.41	**2.19**
	Still delinquent (June 2025, %)	11.59	12.41	12.97	12.05	14.72	15.88	18.76	18.34	18.72	22.97	22.34	23.47	**16.68**
Loans not in Forbearance	Number of loans 90-day delinquent	212	258	215	201	195	267	260	257	259	292	285	327	**3,028**
	Foreclosure rate (%)	4.42	4.18	4.3	6.34	6.16	5.65	4.27	4.68	4.31	4.1	5.24	3.25	**4.66**
	Removal rate (%)	2.52	3.58	2.15	2.11	1.81	3.95	3.13	1.65	4.31	2.82	3.99	3.25	**3.02**
	Still delinquent (June 2025, %)	13.88	11.94	13.26	14.44	17.39	19.77	17.09	18.46	21.02	26.15	20.45	22.13	**18.42**

This table presents the outcomes of loans that became exactly 90 days delinquent in each month of 2022, categorized by forbearance status. Each loan is tracked until it exits the dataset or until June 2025, whichever occurs first. The foreclosure rate represents the percentage of delinquent loans that transitioned into foreclosure or liquidation. The removal rate indicates the percentage of delinquent loans removed from the dataset due to repurchase or sale. The "still delinquent" category reflects the share of loans remaining delinquent as of June 2025. The final column summarizes the outcomes for the entire cohort of loans that became 90 days delinquent in 2020. Section 8 provides further details on the mortgage outcomes.