Forbearance and the Cost of Credit.*

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Abstract

Economic theory and prior empirical research are ambiguous about the effect of mortgage forbearance on expected loan delinquency and default risk. We contribute to this literature by examining the effect of a forbearance policy on forward-looking private markets for mortgage credit risk, specifically Credit Risk Transfers (CRTs). We document that the forbearance provisions under the 2020 CARES Act significantly increased CRT credit spreads, by 3 to 4 times, especially in states that already have longer foreclosure timelines. This indicates that credit markets anticipated forbearance policies would cause higher default losses for lenders. While we show that heightened delinquency risk materialized as expected, historic Covid-19 interventions, primarily through unprecedented levels of fiscal support, effectively mitigated its progression into default risk.

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

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1 Introduction

Mortgage forbearance policies are gaining wide acceptance and popularity, although neither economic theory nor prior empirical work clearly identify their impact on ex ante predicted default or the eventual loan outcomes. 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 in financial difficulty to delay payments without the threat of foreclosure.[1] The CARES Act called for mortgage insurers to pause payments upon request for 12 to 18 months, without penalty, with delinquent payments to be repaid in a waterfall of options including through principal at the end of the loan. These policies allow some borrowers to get back on track but worsen the eventual outcomes for others, as non-paid debt accumulates.

The current literature has not established how financial markets ex ante price expected effects. Financial markets may expect forbearance to mitigate or worsen expected credit risk. This matters because the pricing of credit risk, if it is expected to worsen, may contribute to further destabilization of financial markets. To fill this gap, we analyze the credit spreads of Credit Risk Transfer (CRT) securities around the introduction of the 2020 CARES Act. The CRT spreads are forward-looking, based on an active market, and are highly sensitive to expected delinquency and default losses.

We document that CRT spreads increased by 3 to 4 times on the day mortgage forbearance was mandated as part of the CARES Act. This means lending costs increased and investors expected forbearance to worsen, rather than improve, future default outcomes. The jump in CRT spreads coincided perfectly with the introduction of the CARES Act, not with the declaration of a global pandemic or any other major news related to Covid-19. This strongly indicates that the effect on spreads is related to the provisions under the 2020 CARES Act. The CARES Act allowed for no-questions-asked forbearance for delinquent borrowers, resulting in delinquency losses being borne by the GSEs and investors in CRTs.[2]

Furthermore, we investigate the differential spread response of securities with high and low exposure to states with judicial foreclosure requirement ("judicial states"). These states require judicial review for all mortgage foreclosures. This requirement increases the foreclosure

[1] https://home.treasury.gov/policy-issues/coronavirus/about-the-cares-act. https://www.bloomberg.com/news/articles/2023-07-05/canada-adds-guidelines-for-banks-to-prevent-mortgage-defaults?leadSource=reddit_wall

[2] All but four early CRT securities are insulated from losses arising from payment delays due to forbearance. However, loans exit forbearance when they become current, modified, liquidated or after 18 months, whichever occurs first. This eventual exit from forbearance exposes CRT investors to default losses.

timeline. If the blanket forbearance of the CARES Act was expected to increase (reduce) overall foreclosure losses, then the extended time to foreclose in judicial states would have become more (less) relevant. Consequently, the spreads of CRTs with high exposure to judicial states would have increased (declined) relative to the rest.

We find that the spreads of CRTs with high judicial exposure increased more than the rest. Therefore, based on the above reasoning, the forbearance introduced in the CARES Act was expected to increase future default losses. The CARES forbearance made judicial states even more "judicial" in the sense that the longer foreclosure timeline became more relevant for investors. We take the above findings as evidence that investors expected the forbearance program to increase default losses, rather than decrease them. The lending costs increased in response to this expectation.

The above findings establish a causal response of CRT investors to the CARES Act. An alternative event that could have caused the observed response must have occurred at the same time as the CARES Act introduction and it must have impacted CRTs with high exposure to judicial states differently. The existence of such an event is unlikely, especially since there were no major COVID- or economy-related events on that day, let alone events that deferentially impact judicial states. Falsification and other robustness tests reported below provide further support that the documented relationship is causal.

Our findings are contrary to most of the literature which finds that forbearance either improves or has no impact on loan outcomes. To name a couple of studies, 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. Using data from post-2020 delinquent loans, Goodman and Zhu (2024) show that loans in forbearance experienced only a quarter of the liquidation rate of the loans not in forbearance. On the more pessimistic side, Fout et al. (2017) document no effect of forbearance on subsequent loan outcomes. The above studies are representative of the broader literature, which finds either positive or neutral effects of forbearance on subsequent default outcomes.

While our findings differ from the prevailing literature, they are not inconsistent with it. All prior forbearance studies focus on the eventual loan outcomes or credit availability, which are measured months, even years, after the introduction of the forbearance. While the above studies are valuable and make the best possible use of the available data, they are forced to use ex-post outcomes to approximate ex-ante expectations. As Goodman and Zhu (2024) point out, this is particularly problematic for investigations of the CARES forbearance program because the economy benefited from unprecedented stimulus and property price increases. Our method, on the other hand, directly measures the change of forward-looking investor expectations on a very precise date, rather than over an extended period. Therefore, the relevance of our results for the effect of future forbearance on capital markets' pricing of mortgage risk is not compromised by look-ahead bias.

Next, we develop a model that links mortgage rates to default risk, allowing us to estimate investors' expectations of mortgage default following the enactment of the forbearance policy. Leveraging a zero-profit condition for mortgage lenders, we infer default probabilities based on market-implied mortgage rates and the legal framework governing foreclosure—whether the property is in a judicial or non-judicial state. Our model quantifies the shift in investors' default expectations that aligns with the observed increase in CRT spreads after the passage of the CARES Act.

The model simulations show that the expected monthly default probability in judicial states is 2.71%, representing a 226.5% increase from the baseline rate of 0.83%. In non-judicial states, the model estimates an expected monthly default probability of 1.49%, reflecting a 79.5% increase relative to the baseline.

Finally, to evaluate whether the initial CRT investor reaction was justified by subsequent loan experience we investigate the ex-post loan performance. We find that the 90-day delinquency increases substantially 90 days after the introduction of the CARES Act. This increase is particularly high in judicial states. This is consistent with the initial reaction of the CRT market. We only briefly present these results because the question of post-forbearance performance is already thoroughly investigated in Fout et al. (2017). Our findings are consistent with theirs.

We proceed as follows. Section 2 reviews the broader literature on forbearance, in addition to the key studies already mentioned above. Section 3 presents our theoretical considerations that link CRT spreads to expectations of future default losses. Section 4 provides basic information on the CRT securities and their exposure to future default losses. We review the forbearance program introduced in the CARES Act in Section 5 and describe the data in Section 6. Section 7 presents the main empirical analysis and results, with robustness checks presented in Section 7.5. Utilizing a model of mortgage default we derive the expected probabilities of default implied by the CRT spread increases in Section 8. We offer a discussion and review of actual default results in Section 9. Section 10 concludes.

2 Related Literature

This paper contributes to several research streams. First, in addition to the studies mentioned above, our work more generally extends the recent literature on the effects of COVID-19 and the CARES Act on mortgage delinquency and forbearance (An et al. 2022; Gerardi, Lambie-Hanson and Willen 2021). The literature shows how forbearance introduced by the CARES Act was used by borrowers and also how federal stimulus policies and Federal Reserve action helped borrowers to repay forborne debt. We document how the CRT market reacted to this trajectory.

Second, a literature on the efficacy of forbearance in reducing unnecessary foreclosures is only now developing, as exemplified by a recent paper discussed further below by Goodman and Zhu (2024). Earlier literature on forbearance shows mixed results. In the Great Financial Crisis, forbearance policies were generally associated with increased default risk (Acolin and Wachter 2022). Comparing outcomes in judicial states with greater borrower protections similar to forbearance to nonjudicial states, Mian et al. (2014) concludes that housing price decline mitigation due to forbearance was balanced by higher moral hazard, so that overall default risk was similar across the two sets of states during the GFC. But this literature, as noted, is based on ex post results. Here we show how CRT investors weighed these risks in their pricing response to forbearance introduced by the CARES Act.

Third, this paper contributes to the literature on housing finance and GSEs. Papers like Lucas and McDonald (2010), Jeske, Krueger and Mitman (2013), Frame, Wall and White (2013), Elenev, Landvoigt and Van Nieuwerburgh (2016), Hurst et al. (2016) and Gete and Zecchetto (2018) have analyzed different topics related to the GSEs. Pavlov, Schwartz and Wachter (2021) and Stanton and Wallace (2011) study how mortgage credit risk was not reflected in the cost of credit default swaps during the 2008 financial crisis, pointing out the failure of transferring credit risk to the market.

Fourth, our paper contributes to the literature that studies the CRT market. Gete, Tsouderou and Wachter (2024 study how CRT spreads react to catastrophic hurricanes and quantify the effects for the price of credit risk. Finkelstein, Strzodka and Vickery (2018) and Golding and Lucas (2022) explore whether the CRTs are an effective and efficient means of reducing the exposure of the federal government to mortgage credit risk. The CRT market, as described below, is far more transparently dependent on credit risk than the CDS market and lacks counterparty risk. The literature has shown that CRT pricing does reflect heightened delinquency risk in natural hazards (Gete, Tsouderou and Wachter 2024) and more generally (Golding and Lucas 2022). Here we extend this literature to consider the CRT market response to the CARES Act.

3 Theory and CRT Pricing

Unlike credit default swaps, the CRT securities are structured in a way that precludes investor default even in the case of extreme loan losses. Therefore, the price and yield of CRTs are driven by the expectations of mortgage default, recovery, and prepayment, not by the credit worthiness of the issuer or the investor. Given our focus on the most junior tranches available to investors, the primary driver of CRT pricing is expected default losses.

Zandi et al. (2017) and Golding and Lucas (2022) develop and calibrate CRT pricing models. One of their main conclusions, presented in Golding and Lucas (2022) Table 6, is that an increase in the default rate or the loss given default, or both, reduces the price of CRTs. This, in turn, increases the CRT yield. Zandi et al. (2017) also establishes the same relationship.

Therefore, there is a direct mapping of expectations about future default losses to current CRT yields. When CRT investors expect high future losses the yield on CRT securities increases. This is especially true for the most junior traded tranches, as they are the first to absorb any default losses.[3] If investors expect forbearance to decrease future losses, then yields would fall, and vice versa.

Equally important is the different response of securities with exposure to "judicial" versus "non-judicial" states. Foreclosure in states that require judicial review is particularly painful for lenders because of the longer time required, higher cost, and likely higher loss severity because the asset is likely to deteriorate during the foreclosure procedures. Therefore, any event that increases the expected future default losses would have a disproportionately large effect in judicial states (Ghent 2011)

Neither of the above models is able to identify whether yields respond to an increased probability of default or loss severity. However, this is not required for our purposes. Our main question is whether investors expect forbearance to increase or decrease future default losses, regardless of whether the expectation is about the default rate or the loss severity.

The literature identifies delinquency as a precursor to default. Delinquency is necessary but not sufficient for default. Foreclosure depends not only on payment difficulties which cause delinquency but also on mortgage balances which determine whether borrowers can short sell the property to cover missed mortgage payments. Whether forbearance spikes lead to foreclosure spikes will depend on the trajectory of housing prices. As the empirical literature shows, this depends on the equity position of borrowers prior to the economic shock and the policy response

[3] The GSEs retain the most junior tranche of each security. Here we mean the most junior tranche available to investors.

to the shock. We document that the CRT market anticipated the rise in delinquency. The Covid stimulus response to what was an historic health crisis was not anticipated ex ante; however, we document how the trajectory of the impact of stimulus on mortgage repayment affected CRT pricing.

In short, CRT spreads, especially for junior tranches, reflect future ex ante default loss expectations. Therefore, the change in CRT spreads when a forbearance program is introduced reflect the changing investor expectations about future default losses.

4 CRT Market Background

Under the directive of the Federal Housing Finance Administration (FHFA), the GSEs began issuing Credit Risk Transfer (CRT) securities in July 2013. This initiative aimed to mitigate the credit risk associated with the guarantees provided to mortgage-backed securities. By the end of 2022, CRT securities had afforded the GSEs loss protection on approximately $6.2 trillion in mortgage loans (FHFA 2023).

CRTs are notes with a final maturity of 10 or 12.5 years, granting investors rights to cash flows from a reference pool of mortgages underlying recently securitized agency mortgage-backed securities. These notes provide investors with monthly payments comprising both a share of the mortgage principal and interest. The GSEs transparently disclose the characteristics and performance over time of the underlying mortgage pools as well as individual loans, ensuring that investors have complete information.

The mortgage reference pools include mortgages from all U.S. states, with the highest concentrations typically found in California, Texas, Florida, Illinois, Georgia, and Virginia. These pools are categorized based on loan-to-value (LTV) ratios into high LTV pools (80.01% to 97%) and low LTV pools (60.01% to 80%).

At issuance, the outstanding principal balance of these mortgages is divided into tranches of varying seniority. The most senior tranche is fully retained by the GSEs. Below this are two or three mezzanine tranches, followed by a subordinated (junior) tranche, all of which are sold to investors. Initially, the GSEs retained a second subordinated tranche ("first loss") in early CRT transactions, but since 2016, this tranche has also been sold to investors. Typically, the allocation of the outstanding principal balance is as follows: 94.5–96% to the most senior tranche retained by the GSEs, 3.5–4% to the mezzanine tranches, and 0.5–1.5% to the junior tranches. Additionally, the GSEs retain a vertical slice of each tranche to mitigate moral hazard in mortgage selection.

The performance of CRTs is intrinsically linked to the default risk of the underlying mortgages. Cash flows from the reference pool mortgages repay the tranches according to a hierarchy of seniority. The most senior tranche is paid off first, followed by the subsequent tranches in order of seniority. Losses from the reference pool mortgages reduce the principal balance, beginning with the most subordinated tranches (a process known as the "cash flow waterfall"). Conversely, prepayments of mortgages in the pool are first applied to the most senior tranche.

CRT securities pay interest based on the one-month US Dollar LIBOR plus a floating spread.[4] This spread's fluctuations reflect the private capital market's pricing for sharing the credit risk borne by the GSEs (Wachter 2018).

5 The CARES Act

The first recorded case of coronavirus in the United States was announced on January 21, 2020. Subsequently, the World Health Organization declared a global health emergency on January 31, 2020. Following these developments, the U.S. government declared a public health emergency on February 3, 2020, in response to the Covid-19 outbreak. On March 13, 2020, the U.S. government further declared Covid-19 a national emergency, which unlocked federal funding to combat the spread of the virus.

The Covid-19 outbreak was a significant and unexpected shock to both U.S. public health and the economy. The pandemic led to unprecedented levels of unemployment and health-related expenses. Despite these developments, CRT spreads did not exhibit significant reactions in January and February 2020.

The Coronavirus Aid, Relief, and Economic Security (CARES) Act, signed into law on March 27, 2020, had a substantial impact on CRT investors. Section 4022 of the CARES Act allowed borrowers of federally backed mortgages, primarily those backed by the GSEs, to request forbearance for up to 12 months without incurring fees, penalties, or additional interest beyond what was scheduled. This forbearance was widely adopted during the pandemic, with minimal requirements for borrowers; they only needed to request it without providing proof of financial hardship or inability to pay.

[4] On December 22, 2022, the GSEs announced their SOFR-based replacement rates for legacy LIBOR products, based on the benchmark replacements selected by the Board of Governors of the Federal Reserve System in its regulation implementing the Adjustable Interest Rate (LIBOR) Act.76.

Although the CARES Act provided a grace period of 12 months, later extended to 18 months, it did not eliminate the risk of mortgage defaults. Forbearances lasting 180 days could result in losses for some CRT investors, particularly those holding the earliest CRTs, even if the forbearances were requested under the CARES Act. For other investors, forbearances increased the probability of default. Missed mortgage payments created stress in the CRT market, increasing the risk of default for CRTs. As demonstrated in the next section, investor reaction to the CARES Act announcement was marked by a significant increase in yield spreads, indicating a demand for higher compensation to offset the increased risk of losses.

6 Data

We study how the CRT market reacted to the CARES Act. We assemble a comprehensive database by combining information at the security level from multiple data sources. First, we collect data of the CRT securities from the GSEs (Fannie Mae 2024, Freddie Mac 2024). The securities by Fannie are called Connecticut Avenue Securities (CAS), and by Freddie are called Structured Agency Credit Risk (STACR). Specifically, for all CRTs issued between 2017 and 2019, we collect the deal name, issuance date and the level of the tranches.

We collect data for the underlying mortgages in these CRTs, also from the GSE websites. We collect the average loan-to-value ratio, FICO score, debt-to-income ratio and a composite risk measure that the GSEs publish, called risk layers.

We also utilize the complete history of yields in the secondary CRT market from Refinitiv Eikon, which we merge with the CRT characteristics using the deal and tranche names. We use the 1-month US Dollar LIBOR rates from Refinitiv Eikon to calculate the spread over LIBOR. We use the panel data of daily CRT yields for regression estimations, over different time windows around March 30, 2020, the first trading date the CARES Act went into effect.

Moreover, we follow Fout et al. (2017) to identify states with judicial and non-judicial foreclosure requirements. Figure A1 displays this categorization. From the GSE disclosures about the reference pool of mortgages of the CRTs, we extract the percentage of unpaid principal balance at origination that corresponds to each state. We create the variable judicial exposure to be the percentage of unpaid principal balance at origination of each CRT mortgage pool that is located in judicial states. Finally, we merge with our database the daily values of the 10-year treasury rate from FRED.

The baseline analysis focuses on the junior tranches. These tranches are the first to suffer credit losses from delinquencies and default.

Table 1 presents summary statistics of the key variables in our analysis concerning the junior tranches. The tables included in the paper limit the data to Group 2 (high LTV) deals. These are the deals that are most sensitive to changing expectations of future defaults. We present the results for all deals, both Group 1 and 2, in the Appendix. While the results of using both groups are very similar, we prefer the use of only Group 2 securities in our main analysis because we believe these securities are most sensitive to future default loss expectations.

We also limit the data to securities issued between 2017 and 2019, inclusive. Securities issued before 2017 have a different default exposure that is based on modeled losses. Starting in 2017, the CRT payouts are based on actual default losses and, as such, are more appropriate for our test.

The data includes 34 securities for a total of 1,325 observations over the +/- 30 day window. All securities have 39 daily observations, except for one security, STACR 2018-HQA2 B2, which has only 38. The weighted average LTV for the sample is high, between 91 and 94 percent. This is because we limit the data to high-LTV deals. The Appendix shows that the results for all available securities are similar.

The exposure to judicial states varies between 33 and 41 percent, which reflects the expected geographic diversification of CRT pools. While a larger exposure range would have made the empirical analysis easier, even this relatively small exposure range generates observable differences in the spread response.

7 Empirical Analysis

7.1 Implications From Theory

The theoretical considerations discussed in Section 3 suggest that our empirical analysis should identify how CRT spreads changed when forbearance was introduced. As discussed, the change in CRT spreads captures the change in investor expectations about future default losses. In turn, this addresses our main question - whether forbearance is expected to increase or decrease ultimate default losses.

To estimate the CRT spread change when forbearance was introduced, we first employ a standard event study approach that compares spreads before and after the CARES Act. We further consider the differential spread change in judicial and non-judicial states. These two tests are important because they make the potential existence of a third factor that causes the observed effect extremely unlikely. Such a factor would have to occur at exactly the same time as the event time and deferentially impact judicial and non-judicial states.

7.2 Graphical Analysis of CRT Spreads

Figures 1 and 1 present the evolution of CRT spreads around the CARES Act introduction for different levels of exposure to judicial states. Each figure reports the average spreads for securities with judicial exposure below the 25th percentile, below the 50th percentile, above the 50th percentile and above the 75th percentile. The vertical line indicates the introduction of the CARES Act.

Figure 1 presents the results for securities in Group 1, which contain loans with LTV ratio below 80%. Figure 1 presents the results for Group 2 securities, which contain loans with 80% or higher LTV.

Similar increase in overall spreads is also documented in the Federal Reserve Bank of St. Louis data tracking aggregate CRT spreads. Appendix Figure A2 reproduces this data.

All three figures show that CRT spreads greatly increased when CARES was introduced. The increase is particularly large for the high-LTV securities presented in Figure 1. Typical spreads increased three times or more. The Federal Reserve Bank of St. Louis data reproduced in figure A2 shows an even larger increase in average spreads.

Furthermore, spreads increased substantially more for securities with high exposure to judicial states. For instance, securities with above 75th percentile exposure (not depicted in the figure but available upon request) to judicial saw spreads increase of about 15 percentage points. Spreads for securities with low judicial exposure also increased, but by a smaller amount, about 11 percentage points.

The data presented in Figures 1, 1, and A2 show clearly that investors expected the forbearance program introduced with the CARES Act to increase future default losses. This expected increase was particularly pronounced in judicial states where foreclosure timelines were already longer.

If forbearance was expected to reduce defaults, then not only would the spreads have not increased, but spreads in judicial states would have declined on a relative basis. This is because the additional costs of default in the judicial states would have become less relevant to CRT investors.

Figures 1 and 1 show the opposite result. Spreads increase, especially in judicial states. Both of these findings suggest that investors expected defaults to increase in the wake of the forbearance program.

The increase in spreads is followed by a jump in 90-day delinquencies exactly 90 days after the introduction of the CARES Act. Analogous to the spread increase, the increase in delinquencies was higher for judicial states. This suggests the investors correctly predicted the increase in delinquencies, including the differential response of securities with higher and lower exposure to judicial states.

7.3 Base Case CRT Response Estimation

While the above figures are highly informative, they depict spreads without any security-level control variables. To formally identify the change in spreads and the differential change in spreads, we employ the following empirical model:

$$\begin{aligned} Spread_{i,t} = \beta_1 + \beta_2 postCARES_t + \beta_3 judicialExposure_{i,t} \times PostCARES_t \\ +\beta_4 Issuer_i + \beta_5 Issuer_i \times postCARES_t + \beta_6 Tranche_i + \beta_7 Tranche_i \times postCARES_t \\ +\beta_8 riskLayers_{i,t} + \beta_9 judicialExposure_{i,t} \end{aligned} \quad (1)$$

where $Spread_{i,t}$ denotes the spread of CRT tranche i at time t, computed as the yield to maturity minus the 1-month LIBOR rate. We use the 1-month LIBOR rate because this is the reference rate used in the CRT documentation at the time. $JudicialExposure_{i,t}$ denotes the percent of the outstanding mortgage balance that is in judicial states for security i at time t and $PostCARES_{i,t}$ is an indicator variable that takes the value of 1 on March 30, 2020 and thereafter. The CARES Act became law on March 27, 2020, which falls on a Friday. March 30 and 31 are the first trading days following the CARES Act. $Issuer_i$ and $Tranche_i$ are indicator variables that encode each issuer and tranche. The issuer is either Fredie Mac or Fannie Mae. Tranche encodes one of the following two categories that describe the tranche: B1 or B2. One of the issuers has tranches that have slightly different designations. We convert those to B1 or B2 based on their subordination level.

Finally, the variable $riskLayers$ is a summary measure of the weighted average risk layer for each loan. The loan-level risk layer is computed by the issuer and captures risk characteristics such as low FICO, high DTI, and/or high LTV. Table A1 in the Appendix demonstrates that the risk layers variable is nearly perfectly correlated with FICO, DTI, and LTV thus making it an appropriate summary statistic for all risk factors.

We interact issuer and tranche with the post-CARES indicator variable to account for potential differences in how issuers implemented the forbearance program and the different exposure of different tranches.

In addition to the above variables, we also include time and security fixed effects in some versions of the model. We identify these situations when reporting the estimation results. Security fixed effects, of course, preclude the use of security-level variables such as issuer, tranche, and risk layers.

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

Tables 2 through 5 reports the estimated coefficients for model 1. We report the results for limiting the data to two weeks, 30, 60, and 90 days around the CARES Act introduction. We estimate three models for each event windows - using security characteristics (issuer, tranche, and risk layers), using security fixed effects, and using security characteristics and errors clustered on each deal. For this estimation we keep judicial exposure as calculated end of March, 2020 to ensure the estimated effect is due to spread variation rather than change in exposure.

The results in Tables 2 through 5 show that both the post-CARES coefficient and the interaction between judicial exposure and post-CARES are highly significant in all event windows. The estimated coefficient for post-CARES Act of 12.89 in model (1) in Table 2, for instance, means that spreads increased by 12.89 percentage points on the introduction of the CARES Act at the end of March 2020. The judicial exposure is demeaned (subtracting the mean exposure), so the interaction has no impact for the average exposure security. For each additional 1 percentage point increase in judicial exposure, the spread increases approximately 0.57 percentage points on the CARES introduction.

Model (2) estimates the same model as model (1) by clustering the standard errors by CRT security. Model (3) includes CRT fixed effects and model (4) CRT fixed effects with clustered standard errors. Models (5) and (6) include additionally day fixed effects, with model (6) clustering the standard errors by CRT security.

Although clustering the errors in this manner handles potential serial correlation in the residuals, we note that this is unlikely to work well given that our data contains only 75 securities. Moreover, as Abadie et al. (2023) show "... 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...” This is of course the case in our analysis, as the securities in the sample are the same as the securities in the population. Furthermore, Cameron and Miller (2015) show that within cluster serial correlation can be captured by explanatory variables. We believe is the case in our analysis since the time fixed effects and the security fixed effects or security characteristics capture potential serial correlation. Therefore, we provide the clustering results primarily as a robustness check.

In addition to the high level of significance of the coefficient estimates of interest, the results in Tables 2 through 5 display an important pattern. Both the post-CARES base effect and the interaction effect decline in magnitude (not significance) for longer event windows. This pattern captures the fact that the CRT spreads increased very substantially on the event date but slowly declined over time.

7.4 Parallel Trends

Table 9 presents a falsification/parallel trends test of our base specification. In this test we set the event date to different (false) dates dates for 12 months prior to the introduction of the CARES Act. Out of the 12 false event dates, only two show positive and significant estimates of the post-event coefficient. Even then, the point estimate is small (.53%), while the coefficient corresponding to the CARES introduction is 11.38% or higher. There are no positive and significant interaction coefficient estimates.

In short, the positive and significant effects occur on the day of CARES introduction, and only on that day.

7.5 Additional Robustness Checks

Tables 2 through 9 already present several model specifications and falsification tests. We consider further model variations, presented in the Appendix.

For instance, in addition to measuring the exposure of each security to judicial states as a continuous variable we consider indicator variables that take the value of 1 if exposure is above the median exposure and 0 otherwise. These results are presented in Table A2.

We also consider specifications in which the indicator variable takes the value of 1 if the security’s exposure to judicial states is above the 75th percentile and 0 if below the 25th percentile. Securities with exposure between the 25th and 75th percentiles are excluded in these specifications. Table A3 presents those results.

All robustness specifications considered show some variation in point estimates, but the overall sign and significance of the post-CARES and the interaction coefficients remains unchanged. This gives us confidence that the findings reported in our main analysis are robust to model specification and data selection.

8 CRT Spreads and Default Risk

We develop a model that maps mortgage rates into mortgage default risk to derive an estimate of the investors' expectation of default risk after the forbearance policy was enacted. Using a zero-profit condition for mortgage lenders, we solve for default probabilities, given market-implied mortgage rates and the location of the house in a judicial or non-judicial state. We use the model to infer the magnitude of the change in investors' default expectations that is consistent with the CRT spread increase after the CARES Act.

8.1 Setup

We model mortgages as long-term, fixed-rate loans, as in Campbell and Cocco (2015) and Garriga, Kydland and Šustek (2017). Mortgage lenders are risk neutral and compete loan by loan. They originate mortgages at time $t = 0$, with a fixed term k. We denote by M_t the loan balance, by r^m the mortgage rate and by x the fixed payment. Thus, the annuity formula implies

$$M_0 = \frac{x}{r^m}\left(1 - (1 + r^m)^{-k}\right). \tag{2}$$

Borrowers default each period with probability $0 \leq \pi_t \leq 1$. In case of default the borrower makes no more payments and the lender recovers a fraction $0 \leq (1 - \delta) \leq 1$ of the value of the house posted as collateral (PH). The parameter δ is the expected deadweight loss from default. This foreclosure cost captures various expenses that lenders incur throughout the process. Moreover, foreclosed properties usually appreciate less than the area average and they are sold at a price lower than the market value, which is a source of loss for the lender.[5] We can write recursively the value at t of an outstanding mortgage right after a payment is been

[5]During the period of the study (2017–2021) the U.S. housing market experienced notable appreciation, which we assume it offset the usual housing depreciation rate. Thus, the model does not include a separate parameter for annual depreciation of the housing structures.

made as

$$M_t = (1 + r^d + r^w)^{-1}[(1 - \pi_t)(x + M_{t+1}) + \pi_t \min\{(1 - \delta)PH, x + M_{t+1}\}], \tag{3}$$

where the first term on the right-hand side is the expected loan balance if the borrower makes the next payment. That is the probability of repayment $(1 - \pi_t)$, multiplied by the discounted value of the next period payment (x) and the loan balance the following period (M_{t+1}). We discount using the funding and operating cost rate $r^d + r^w$. The second term is the discounted probability of borrower's default multiplied by the recovery value of the house $(1 - \delta)PH$. Since the recovery value of the house might be larger than the mortgage balance, the minimum operator ensures that borrowers in default do not overpay. In other words, in case of default the maximum received by the lender is the the outstanding mortgage balance.

Competition among lenders ensures that mortgage rates are set so the expected revenue from lending covers the lender's costs. We assume that lenders need to cover every period a constant funding cost r^d (e.g. deposits or warehouse funding) and constant operating costs r^w (e.g. origination and servicing costs) that are proportional to the outstanding mortgage. The zero-profit condition implies that, if there is no default risk $(\pi = 0)$, the lenders would charge $r^m = r^d + r^w$. That is, the mortgage rate would cover exactly the funding and operating costs. In the presence of a positive probability of default, the lenders charge an additional fee (r^g) above funding and operating costs, to cover the expected loss.

The goal of the model is to solve endogenously for default probabilities. We assume as exogenous the mortgage size, mortgage rates, home values and discount rates. We refer to the mortgage rates as *market-implied* mortgage rates, since there dynamics are determined by the yields in the CRT market. We also define the market-implied guarantee fee (g-fee or r^g) as the excess of the mortgage rate over the cost of funds and operating cost of the lender. That is,

$$r^g = r^m - r^d - r^w. \tag{4}$$

The g-fee is the part of the mortgage rate that compensates for the credit risk. Our definition assumes that the total g-fee is ongoing and there is no upfront g-fee.

8.2 Model Parameters

Table 7 summarizes the calibration of the model parameters. We set the mortgage term $k = 10$ years to approximate the term of the CRT securities. Our key results are robust to different mortgage terms. We set the loan-to-value ratio to be 83.2%, which is the average ratio for the loans we study and we standardize the loan size to 1.

We set the pre-CARES Act mortgage rate to be $r^m = 3.47\%$, the average 30-year fixed mortgage rate in February 2020 (Freddie Mac 2025). Moreover, we select the level of default probability pre-CARES Act to be constant each period. We set $\pi_{monthly} = 0.83\%$, consistent with the average defaults of fixed-rate agency mortgages originated between 1999 and 2019. We convert the default rate to an annual rate, using $\pi = \sum_{i=1}^{12} \pi_{monthly}(1 - \pi_{monthly})^{i-1}$.

We set two different parameters for the deadweight loss, δ_j and δ_n, for judicial and non-judicial states respectively, to capture the different cost of foreclosure. The judicial requirement raises the lender foreclosure cost by as much as 10% of the loan balance (Pence 2006). That is, $\delta_j = 1.1(\delta_n)$. Moreover, 37.2% of the mortgage loan balance in our data is situated in judicial states, and we set the weighted average deadweight loss to be 22% of the original house price (Pennington-Cross 2006). Thus, $0.372(\delta_j) + 0.628(\delta_n) = 0.22$. Solving the last two equations, we obtain $\delta_j = 23.3\%$ and $\delta_n = 21.2\%$.

Lenders' costs $\left(r^d \text{ and } r^w\right)$ are constant as these costs are likely not affected by the CARES Act. Keeping them constant allows us to isolate and focus on the cost of credit risk. We set the cost of funds $r^d = 1.50\%$ that is the 10-year U.S. government bond yield in February 2020, the month before the CARES Act was enacted. We calibrate the operating cost to generate the discount rate of the lenders that satisfies the recursive equation (3). The calibration yields $r^w_j = 1.690\%$ for judicial states, and $r^w_n = 1.788\%$ for non-judicial states.

8.3 Market-implied default risk

Based on the previous calibration, the market implied g-fee in judicial states, pre-CARES Act is $r^g_j = 3.47\% - 1.50\% - 1.69\% = 0.28\%$ (from equation (4)). The market implied g-fee in non-judicial states, pre-CARES Act is $r^g_n = 3.47\% - 1.50\% - 1.79\% = 0.18\%$. These fees compensate for credit risk, and increase to $r^g_j = 1.21\%$ and $r^g_n = 0.37\%$ post-CARES Act. These increases are estimated to be proportional to the CRT spread increase from our difference-in-difference analysis (Model (3) in Table 3).

The CRT spread during the 30 days before the enactment of the CARES Act was 3.17% on average[6]. Our estimation shows that this spread increased by 4.33 times after the enactment of the forbearance policy, assuming the maximum level of exposure to judicial states, and by 2.01 times assuming the minimum level of exposure. The corresponding mortgage rates are is

[6]This is the fitted value of Model (3) for Post-CARES = 0. The judicial exposure level does not affect this value, since the exposure is absorbed by the fixed effects.

$r^m_{j,\ post} = 1.50\% + 1.69\% + 1.21\% = 4.40\%$ in judicial states and $r^m_{n,\ post} = 1.50\% + 1.79\% + 0.37\% = 3.65\%$ in non-judicial states.

We input the mortgage rates implied by the CRT market reaction into the calibrated model to compute the expected probability of default caused by the CARES Act. Table 8 shows the model-implied expected probabilities of default in judicial and non-judicial states.

The model-implied expected monthly probability of default in judicial states is 2.71%. This is a 226.5% increase from the baseline probability of default of 0.83%. The model-implied expected monthly probability of default in non-judicial states is 1.49%, which is 79.5% higher than the baseline.

9 Actual Default Experience

As can be seen from Figures 2 and 3, the default increase expected by CRT investors did not materialize. As shown in Figure 4, forbearance increased immediately and in parallel to increases in delinquency through the first quarter and part of the second quarter of 2020. By the second half of 2020, delinquency rates had mostly returned to pre-COVID levels at the same time as an unprecedented surge in fiscal support returned income and unemployment to pre-COVID levels.

As documented by Gerardi et al. (2022), fiscal support through additional unemployment benefits entirely compensated for income declines by mid-year 2020, by which point CRT spreads had mostly normalized. The sharpest rise in unemployment rates recorded reversed by May 2020, as shown in Figure 6, with the result that mortgage payments were resumed. If unemployment increases and income decreases had persisted and led to lower housing prices with potential negative feedback effects, delinquencies may have well led to default markets anticipated.

The GSEs and the Federal Reserve also played a role in this recovery. The Fed stepped in to increase liquidity and lower interest rates and mortgage rates in the immediate aftermath of the March 2020 liquidity crisis. Gerardi et al. (2022) shows that this intervention lowered mortgage rates and helped to stabilize mortgage and financial markets. The GSEs maintained stable g-fees, which did not reflect the increase in CRT rates. If GSEs had increased g-fees, there undoubtedly would have been further destabilization of markets (Gete, Tsourderou, and Wachter 2024). As it was, substantial fiscal support which came with a delay enabled those delinquent borrowers with loans in forbearance to repay, which they substantially did in May

2020. In Table ??, we show recovery rates and the impact of the forbearance program on recovery rates. Recoveries of loans that were in forbearance skyrocketed in May 2020 as fiscal support surged.

This positive outcome occurred due to the fiscal support, high housing prices and equity, and the structure of the mortgage industry at the time of the COVID shock. The GSEs were able to offer forbearance, absorbing the loss in income due to the nonpayment of delinquent loans without raising their g-fees. In a privatized system, the liquidity provisions of the GSEs might not have been possible with the potential for further destabilization of the mortgage market, prior to the provision of fiscal support. Fiscal stimulus policies were put into place along with forbearance in this national health crisis, similar to the way forbearance followed by insurance and FEMA assistance supports borrowers in default in natural disasters. The GSEs subsidized borrowers in this period.In conservatorship under government ownership they were able to help stabilize the mortgage market before the federal government stepped in with fiscal stimulus to ultimately reverse the rise in delinquencies.

This level of federal support was unprecedented. The precedent, however, does not establish a future likely outcome in response to a credit shock. The results of this paper showing the sharp rise in delinquency in CRT rates point to the potential of destabilization through negative feedback effects of rising CRT risk spreads, which could very well be incorporated into mortgage pricing.

10 Conclusions

Our work presents evidence that CRT spreads vastly increased at the time of the CARES Act introduction, especially for securities with high exposure to judicial states. The theoretical considerations discussed in Section 3 imply that the increase in spreads reflects an expectation of increased future default losses. Therefore, our work shows that the forbearance program introduced with the CARES Act increased the expectation of future default losses.

We also document that this expectation was correct at least in terms of future delinquencies. We find that the 90-day delinquencies significantly increased 90 days after the introduction of the CARES Act.

Taken together, our findings identify a cost to large-scale forbearance programs. This cost has not been identified or estimated in the prior literature.

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Figures

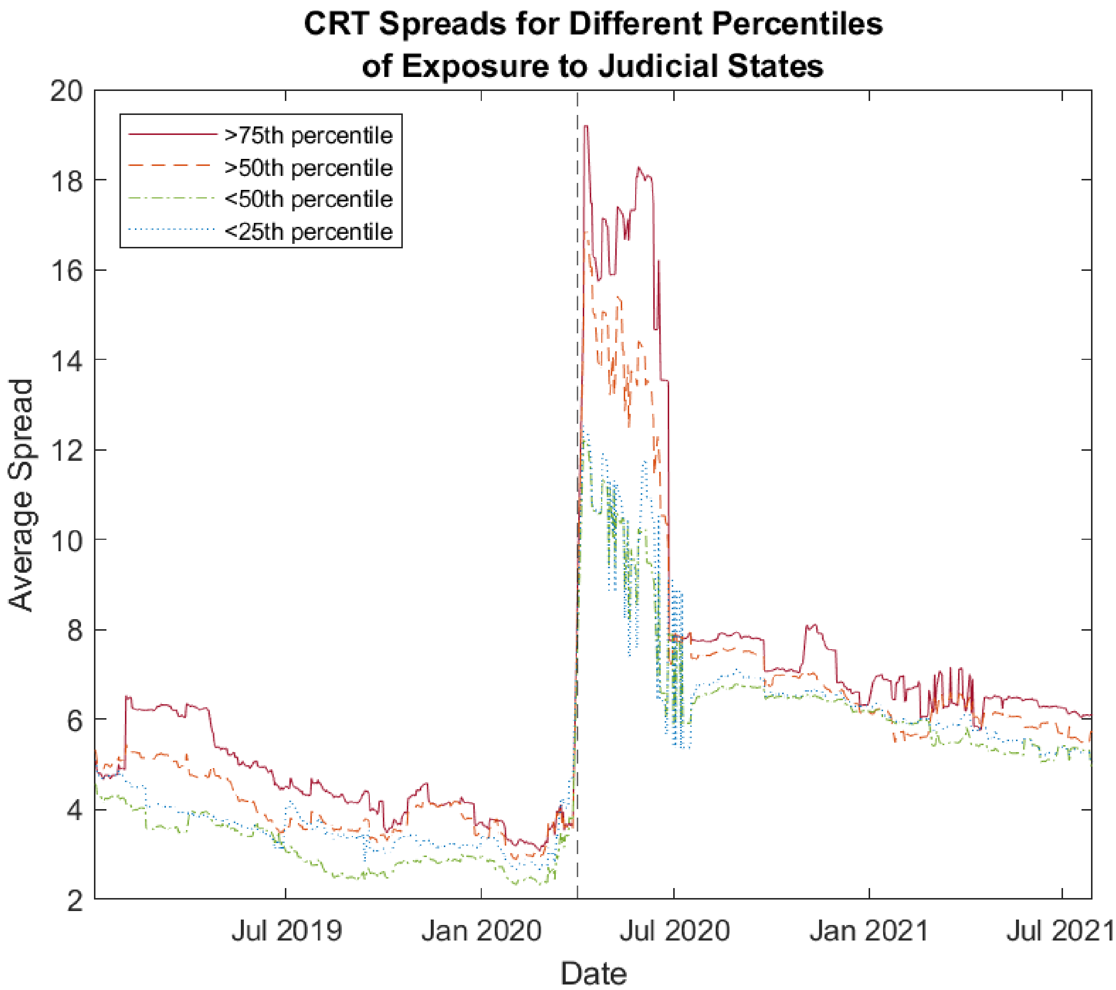

Figure 1. CRT Daily Spreads by Exposure to Judicial States. This figure depicts the average junior tranche CRT spread for securities containing below 80% loans. The two lines peaking on March 31, 2020 depict the spreads and the two lines peaking after July, 2020 depict the 90-day delinquency rates. The solid lines are for securities with above-median exposure to judicial states. The dashed lines are for below-median exposure. The vertical line denotes the first trading day following the CARES Act introduction. This figure uses securities issued between 2017 and 2019, inclusive. The Appendix presents an analogous figure that includes all available securities.

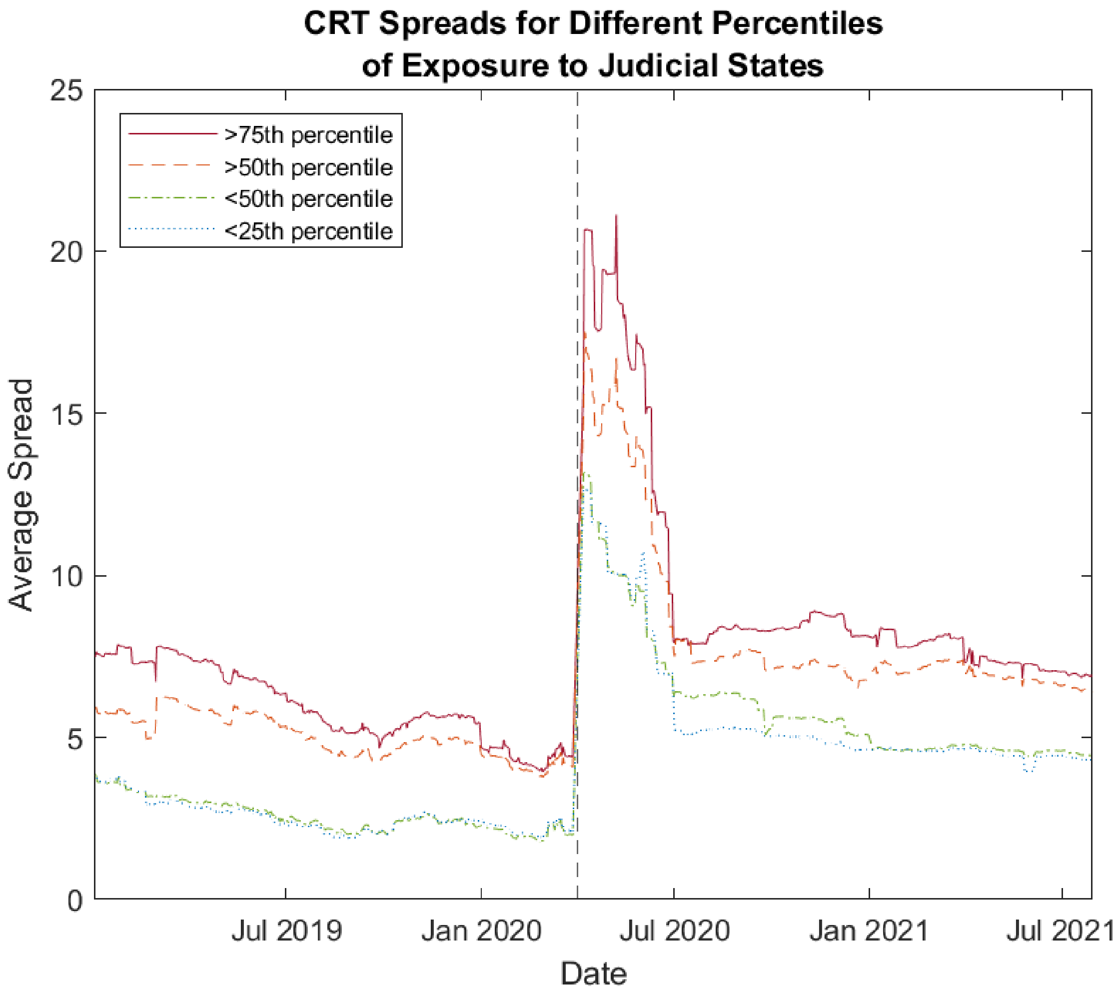

Figure 1: This figure depicts the average junior tranche CRT spread for securities containing 80% or higher LTV loans. The two lines peaking on March 31, 2020 depict the spreads and the two lines peaking after July, 2020 depict the 90-day delinquency rates. The solid lines are for securities with above-median exposure to judicial states. The dashed lines are for below-median exposure. The vertical line denotes the first trading day following the CARES Act introduction. This figure uses securities issued between 2017 and 2019, inclusive. The Appendix presents an analogous figure that includes all available securities.

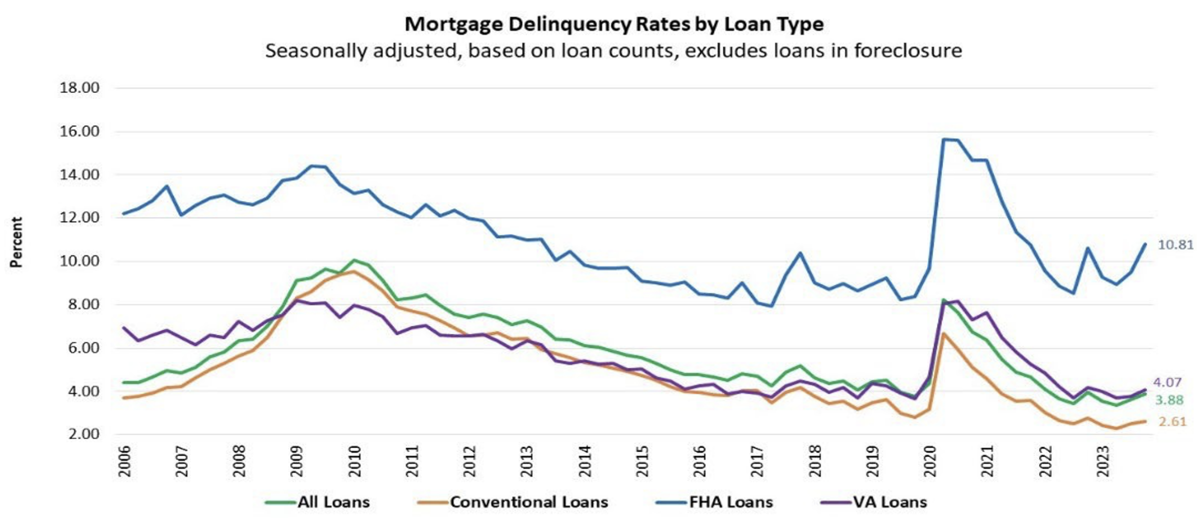

Figure 2: Mortgage delinquency rates by loan type. Source: MBA National Delinquency Survey. (Pavlov and Wachter, 2024)

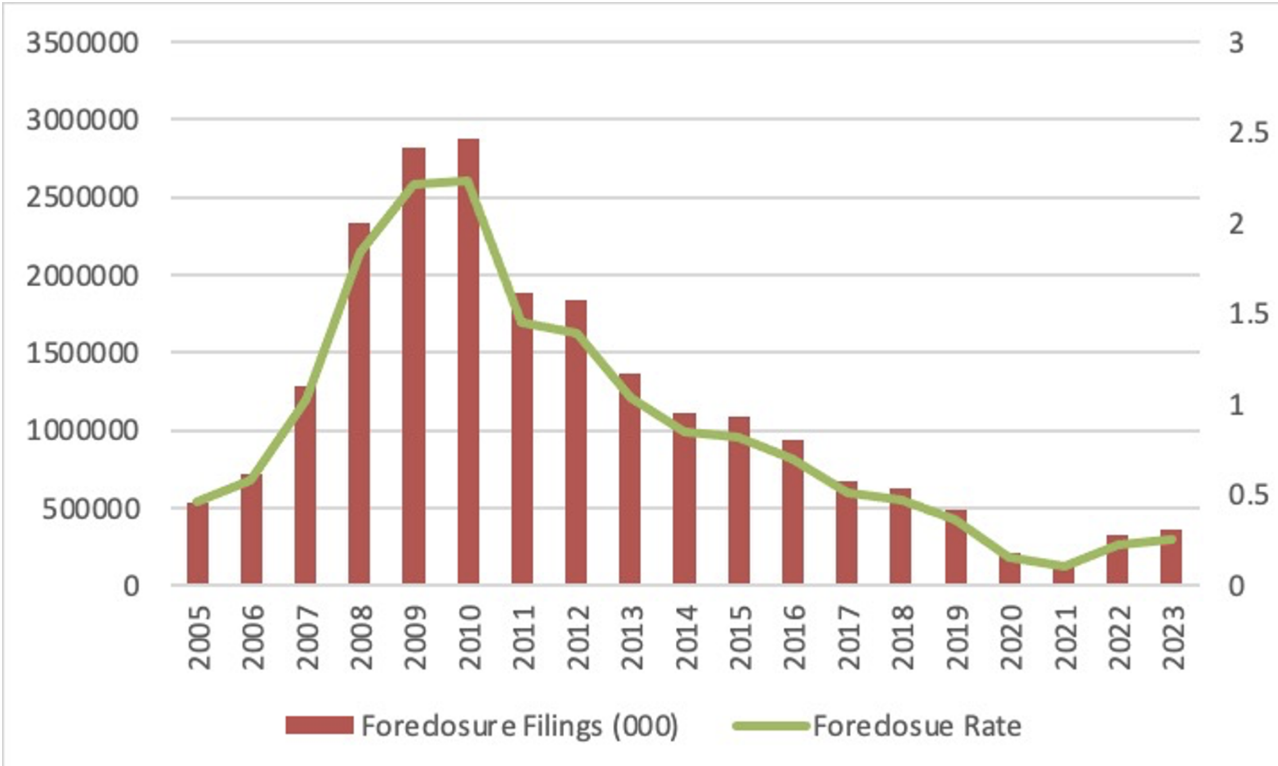

Figure 3: Great Financial Crisis foreclosure filings and rates. Source: ATTOM data. (Pavlov and Wachter, 2024) (We do NOT yet have permission to reproduce this figure, but will seek permission from the NBA.)

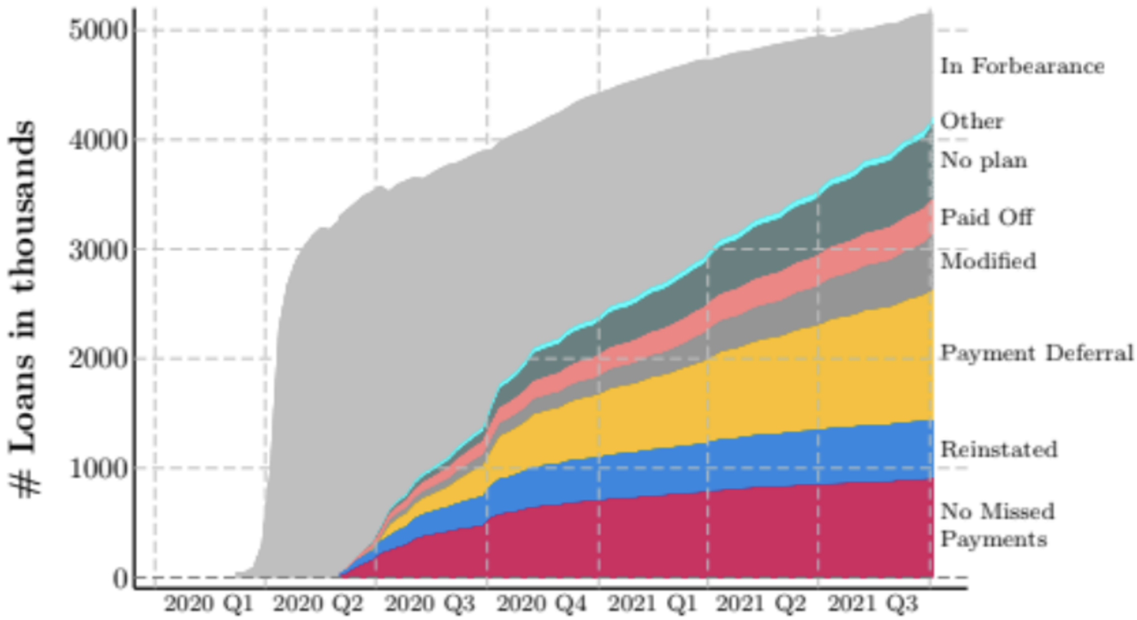

Figure 4: Forbearance Outcomes

Tables

Table 1. Descriptive Statistics

	Observations	Mean	Std. Dev.	Min	Max
CRT Spread (%)	2,918	8.343	8.220	0.023	62.18
Post CARES Indicator	2,918	0.486	0.500	0	1
Judicial Exposure (%)	2,918	34.75	3.424	25.82	41.19
FICO Credit Score	2,918	740.7	6.027	728.6	753.8
Loan-to-Value Ratio	2,918	0.832	0.086	0.747	0.933
Debt-to-Income Ratio	2,918	0.367	0.015	0.336	0.389
Risk Layers	2,918	0.490	0.269	0.085	0.944
Issuer (1 = Fannie)	2,918	0.574	0.495	0	1
10-Year Treasury Rate (%)	2,918	0.780	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 75 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 31, 2020. The CRT spread is calculated as the yield to maturity minus the one-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.

Table 2. CARES Act Impact on CRT Spreads: 2-Week Window

	Dependent Variable: CRT Spread					
	(1)	(2)	(3)	(4)	(5)	(6)
Post-CARES	12.893***	12.893***	11.265***	11.265***		
	(0.851)	(1.826)	(0.332)	(0.971)		
Exposure × Post-CARES	0.566***	0.566**	0.523***	0.523**	0.523***	0.523**
	(0.101)	(0.232)	(0.076)	(0.259)	(0.076)	(0.260)
Treasury Rate	Yes	Yes	Yes	Yes	No	No
CRT Features	Yes	Yes	No	No	No	No
CRT Fixed Effects	No	No	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	Yes	Yes
Clustered Errors	No	Yes	No	Yes	No	Yes
Observations	1,200	1,200	1,200	1,200	1,200	1,200
Adj R Squared	0.608	0.608	0.710	0.710	0.708	0.708
Event Window	2 Weeks	2 Weeks	2 Weeks	2 Weeks	2 Weeks	2 Weeks

This table reports the results from the estimation of Equation (1), for a 2-week event window. The spread and 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, and zero otherwise. Exposure is the percentage of unpaid principal balance within each CRT mortgage pool that is located in judicial states. The CRT features control for the following: issuer, tranche seniority (junior or first loss), risk layer (a continuous variable that combines the weighted average loan-to-value, debt-to-income and FICO score of the CRT pool), and their interactions with the post-CARES indicator. The event window shows the number of days before and after March 31, 2020. The sample consists of the junior tranches of CRT securities issued between 2017 and 2019. We present the results with robust or security-clustered errors. ***p<0.01; **p<0.05.

Table 3. CARES Act Impact On CRT Spreads: 30-Day Window

	Dependent Variable: CRT Spread					
	(1)	(2)	(3)	(4)	(5)	(6)
Post-CARES	10.868***	10.868***	10.644***	10.644***		
	(0.568)	(1.596)	(0.226)	(0.910)		
Exposure × Post-CARES	0.451***	0.451**	0.478***	0.478*	0.478***	0.478*
	(0.067)	(0.187)	(0.048)	(0.252)	(0.048)	(0.253)
Treasury Rate	Yes	Yes	Yes	Yes	No	No
CRT Features	Yes	Yes	No	No	No	No
CRT Fixed Effects	No	No	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	Yes	Yes
Clustered Errors	No	Yes	No	Yes	No	Yes
Observations	2,918	2,918	2,918	2,918	2,918	2,918
Adj R Squared	0.572	0.572	0.704	0.704	0.705	0.705
Event Window	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days

This table reports the results from the estimation of Equation (1), for a 30-day event window. The spread and 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, and zero otherwise. Exposure is the percentage of unpaid principal balance within each CRT mortgage pool that is located in judicial states. The CRT features control for the following: issuer, tranche seniority (junior or first loss), risk layer (a continuous variable that combines the weighted average loan-to-value, debt-to-income and FICO score of the CRT pool), and their interactions with the post-CARES indicator. The event window shows the number of days before and after March 31, 2020. The sample consists of the junior tranches of CRT securities issued between 2017 and 2019. We present the results with robust or security-clustered errors. ***p<0.01; **p<0.05; *p<0.10.

Table 4. CARES Act Impact On CRT Spreads: 60-Day Window

	Dependent Variable: CRT Spread					
	(1)	(2)	(3)	(4)	(5)	(6)
Post-CARES	8.511***	8.511***	9.902***	9.902***		
	(0.360)	(1.376)	(0.167)	(0.816)		
Exposure × Post-CARES	0.397***	0.397***	0.502***	0.502**	0.501***	0.501**
	(0.042)	(0.149)	(0.033)	(0.207)	(0.033)	(0.208)
Treasury Rate	Yes	Yes	Yes	Yes	No	No
CRT Features	Yes	Yes	No	No	No	No
CRT Fixed Effects	No	No	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	Yes	Yes
Clustered Errors	No	Yes	No	Yes	No	Yes
Observations	6,016	6,016	6,016	6,016	6,016	6,016
Adj R Squared	0.645	0.645	0.701	0.701	0.702	0.702
Event Window	60 Days	60 Days	60 Days	60 Days	60 Days	60 Days

This table reports the results from the estimation of Equation (1), for a 60-day event window. The spread and 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, and zero otherwise. Exposure is the percentage of unpaid principal balance within each CRT mortgage pool that is located in judicial states. The CRT features control for the following: issuer, tranche seniority (junior or first loss), risk layer (a continuous variable that combines the weighted average loan-to-value, debt-to-income and FICO score of the CRT pool), and their interactions with the post-CARES indicator. The event window shows the number of days before and after March 31, 2020. The sample consists of the junior tranches of CRT securities issued between 2017 and 2019. We present the results with robust or security-clustered errors. ***p<0.01; **p<0.05.

Table 5. CARES Act Impact On CRT Spreads: 90-Day Window

	Dependent Variable: CRT Spread					
	(1)	(2)	(3)	(4)	(5)	(6)
Post-CARES	6.724***	6.724***	8.988***	8.988***		
	(0.300)	(1.296)	(0.151)	(0.800)		
Exposure × Post-CARES	0.291***	0.291**	0.407***	0.407**	0.413***	0.413**
	(0.034)	(0.125)	(0.028)	(0.192)	(0.027)	(0.192)
Treasury Rate	Yes	Yes	Yes	Yes	No	No
CRT Features	Yes	Yes	No	No	No	No
CRT Fixed Effects	No	No	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	Yes	Yes
Clustered Errors	No	Yes	No	Yes	No	Yes
Observations	9,180	9,180	9,180	9,180	9,180	9,180
Adj R Squared	0.609	0.609	0.658	0.658	0.679	0.679
Event Window	90 Days	90 Days	90 Days	90 Days	90 Days	90 Days

This table reports the results from the estimation of Equation (1), for a 90-day event window. The spread and 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, and zero otherwise. Exposure is the percentage of unpaid principal balance within each CRT mortgage pool that is located in judicial states. The CRT features control for the following: issuer, tranche seniority (junior or first loss), risk layer (a continuous variable that combines the weighted average loan-to-value, debt-to-income and FICO score of the CRT pool), and their interactions with the post-CARES indicator. The event window shows the number of days before and after March 31, 2020. The sample consists of the junior tranches of CRT securities issued between 2017 and 2019. We present the results with robust or security-clustered errors. ***p<0.01; **p<0.05.

Table 6 Falsification Test

	Dependent Variable: CRT Spread									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	**(10)**
Event Name	June2019	July2019	Aug2019	Sep2019	Oct2019	Nov2019	Dec2019	Jan2020	Feb2020	**Mar2020 CARES Act**
Post-Event	-0.18	-0.20*	-0.10	0.04	0.17***	-0.12	-0.19***	-0.36***	0.53***	**11.38*****
	(0.14)	(0.11)	(0.10)	(0.17)	(0.05)	(0.10)	(0.05)	(0.11)	(0.12)	**(1.69)**
Exposure × Post-Event	-1.86	-1.49	-4.81	-3.74	1.72	0.58	-2.03	-3.21	3.05	**87.80****
	(3.62)	(2.70)	(4.70)	(4.94)	(1.16)	(2.85)	(3.05)	(2.85)	(3.25)	**(42.69)**
Observations	955	1,022	1,008	1,110	1,238	1,315	1,467	1,462	1,428	**1,325**
Adj R Squared	0.542	0.545	0.513	0.473	0.464	0.469	0.473	0.487	0.482	**0.471**
CRT Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**
CRT Fixed Effects	No	No	No	No	No	No	No	No	No	**No**
Clustered Errors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**Yes**
Event Window	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	**30 Days**

This table reports the same estimation as Table 3 but for different (false) event dates. The last column, model 10, reports the results for the actual CARES Act introduction. The table reports the results for the 30-day event window and continuous judicial exposure, as presented in Equation (1).

Table 7. Model Calibration

Parameter	Value	Description
Exogenous parameters		
k	10	Mortgage term in years
ltv	0.832	Loan-to-value ratio
r^d	1.50%	Lender's cost of funds: 10y government bond rate in February 2020
δ_j	23.3%	Deadweight loss in judicial states
δ_n	21.2%	Deadweight loss in non-judicial states
r^m	3.47%	Mortgage rate before CARES Act (February 2020)
Endogenous parameters		
r_j^w	1.690%	Lender's operating cost in judicial states
r_n^w	1.788%	Lender's operating cost in non-judicial states
Targets		
r_j^g	0.962%	G-fee post-CARES Act in judicial states
r_n^g	0.346%	G-fee post-CARES Act in non-judicial states

This table lists the parameters used in Section 8.

Table 8. Simulation results

State forbearance proceedings	Market-implied mortgage rate (%) r^m	Market-implied g-fee (%) r^g	Monthly default probability (%) π	Change in default probability (%)
Baseline values pre-CARES Act				
Judicial	3.470	0.280	0.83	
Non-judicial	3.470	0.182	0.83	
Post-CARES Act				
Judicial	4.403	1.213	2.71	226.5
Non-judicial	3.654	0.366	1.49	79.5

This table shows the results of the simulation using the model with the probability of defaults as inputs as described in Section 8 and the calibration from Table 7.

Table 9 Monthly Outcomes

		Loans exactly 90-days delinquent as of:												
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	To
	Loan count	257	304	362	590	2760	41130	26266	12349	8012	6671	5449	4627	108
	Liquidation rate (%)	3.89	2.32	3.31	1.53	1.05	0.15	0.15	0.24	0.43	0.28	0.32	0.38	0.
Forbearance in 2020-2023	Removal rate (%)	8.17	9.93	10.22	8.31	3.31	0.64	0.46	0.59	0.65	0.62	0.57	0.47	0.
	Still delinquent (Dec 2023, %)	15.95	23.51	19.89	17.46	11.41	1.69	1.65	2.32	3.11	3.26	4.27	4.25	2.
	Liquidation + delinquent (%)	19.84	25.83	23.20	18.99	12.46	1.84	1.80	2.56	3.54	3.54	4.59	4.63	2.
	Loan count	248	305	270	224	186	241	196	183	191	215	190	224	26
	Liquidation rate (%)	8.87	9.45	12.22	12.95	11.40	3.32	2.58	2.81	4.44	5.92	5.11	6.39	7.
No Forbearance in 2020-2023	Removal rate (%)	5.65	6.84	8.89	6.70	8.29	2.15	1.85	0.88	1.01	0.71	3.41	1.47	4.
	Still delinquent (Dec 2023, %)	6.05	4.89	6.30	6.70	6.74	2.34	3.32	2.81	4.65	5.92	7.39	7.62	5.
	Liquidation + delinquent (%)	14.92	14.34	18.52	19.65	18.14	5.66	5.90	5.62	9.09	11.84	12.50	14.01	12

This table reports the outcomes of loans that were 90 days delinquent in each month of 2020, split into forbearance and “no forbearance” groups. Each loan is followed until it leaves the data or until December 2023, whichever happens first. Recovery is defined as 6 months of current payments, measured at the start of the 6-month period, or loan prepayment, whichever happens first. Recovery represents the remainder of loans in the table to 100%. The last row in each group, ”Liquidation + delinquent” is analogous to the Goodman and Zhu (2024) definition of liquidation, which includes loans that were 6 months delinquent at the end of their data sample. Our preferred definition is reported on the second line of each category, ”Liquidation rate,” which uses the liquidation definition in the data. Loans that left the data because of repurchase or sale are reported on the third line,

”Removal rate,” and loans that were still delinquent as of December 2023 are reported in the fourth line (Pavlov and Wachter 2024).

A Additional Robustness Analysis

This appendix presents further details about the data and additional robustness analysis.

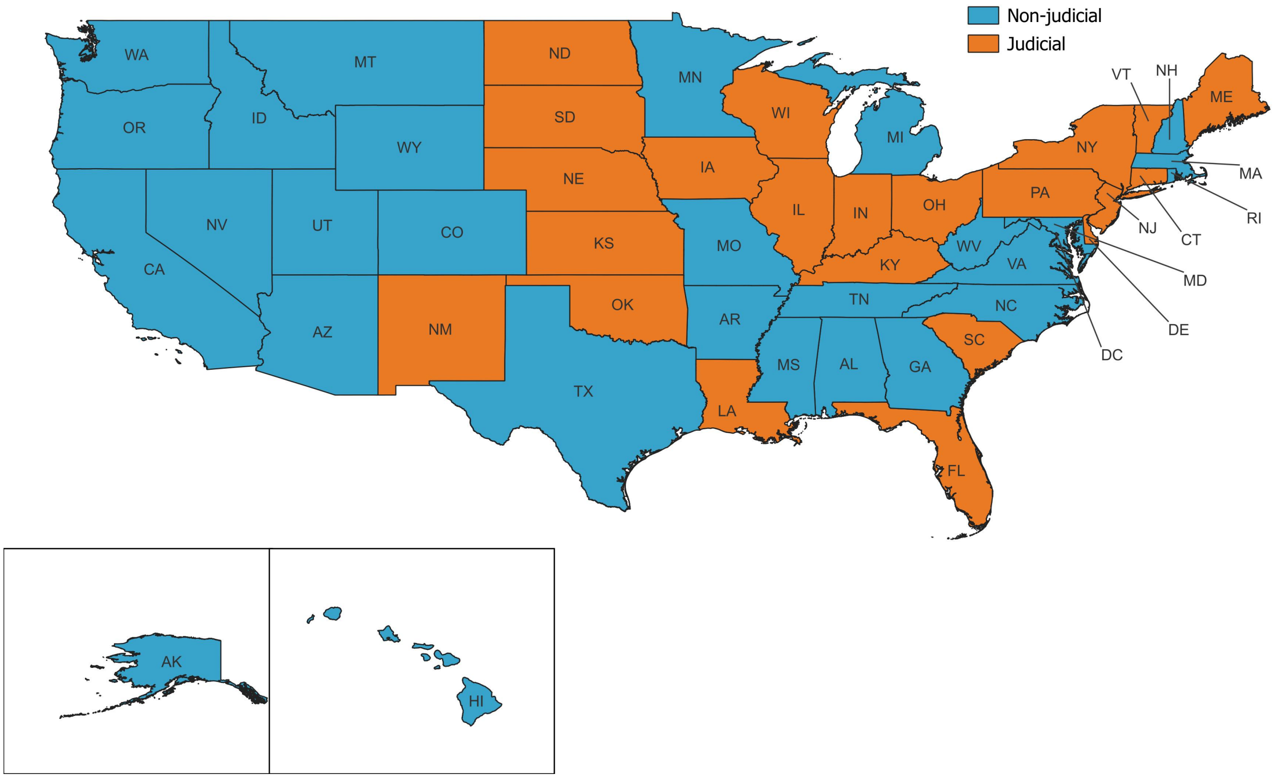

Figure A1: This figure displays the states with judicial and non-judicial foreclosure requirements, which follows Fout et al. (2017)

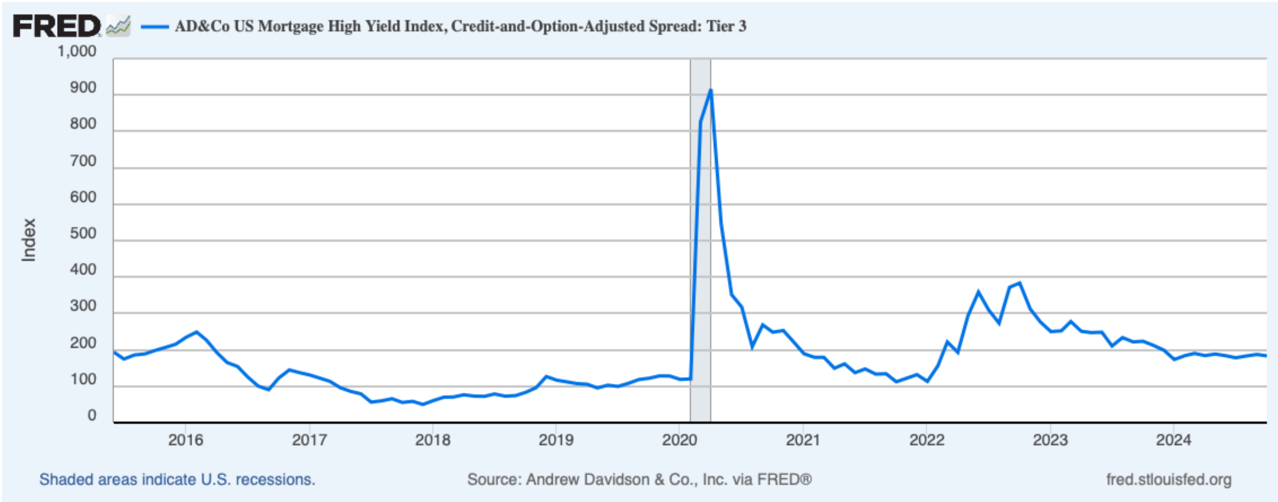

Figure A2: This figure reproduces data from the Federal Reserve Bank of St. Louis, which tracks the average spreads on CRT securities.

Table A1 Correlation Matrix

	FICO	LTV	CLTV	DTI	Rate	Risk Layers
FICO	1	-0.94	-0.94	-0.89	-0.91	-0.87
LTV	-0.94	1	1	0.81	0.86	0.82
CLTV	-0.94	1	1	0.81	0.85	0.82
DTI	-0.89	0.81	0.81	1	0.87	0.97
Rate	-0.91	0.86	0.85	0.87	1	0.79
Risk Layers	-0.87	0.82	0.82	0.97	0.79	1

Correlation matrix for loans with LTV ratio of 80% or above (Group 2). Contains data for all junior tranche issuances with origination dates between 2017 and 2019. The "Risk Layers" variable is computed by the issuers and is a summary risk score that incorporates low FICO, high DTI, and/or high LTV loans.

Table A2 Alternative Exposure Definition

	Dependent Variable: CRT Spread											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Post-CARES	11.34***	10.76***	11.34***	9.76***	10.00***	9.76***	7.97***	8.74***	7.97***	6.57***	7.75***	6.57***
	(0.73)	(0.37)	(1.97)	(0.52)	(0.27)	(1.81)	(0.32)	(0.16)	(1.38)	(0.25)	(0.14)	(1.12)
Exposure × Post-CARES	2.87**	2.10***	2.87	2.27***	2.33***	2.27	2.27***	3.07***	2.27**	1.72***	2.58***	1.72**
	(1.16)	(0.68)	(2.24)	(0.71)	(0.48)	(1.54)	(0.42)	(0.32)	(1.03)	(0.32)	(0.25)	(0.75)
Observations	680	680	680	1,325	1,325	1,325	2,731	2,731	2,731	4,179	4,179	4,179
Adj R Squared	0.466	0.724	0.466	0.463	0.714	0.463	0.527	0.707	0.527	0.511	0.670	0.511
CRT Characteristics	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
CRT Fixed Effects	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Clustered Errors	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Event Window	2 Weeks	2 Weeks	2 Weeks	30 Days	30 Days	30 Days	60 Days	60 Days	60 Days	90 Days	90 Days	90 Days

This table replicates Tables 2 through 5 except that the judicial exposure is measured as an indicator variable that takes the value of one if exposure is above the median and zero otherwise. The table uses 2017-2019 high-LTV (Group 2) issues.

Table A3 Alternative Exposure Definition

	Dependent Variable: CRT Spread											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Post-CARES	11.52***	10.19***	11.52***	9.75***	9.62***	9.75***	8.06***	8.82***	8.06***	6.40***	7.77***	6.40***
	(1.00)	(0.51)	(2.87)	(0.72)	(0.37)	(2.64)	(0.47)	(0.23)	(2.00)	(0.37)	(0.20)	(1.64)
Exposure × Post-CARES	8.14***	5.19***	8.14***	6.20***	5.37***	6.20***	4.70***	5.38***	4.70***	3.00***	4.35***	3.00**
	(2.33)	(1.13)	(1.56)	(1.54)	(0.80)	(1.23)	(0.95)	(0.53)	(1.27)	(0.70)	(0.42)	(1.33)
Observations	420	420	420	814	814	814	1,616	1,616	1,616	2,478	2,478	2,478
Adj R Squared	0.438	0.708	0.438	0.436	0.700	0.436	0.507	0.692	0.507	0.485	0.650	0.485
CRT Characteristics	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
CRT Fixed Effects	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Clustered Errors	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Event Window	2 Weeks	2 Weeks	2 Weeks	30 Days	30 Days	30 Days	60 Days	60 Days	60 Days	90 Days	90 Days	90 Days

This table replicates Tables 2 through 5 except that the only observations with judicial exposure below the 25th and above the 75th percentiles is included. The exposure variable takes the value of one for high-exposure securities and 0 otherwise. The table uses 2017-2019 high-LTV issues (group 2).

B Delinquency Experience

In addition to the spread response at the time of CARES introduction, we also analyze the 90-day delinquency change. The event date in this case is June 30, 2020, 90 days after the CARES Act was introduced.

Since the delinquency data is updated monthly and at the deal level, rather than the tranche level, this estimation is based on far fewer observations. As a result, we limit the number of variables and estimate a basic model, as follows:

$$\begin{aligned} DelinquencyRate_{i,t} = \beta_1 + \beta_2 postEvent_t + \beta_3 judicialExposure_{i,t} \times PostEvent_t + \\ \beta_4 Issuer_i + \beta_5 riskLayers_{i,t} + \beta_6 judicialExposure_{i,t} \end{aligned} \tag{5}$$

Table A4 reports the post event and the interaction coefficients as estimated on July 30, August 30, or September 30, relative to June 30, 2020. We report the results using continuous definition of judicial exposure as well as using an indicator variable that takes the value of one if exposure is above median and zero otherwise.

Delinquencies jump immediately after the event date, meaning many borrowers stopped making payments just a few days after the CARES Act. The July 30th interaction coefficient is not significant, but still positive and sizeable. After that, both the level and the interaction coefficients are highly significant.

Table A4 reports the estimation results from the same regression model, except with different, false, event dates. For instance, the first implementation, labeled "Mar 2020", captures the 90-day delinquencies reported during March, 2020, meaning between end of February and end of March.

The delinquency rates increased substantially relative to the previous month in July, August, and September, especially in judicial states. June also shows a statistically significant increase, but the coefficient is small, one-tenth of the coefficient for July.

The R-squared statistic also presents an interesting pattern - the deal characteristics and judicial exposure explain only about 30% of the delinquency variation prior to July, 2020. After that, it explains 95% of the variation. This indicates delinquencies prior to July were mostly random, while delinquencies after that were closely tied to the deal characteristics and judicial exposure.

The above results show that the CARES Act had a significant impact not only on the immediate CRT spreads, but also on the subsequent delinquencies. Therefore, the CRT investors did not simply over-react to the CARES Act. Instead, they correctly predicted the increase in delinquencies, and that this increase would be bigger in judicial states. If any over-reaction occurred, it may have been in the magnitude of the delinquency increase. However, even this conclusion is debatable because the eventual delinquencies were influenced by the strong increase in home prices and the relatively muted economic slowdown. CRT investors would have had no way to predict these positive influences on March 27 when the CARES Act was introduced. Therefore, we see no evidence of investor over-reaction.

Table A4 Probability of 90 days delinquency at different points in time

	Dependent Variable: 90-day Delinquency Rate		
Days After June 30	30	60	90
Post-Event	0.0391***	0.0536***	0.0586***
	(0.0023)	(0.0025)	(0.0026)
Exposure × Post-Event	0.0717	0.1888***	0.2566***
	(0.0567)	(0.0608)	(0.0663)
Observations	38	38	38
Adj R Squared	0.957	0.970	0.974
CRT Characteristics	Yes	Yes	Yes
CRT Fixed Effects	No	No	No
Clustered Errors	No	No	No

Model 5 estimation results. We compare the 90-day delinquency rate measured 30, 60, or 90 days past June 30 to the delinquency rate as of June 30, 2020. For instance, the first regression compares the 90-day delinquency rate on July 31st to that on June 30th. June 30th is 90 days past the introduction of the CARES Act and the first 90-day delinquencies in response to the CARES Act would be reported between June 30 and July 31. We report the results from using continuous judicial exposure.

Table A4 Delinquency Time Pattern

	Dependent Variable: 90-day Delinquency Rate										
	Pre-CARES Delinquencies			Post-CARES Delinquencies							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Event Month	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021
Post-CARES	0.0002	0.0003	0.0008	0.0036***	0.0391***	0.0145***	0.0050***	0.0001	-0.0006	0.0025	0.0011
	(0.0006)	(0.0005)	(0.0005)	(0.0006)	(0.0023)	(0.0018)	(0.0016)	(0.0016)	(0.0016)	(0.0018)	(0.0019)
Exposure × Post-CARES	0.0024	0.0077	0.0036	0.0013	0.0717	0.1172**	0.0678**	0.0172	0.0284	0.0397	0.0292
	(0.0138)	(0.0132)	(0.0134)	(0.0138)	(0.0567)	(0.0469)	(0.0318)	(0.0299)	(0.0299)	(0.0342)	(0.0378)
Observations	38	38	38	38	38	38	38	38	38	38	38
Adj R Squared	0.315	0.276	0.312	0.698	0.957	0.974	0.940	0.912	0.904	0.896	0.894
CRT Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CRT Fixed Effects	No	No	No	No	No	No	No	No	No	No	No
Clustered Errors	No	No	No	No	No	No	No	No	No	No	No
Event Window	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days	30 Days

This table repeats the estimation presented in Table A4 with a continuous definition of exposure for alternative (false) event dates. For instance, the first implementation, labeled "Mar 2020", compares the delinquency rates at the end of March to those at the end of February. In other words, the first model captures the delinquencies that occurred during March, 2020.