# Recourse as Shadow Equity: Evidence from Commercial Real Estate Loans*

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**Abstract**

We study the role that recourse plays in the commercial real estate loan contracts of the largest U.S. banks. We find that recourse is valued by lenders as a substitute for conventional equity. At origination, recourse loans have rate spreads that are 20 basis points lower and loan-to-value ratios that are almost 3 percentage points higher than non-recourse loans. Dynamically, recourse affects loan modification negotiations by providing additional bargaining power to the lender. Recourse loans were half as likely to receive accommodation during the COVID-19 pandemic, and the modifications that did occur entailed a relatively smaller reduction in payments.

**Keywords:** commercial real estate, recourse, LTV
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# 1. INTRODUCTION

The commercial real estate market provides a valuable setting for exploring the economic incentives between borrowers and lenders. In particular, commercial mortgages have characteristics that make them uniquely vulnerable to strategic default: the market is illiquid, foreclosure is costly, and borrowers are sophisticated enough to extract concessions from foreclosure-averse lenders. Banks are thus incentivized to structure loans to insulate themselves from such behavior.

Recourse, which gives the lender access to a borrowers' assets beyond the pledged collateral, is one method used to mitigate these risks. In theory recourse can provide significant value to banks by discouraging strategic default and increasing the recovery from a liquidation (Childs et al., 1996; Ghent and Kudlyak, 2011; Glancy et al., 2022). However, empirical evidence for such effects for commercial mortgages is lacking.

We take advantage of detailed loan-level data on the commercial real estate (CRE) portfolios of the largest U.S. banks to perform a comprehensive analysis of the value of recourse to lenders at loan origination and during loan modification negotiations. Unlike other CRE lenders, who overwhelmingly provide non-recourse loans, banks offer both recourse and non-recourse financing.[1] This heterogeneity in bank CRE loan contracts allows us to use within-lender variation to study how recourse clauses affect loan terms and outcomes relative to otherwise similar non-recourse loans.

Our analysis makes three contributions to the literature. First, we present basic (but previously undocumented) empirical facts about the prevalence of recourse in bank CRE loan portfolios and the observable differences between loans with and without recourse. Roughly three-quarters of bank CRE loans by count, and about half by value, have full or partial recourse. The most notable differences between recourse and non-recourse loans are that recourse loans tend to be smaller and have longer terms.

Second, we analyze how recourse affects the underwriting of bank CRE loans. We find that recourse enables borrowers to receive loan rate spreads that are 20 basis points lower and LTVs that are almost 3 percentage points higher than otherwise similar loans. The results suggest that banks value recourse and are willing to expand the array of loan terms available to borrowers that provide it. In return for providing lenders an additional means of recovery, recourse borrowers are able to achieve lower spreads and higher leverage.

Though these findings are robust to a battery of risk controls, our OLS estimates may be biased due to recourse being correlated with unobserved risk-factors. The expected direction of this bias is unclear. On one hand, banks may use recourse to mitigate other

[1] CMBS loans are bankruptcy remote by design and therefore non-recourse outside of "bad boy" clauses, which trigger recourse in the event of a particular bad act (such as fraud) on the part of the borrower.

unobserved risks. This behavior would cause recourse loans to be riskier on unobserved dimensions, biasing the estimated effects of recourse toward zero. On the other hand, safer borrowers may provide recourse as a signal of quality. In this case, recourse loans would have safer unobservables, thus inflating the estimated benefits of recourse.

We address this identification issue in three ways. First, we establish that the use of recourse at loan origination has no ability to predict ex-post net operating income (NOI) growth or volatility.[2] Second, we demonstrate that estimated effects of recourse are undiminished when using banks' tendency to require recourse for observably similar loans as an instrument—thus identifying off lender preferences rather than borrower-specific underwriting. Last, we show that our results are robust to estimation by propensity score matching. The matched-sample results provide further evidence that our findings are not driven by differences in observable characteristics.

The final contribution of our paper is to demonstrate that recourse enhances lenders' bargaining power in loan modification negotiations. Our empirical approach compares the effects of recourse on loan performance before and during the COVID-19 pandemic. In the pre-pandemic period, we find that recourse loans were modestly less likely to receive a modification or internal credit rating downgrade.[3] During the pandemic, credit rating downgrades for recourse and non-recourse loans increased in parallel, but recourse loans were half as likely to receive modifications as non-recourse loans. In other words, borrowers with recourse experienced similar levels of stress during the pandemic, but they were much less likely to receive a modification. In a second exercise examining the composition of modifications, we find that recourse loans received less borrower-friendly modifications during the pandemic. Both exercises are consistent with recourse providing lenders more bargaining power in loan modification negotiations.

Our paper is closely related to the literature on the use of recourse in real estate lending. Most empirical work on this topic focuses on residential mortgage lending, most notably Ghent and Kudlyak (2011) who show that a significant fraction of loans in the residential mortgage market are subject to recourse and this impacts borrower and lender behavior.[4] The recourse literature on commercial mortgages is largely theoretical.

[2]Different from loan performance metrics, NOI is useful as it reflects fundamental property risks that should not be affected by recourse. The risk-mitigation hypothesis and the signaling hypothesis both predict that recourse loans should fund properties with different risk characteristics than non-recourse loans. That this is not the case indicates that such effects (if they exist) are offsetting, and any bias from unobserved risk-factors is small.

[3]Banks often use loan modifications to manage risk prior to a loan becoming delinquent (see Black et al. 2017).

[4]Ghent and Kudlyak (2011) exploit variation in state-level laws on the use of recourse for owner-occupied residential mortgages and find, among other results, that recourse acts as a strategic default deterrent and induces more lender-friendly default when default does occur. Interestingly, the authors find higher interest rates on mortgages in recourse states, which they leave as a puzzle. With the more granular loan-level

The models of Childs et al. (1996), Lebret and Quan (2017) and Glancy et al. (2022) demonstrate that borrowers can achieve lower spreads or higher leverage by taking out recourse loans.[5] To our knowledge, the only other paper that empirically studies recourse in commercial mortgages is Binder and Kim (2019), who show that recourse has little ability to predict future defaults.[6]

More broadly, we also contribute to the literature examining the role of collateral in the underwriting of commercial loans. This work generally finds that better collateralized loans carry higher unobserved risks. Consequently, CRE loans with low LTVs do not necessarily have lower default risk (Ambrose and Sanders, 2003; Grovenstein et al., 2005) or lower spreads (Titman et al., 2005). Likewise, in the commercial and industrial loan market, creditors are more likely to require collateral from riskier borrowers (Berger and Udell, 1990; Boot et al., 1991; Jiménez and Saurina, 2004; Benmelech and Bergman, 2009). We document that recourse is one (typically overlooked) factor that often mitigates the risk associated with higher LTV CRE loans.

The rest of the paper is structured as follows. In Section 2, we discuss the data used in our analysis. In Section 3, we review the prevalence of recourse in bank CRE portfolios and discuss observable differences between recourse and non-recourse loans. In Section 4, we analyze the effects of recourse on rate spreads and leverage for CRE loan originations. In Section 5, we investigate the relationship between recourse and loan performance. In Section 6, we conclude.

## 2. DATA

We use supervisory data collected to support the Federal Reserve stress tests, which contain loan-level information on the commercial real estate portfolios of the largest banks in the United States. The reporting panel consists of banks with consolidated assets of $100 billion or more.[7] These banks report information for construction and land

heterogeneity in recourse from our data, we show that recourse is associated with lower spreads, consistent with theory.

[5] In addition, Corbae and Quintin (2015) explore the role of leverage in inducing foreclosures in the Great Recession and its aftermath. The authors include an extension of their model, finding that recourse can play an important role in mitigating foreclosures by reducing the incentive for strategic default.

[6] Also related is work by Beyhaghi (2022), which studies third-party guarantees in commercial and industrial loans. Though the setting is quite different—his study focuses on non-collateralized lending and includes government guarantees—many of the findings are complementary; he also finds lower loan rates, better performance, and lower collateralization for loans with guarantees.

[7] As part of their capital assessment and stress tests, banks file Y-14Q regulatory forms on a quarterly basis. Schedule H.2 provides the commercial real estate data. Our sample also includes some loans from banks with $50 to $100 billion in assets because of the lower asset threshold before 2019. The data are at the facility level, and a facility can include multiple loans to the same entity; nonetheless, most facilities have only one loan, so we treat the data as loan level.

development (CLD) and non-owner-occupied CRE loans with a committed balance of $1 million or more.

The data include an array of information on banks' portfolio loans: the interest rate, committed exposure (drawn plus undrawn credit), loan balance, dates of origination and maturity, amortization (for example, interest only versus fully amortizing), whether there is a prepayment penalty, and the interest rate variability type (fixed versus floating). It also includes information on the property securing the loan: appraised value, net operating income (NOI), type (for example, hotel versus retail), and geographic location.[8] We construct the LTV ratio using the loan balance and appraised value.[9] The spread between the loan interest rate and the bank's cost of funds is calculated using the interest rate, the dates of origination, and the term.[10] We calculate a measure of ex-post NOI growth using the NOI reported at origination and the last pre-COVID19 value.

The data also include loan-level risk measures. First, banks provide a standardized version of their internal borrower risk rating for each loan. Banks have their own internal risk categorizations but provide a mapping from these internal ratings to a common scale along the lines of what is used for bond ratings.[11] A subset of stress test banks are also "advanced approaches" institutions. These banks are required to report their estimates of loan probability of default and loss given default, the product of which is the expected loss of the loan. For loans from banks that do not report these variables, we impute the expected loss using the average value for the loan's particular borrower risk rating to avoid limiting our sample.

Key to our analysis, banks also provide information on whether a loan has recourse. As of September 2014, the recourse field indicates whether the loan has full, partial, or no recourse. Before that date, banks only indicated whether a loan had any form of recourse and did not distinguish between full and partial recourse. We label any loan that has partial or full recourse as having recourse.[12]

[8]Location is reported at the ZIP code level, which we map to core-based statistical areas (CBSAs). For loans with a ZIP code that does not map to a CBSA, we assign a CBSA code of 0.

[9]For cross-collateralized loans, banks report the property value as the total value of all cross-collateralized properties. For example, two cross-collateralized 80 percent LTV loans on two different $10 million properties would be reported as loans of $8 million against $20 million in collateral. Because collateral is double-counted and loan amounts are not, we adjust property values and LTVs to only reflect the portion of the collateral applicable to that loan. Therefore, the LTVs in the example loans would be treated as 80 percent rather than 40 percent.

[10]For floating rate loans, we use one-month LIBOR as the reference rate. For fixed-rate loans, we compute the maturity-matched swap rate. For loans with terms under two years, we linearly impute between one-month LIBOR and the two-year swap rate. For terms above two years, we linearly impute between available swap rates.

[11]Internal ratings can sometimes span multiple ratings on the common scale, in which case a different minimum and maximum rating is provided. When constructing an indicator for whether a borrower is rated the equivalent of BBB+ or higher, we take the maximum rating.

[12]To give a sense of what the data look like before combining partial and full recourse loans, Table B.2 in

We exclude from our sample all loans that are missing key information or that contain outliers. In particular, we drop all loans with a negative or missing committed balance, all loans with an LTV greater than two or less than zero, all leveraged loans, all acquired loans, all loans to foreign borrowers, and all loans secured by properties outside the United States. We also drop loans that have missing values for recourse, cross-collateralization, loan value, origination or maturity date, state code on the property, whether the loan is floating rate, or whether the loan is the first lien on the property. In addition, we drop loans if they are the only observation for that lender-state-year-property type combination.[13]

We use different samples in our at-origination and dynamic analyses. In Section 5, in which we analyze the performance of loans over time instead of outcomes at origination, we use the full sample of loan observations between 2012 and 2020, cleaning the data as above. In Sections 3 and 4, in which we analyze data as of origination, we also exclude loans that appear in the data with a lag in order to avoid selection bias due to differential attrition.[14] Specifically, we drop loans that were originated before the bank began reporting data, were originated more than two quarters before they first appear in the data, or that have an origination date that differs from the earliest reported origination date (to exclude modified loans).

We focus our analysis on investor-owned commercial loans secured by stabilized properties, as we are better able to control for key characteristics affecting risk premiums on such loans. Loans against transitional properties—those properties underlying renovation or construction projects—are often valued using an estimate of its future income instead of actual income, making the property value subject to measurement issues.[15] Furthermore, the performance of loans on transitional properties is highly dependent on the business model of a particular borrower, making the loan and property controls employed in our analysis less effective at controlling for risk.

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the appendix parallels Table 1, but breaks out loans by whether they have full or partial recourse. Note that this table only uses data from 2015 on, as that is when the more detailed recourse field was incorporated.

[13]This last condition is applied for the sake of keeping the sample consistent in OLS and IV specifications. OLS estimates are little changed when including these singleton observations.

[14]Loans that appear in the data with a lag—for example, loans originated before a bank started Y-14 reporting—may not be reflective of the sample of loan originations for that bank-quarter: shorter-term loans may mature, lower-quality loans may default, loans might prepay, or loans may be modified so that the terms at the time of reporting do not reflect origination values. However, our results are qualitatively similar to those when run on the more expanded sample.

[15]More formally, we define loans on transitional properties as any construction and land development loan or any loan for which the reported property value is an estimate for once the property is completed or stabilized as opposed to the value being reported "as is."

## 3. THE PREVALENCE OF RECOURSE IN BANK CRE PORTFOLIOS

In Table 1, we present summary statistics on key variables from our cleaned sample of loans at origination, with finer detail broken out by recourse status and property type. These statistics provide information on how often recourse is a feature of bank CRE loans and how loans with recourse differ from non-recourse loans in terms of observable characteristics.

Recourse is common: 79 percent of loans secured by stabilized properties have recourse.[16] Origination amounts for recourse loans secured by stabilized properties are, on average, only about one-fourth the size of non-recourse loan amounts, implying that the recourse share is smaller on a value-weighted basis, standing at 45 percent. Other terms also differ between recourse and non-recourse loans. Recourse loans have lower spreads, lower LTVs, longer terms, and are less likely to be interest only or floating rate compared with non-recourse loans, on average.

The prevalence of recourse also varies across property types. For example, 82 percent of multifamily loans have recourse, whereas around 66 percent of lodging loans have recourse. On average, the largest difference in rate spreads by recourse status is for multifamily loans, for which recourse loans carry spreads that are 30 basis points lower than those for non-recourse loans. Recourse loans secured by hotels also carry notably lower spreads, while the average spreads for recourse and non-recourse loans are within 7 basis points of one another for retail, industrial, and office CRE loans.

The use of recourse also differs substantially across lenders. In the top panel of Table 2, we divide lenders into quintiles by the share of their loans that have recourse. The top quintile of lenders have recourse on over 90 percent of their CRE loans, while the lowest quintile of lenders have recourse on 14 percent of such loans.[17]

Differences in the use of recourse are less stark across states. The bottom panel of Table 2 depicts quintiles of states by recourse share. The residential mortgage literature has focused on state differences in recourse laws (Ghent and Kudlyak, 2011). While laws allowing or preventing recourse on owner-occupied residential properties do not generally apply to commercial properties, there are still legal differences across states that can make it more or less difficult to obtain a deficiency judgment. Recourse shares for loans secured by stabilized properties range from 56 percent to 83 percent across state quintiles, with some variation by property type.

[16] Table B.1 in the appendix presents summary statistics for loans on transitional properties, just under 70 percent of which have recourse.

[17] We will exploit this notable heterogeneity in banks' use of recourse in our IV strategy described in the next section, the logic being that if a loan has recourse because the lending bank almost always requires recourse, then the recourse clause is less likely to reflect unobserved borrower risks.

## 4. DO LENDERS VALUE RECOURSE?

Qualitatively, the effect of recourse is straightforward: recourse should act like additional equity and reduce losses in the event of default, better incentivize borrowers to avoid default, mitigate the agency problems that can worsen near default, and provide lenders with more bargaining power if loans need to be modified or liquidated. The inclusion of recourse in a loan contract should enable borrowers to either achieve more favorable loan pricing or be allowed greater risk along other dimensions, such as higher LTVs.

However, the quantitative significance of such effects is uncertain. Property investors tend to specialize in particular regions or property types, meaning that the value of an investor's other assets is likely to be highly correlated with the value of the subject property. By the time a borrower has an incentive to default, their net worth may have declined such that recourse provides little value. Moreover, the costs and difficulties of achieving a deficiency judgment may substantially reduce the value banks place on recourse.

In this section, we study the extent to which lenders value recourse. First, we establish our empirical strategy and how we address potential threats to identification. Second, we present estimates of the effects of recourse on spreads and LTVs. Finally, we analyze our estimates through the lens of a model of CRE loan underwriting to clarify the mechanisms by which recourse affects these loan terms.

### 4.1. *Empirical Strategy and Identification*

To investigate how recourse affects loan spreads, we estimate the following regression:

$$r_{i,b,t} = \beta_1 \text{Recourse}_{i,b,t} + \beta_2 \text{LTV}_{i,b,t} + \gamma' \text{X}_{i,b,t} + \tau_t + \eta_b + \xi_{c(i)} + \varepsilon_{i,b,t}, \tag{1}$$

where $r_{i,b,t}$ is the spread on loan $i$ from bank $b$ in origination year $t$, $\text{Recourse}_{i,b,t}$ indicates whether that loan has recourse, $\text{LTV}_{i,b,t}$ is the loan-to-value ratio, and $\text{X}_{i,b,t}$ is a vector of loan-level controls. The regressions also include lender ($\eta_b$), origination-year ($\tau_t$), and state-by-CBSA fixed effects ($\xi_{c(i)}$).[18] Our baseline set of controls is the natural logarithm of the loan term, the natural logarithm of the committed balance at origination, and indicators for whether the loan is interest only, has a prepayment penalty, has a floating rate, is cross-collateralized, and is the first lien on the property. We also include property

[18]These fixed effects allow us to capture both differences across metropolitan areas and differences in state laws. Counties outside of CBSAs are given a CBSA code of zero; thus, their fixed effect corresponds to all non-urban counties within the state.

type fixed effects (where multifamily is the omitted property type).[19] Analysis of the effect of recourse on LTV is similar, but with $\text{LTV}_{i,b,t}$ on the left-hand side.

The identifying assumption is that potential loan outcomes are independent of recourse status, conditional on observed covariates. The presence of recourse in a loan contract is—of course—not random. For one, banks may decide to require recourse because they perceive a loan as being risky. Thus, even if the causal effect of recourse is to make a loan safer (thus justifying a lower spread), such an effect may be offset by the other risk factors that induced the bank to require recourse. In the opposite direction, borrowers may be more willing to offer recourse for safer loans, since they are less concerned about needing to pay the costs of a deficiency judgment. Namely, recourse may be a signal of quality, and favorable terms on recourse loans may partially reflect these signaling effects. In short, there are reasons to believe that recourse may correlate with risk, but the direction of this effect is ambiguous.[20]

Though conceptually the endogeneity of recourse decisions could bias estimates, there are two reasons why the bias is likely to be small. First, the data we use is collected for the purpose of conducting bank stress tests, and is thus designed to enable the assessment of loan risks. The data include an array of property characteristics and loan terms that should capture the most salient risks associated with the loans in our sample. Second, we only include loans secured by stabilized properties in our sample; for stabilized properties, observed covariates are likely to be relatively more informative about expected performance.

Nonetheless, a natural concern with regard to the OLS analysis—even with the quality risk controls—is that there is selection on unobservables. To address this concern, before reviewing the results for spreads and LTVs, we first demonstrate ex-post property performance does not notably differ for properties securing recourse and non-recourse loans. Specifically, we assess whether recourse at origination predicts future NOI growth. If banks use recourse to offset unobserved risks, we would expect properties secured by recourse loans to perform worse. If borrowers with better performing properties choose recourse loans, properties secured by recourse loans should perform better.[21]

[19] In Table 3, we show the coefficients for industrial, lodging, office, and retail. The coefficients on other property types (for example, "mixed" and "condo") are included in the specification but not displayed (due to space constraints).

[20] Theoretically, the direction of bias should depend on the nature of any asymmetric information. Risk factors observed by banks, but unobservable to the econometrician, may play into the banks' recourse decisions. If banks are more likely to require recourse on unobservably riskier loans, this will bias our OLS estimates towards zero. Alternatively, risk factors observed by the borrower, but not the bank, will play into borrowers' recourse decisions. If borrowers are more likely to offer recourse on less-risky loans, this will bias our OLS estimates away from zero. See Jiménez and Saurina (2004); Jimenez et al. (2006) for similar discussions regarding the collateralization of C&I loans.

[21] This exercise is similar in spirit to Jimenez et al. (2006), who study how the use of collateral relates to

Figure 1 plots estimates from a series of quantile regressions showing the relationship between recourse and NOI growth at various quantiles of the NOI distribution, controlling for the other covariates included in Equation 1.[22] At most percentiles, recourse is associated with modestly higher NOI growth, through recourse is associated with lower growth at the bottom of the distribution. However, the confidence interval contains zero everywhere but at the 95th percentile. Regressions in Appendix Table B.4 tell a similar story; there is no significant relationship between recourse and subsequent NOI growth (Column 1) or the variance of NOI growth (Column 2), though recourse loans are modestly more likely to decline at a more than 10% rate (Columns 3). Given that marginal differences in property performance matter little to lenders if a loan is far from default, the results point to there being modestly elevated risks for properties secured by recourse loans. Consequently, OLS estimates of the effects of recourse on rates or LTVs are likely to be on the conservative side, as unobserved characteristics seem to cause recourse loans to be riskier than observably similar nonrecourse loans.

Beyond the NOI analysis discussed above, we conduct two robustness checks as part of the LTV and spreads analyses that lend further credence to the OLS estimates reviewed in the next subsections. First, as another way to account for differences in observable loan characteristics between recourse and non-recourse loans, we estimate the effects of recourse using propensity score matching. Second, to account for the potential endogeneity of recourse decisions, we estimate equation (1) using two-stage least squares. Specifically, we instrument for a loan's recourse status using the recourse share of other originations in that market (property type-state-year) from the given lender.[23] Intuitively, variation in recourse due to differences in lenders' use of recourse is less likely to reflect loan-specific risk characteristics than recourse decisions for individual loans.

Though we provide more detail in the next subsections, to foreshadow the results, we find similar estimated effects of recourse in our propensity score analysis. In our IV analysis, the predicted effects of recourse rise, consistent with the findings regarding how risk correlates with recourse from the NOI analysis above.

future defaults in order to evaluate the role of private information in collateral decisions.

[22]We measure NOI growth as annualized log difference in NOI at origination and the last NOI update before the COVID-19 pandemic. We exclude the lender and CBSA $\times$ State dummies due to convergence issues. The results are robust to using an alternative measure of NOI that allows for negative values of NOI.

[23]We exclude the loan of interest when calculating the lender's recourse share of similar loans, but additionally include loans secured by transitional properties in order in order to reduce noise from having a small number of loans in a lender-market. We look at a lender's recourse shares by property type-state-year to capture differences in experience or preferences across property types, differences in recourse laws across states, and changes in preferences over time. We also use a similar approach to instrument for the LTV at origination, using the average LTV of loans originated in that market (property type-state-year) for a given lender.

### 4.2. *Recourse and Interest Rate Spreads*

The first four columns of Table 3 present estimates of the effect of recourse on loan rate spreads. Column (1) and (2), which present OLS estimates without and with the LTV control both produce significant (at the 1 percent level) estimates of about -0.21 for $\hat{\beta}_{1,OLS}$. Although positive, the coefficient on LTV is small and statistically insignificant, implying that, on average, lower LTV loans do not command notably lower interest rates, likely reflecting the endogeneity of LTV choice (Titman et al., 2005).

In column (3), we add additional controls for risk based on banks' internal risk ratings for loans. We include a dummy variable for whether the internal risk rating is equivalent to that of an investment-grade credit (rated BBB or higher), and the expected loss (probability of default times loss given default).[24] The interpretation of the coefficients on recourse and LTV is complicated in this specification, as recourse, LTV, and other terms are presumably a component of banks' risk ratings and expected loss calculations. This specification thus tests whether banks offer lower spreads on loans with recourse beyond the assessed effect of these variables on risk ratings. The coefficient on recourse declines only modestly when adding these additional controls. The coefficient on LTV, however, switches signs and becomes negative, indicating that the positive relationship between LTV and loan pricing is captured by banks' risk ratings.

With regard to the control variables, the regression coefficients generally have the expected signs and are similar across the four specifications. One finding worth highlighting is that cross-collateralized loans receive spreads that are about 11 basis points lower than those on other loans. Cross-collateralization pledges properties securing other loans as collateral. As such, cross-collateralization can serve a function similar to that of recourse, but with the claim on borrowers' other assets in a liquidation limited to the equity in another particular property (Childs et al., 1996). This finding is thus consistent with the primary findings regarding the effects of recourse on spreads.[25]

Column (4) presents the IV estimates, where both recourse and LTV are instrumented for using the recourse share and mean LTV, respectively, within the particular property type, origination year, and state for a given lender.[26] We find a value of –0.533 for $\hat{\beta}_{1,IV}$, with the estimate still significant at the 1 percent level. Namely, shifts in recourse reflecting broad underwriting policies rather than loan-specific recourse decisions are associated with larger declines in rate spreads than those coming from OLS estimates. This result suggests that OLS estimates are biased toward zero due to banks requiring

[24] Introducing these variables limits our sample somewhat, because a few hundred observations have a missing risk rating. Adding a full set of fixed effects for credit rating gives similar results.

[25] We focus on recourse in this paper because it is much more widely used. Only about 5 percent of stabilized loans are cross-collateralized.

[26] We excluded the risk rating controls in this specification since they may partially reflect recourse.

recourse to offset other risk-factors. This result is thus consistent with the evidence from Figure 1 that properties secured by recourse loans have somewhat more downside risk. Overall, this set of findings points to the OLS estimate of 21 basis points being a lower bound on the effect of recourse on spreads.[27]

Finally, we present the results of the propensity score analysis in Table 4. In our first-stage probit, we include all the controls and fixed effects from column (1) of Table 3, except we replace lender and CBSA $\times$ State fixed effects with continuous variables measuring the share of loans within a particular lender or area that have recourse. All the covariates are reasonably balanced after the match with the exception of loan term and interest rate variability. As this imbalance is driven by multifamily properties, we also separately conduct the analysis excluding such properties.[28] After excluding multifamily properties, the match results in all covariates being well-balanced, including loan term and the floating rate indicator.

For the full sample, we find that recourse results in a 29 basis point rate spread discount, modestly higher than the estimate from our OLS regression. Once we exclude multifamily loans, this effect falls to about 10 basis points but remains highly significant. The smaller estimate appears to reflect heterogeneous effects across property types rather than the effects of matching: OLS estimates of the effects of recourse on spreads are also around 10 basis points when excluding multifamily properties, as shown in Appendix Table B.3.

### *4.3. Recourse and LTVs*

Recourse need not only affect loan rate spreads. For example, recourse could substitute for conventional equity, allowing borrowers to achieve higher LTVs than would otherwise be available.[29]

To estimate the effect of recourse on LTV, we run the regression specification described in equation (1) but with LTV as the dependent variable. We use the same controls as in our spreads regressions, but with the loan rate spread included in place of LTV in some specifications. The results of these regressions are in columns (5) to (8) of Table 3.

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[27] There are a couple of potential violations of the exclusion restriction that may inflate this estimate. First, safer borrowers may select into banks that favor recourse loans in their market, thus the instrument may not address signaling effects. Second, banks that require recourse may be more risk averse on average, resulting in loan portfolios that are safer on dimensions besides the use of recourse. Consequently, we take the IV results as providing suggestive evidence as to OLS estimates being conservative rather than treating them as our preferred estimate of the effects of recourse.

[28] Details on the balance of the independent variables are available in Tables B.5 and B.6 in the appendix.

[29] As discussed in the next subsection (Section 4.4), the model in Appendix A theoretically examines how recourse affects loan underwriting, and sheds light on the factors that determine the extent to which recourse affects LTVs or spreads. A key determinant is the cost of deficiency judgments; when deadweight costs are greater, borrowers tend to choose lower spreads rather than higher LTVs for recourse loans.

The OLS estimate in column (5) implies that recourse loans have LTVs that are 2.8 percentage points higher than those of non-recourse loans. That is, borrowers who have equity at stake through a recourse clause are able to have modestly less equity at stake through their down payment. When controlling for loan rate spreads in column (6) or loan-level risk ratings in column (7), we find similar effects of recourse on LTVs.

As with studying how recourse affects rate spreads, unobservable characteristics affecting recourse decisions may bias OLS estimates. In column (8) we present estimates with the same specification as in (6), but we instrument for recourse using the frequency with which the lending bank requires recourse for other similar loans. The estimated effect of recourse rises, albeit less than in the spreads IV regression. The IV estimate implies that recourse loans receive LTVs that are 2.9 percentage points higher, although the coefficient is not statistically significant.

The coefficients on the other variables are in line with expectations. Loans with riskier terms or property characteristics typically have lower LTVs to compensate, and loans with high LTVs tend to receive higher spreads and worse risk ratings. The findings again suggest that cross-collateralization has similar effects to recourse; cross-collateralized loans receive LTVs that are 3.2 percentage points higher.

As in the last subsection, we also estimate the effects of recourse on LTV with propensity score matching. The results are in columns (3) and (4) of Table 4. Our full-sample propensity score results indicate that recourse loans attain LTVs that are about 2.7 percentage points higher than non-recourse loans, similar to the OLS estimates. When excluding multifamily loans, we estimate that recourse raises LTVs by about 2.5 percentage points, an effect modestly below the OLS estimates for this sample presented in Table B.3.

### *4.4. Discussion*

The results presented so far demonstrate that banks value recourse. Recourse loans receive a combination of lower interest rate spreads and higher LTVs, expanding the set of loan contracts that are available to borrowers. However, these results are equilibrium outcomes, reflecting both the terms that banks are willing to offer, and the terms chosen by borrowers. To understand what these findings imply about CRE loan underwriting on a more fundamental level, in Appendix A we use our estimates to calibrate the model of Glancy et al. (2022)—a model of CRE loan underwriting where recourse status determines LTVs, spreads, and loan modifications incentives.

In the model, recourse increases banks' recoveries in foreclosure, allowing banks to negotiate less borrower-friendly modifications and discouraging borrowers from strategically renegotiating loans. By discouraging renegotiation, recourse makes banks more willing to offer loans with higher LTVs and lower spreads. In the calibrated model, banks are willing to offer LTVs that are 6.3 percentage points higher for recourse loans (holding spreads constant). However, due to the high costs of recourse, borrowers choose contracts with lower spreads instead of increasing LTV by that full amount.[30] Altogether, our estimates imply that recourse is costly to borrowers in default, but not so costly that they choose to completely eschew the higher available leverage.

The model also provides a motivation for studying loan modifications as we do in the next section. In the calibrated model, recourse lowers the propensity for loans to be modified and reduces the size of modifications when they do occur.

## 5. DYNAMIC EFFECTS OF RECOURSE

In Section 4, we showed that banks value recourse, charging lower spreads and allowing higher LTVs for recourse loans on average. In this section, we demonstrate one way in which recourse provides value to banks. We first document that CRE market stress during the COVID-19 period predominantly manifested itself in the form of higher modification rates and internal credit rating downgrade rates, but only modestly higher delinquency rates. We then show that while recourse loans were just as likely to receive a downgrade as non-recourse loans, they were 50 percent less likely to receive a loan modification. The modifications they did receive generally involved smaller reductions in required loan payments. We interpret these results as implying that recourse provides lenders with bargaining power in loan renegotiations.

### *5.1. Bank Loan Modifications Were Common during the COVID-19 Pandemic*

Banks tend to modify CRE loans before they become delinquent (Black et al., 2017). Given the high costs of foreclosure in commercial real estate and the limited contractual impediments to loan modifications, banks have an incentive to work with borrowers to avoid default.[31]

Incentives for modification were particularly pronounced during the COVID-19 period: the disruption was large, unexpected, outside of borrowers' control, and (initially) expected to be transitory. These conditions limited the moral hazard concerns that can come with modifying troubled loans. Guidance from regulators also encouraged banks to

[30] In the model, the cost of deficiency judgments controls the extent to which recourse affects spreads or LTVs. When costs are high, borrowers need more assets at stake to achieve a given shift in loan terms, making borrowers less interested in high leverage loans. We discuss these mechanisms in more detail in the appendix.

[31] Banks are different from CMBS in this regard, as CMBS servicers have a more limited ability to modify loans due to REMIC rules and pooling and servicing agreements (PSAs).

work with borrowers. An interagency statement from bank regulators stated that "[t]he agencies view loan modification programs as positive actions that can mitigate adverse effects on borrowers due to COVID-19."[32]

We identify loan modifications by comparing loan terms over time.[33] Specifically, a loan is considered modified if it switched from being amortizing to being interest only, if the committed balance rises (indicating interest payments are added to the loan balance as part of a forbearance plan), if the committed balance falls in tandem with a positive cumulative charge-off (indicating a write-off), if the maturity date is extended (outside of a pre-negotiated renewal), or if the loan enters troubled debt restructuring.[34] Because we are interested in banks' decisions regarding particular loans, we omit from the analysis a few banks that modified over 30 percent of their CRE loans in 2020:Q1, as such modifications are more likely to reflect blanket policies rather than banks' assessments of the need to modify particular loans.

We additionally assess loan performance based on whether loans receive rating downgrades or become distressed. We consider loans as distressed if they are delinquent, non-accrual, or involuntarily liquidated. We define a downgrade as a decline in the lender's internal credit rating in a given quarter.

Our estimates of quarterly modification, downgrade, and distress rates before (2012-2019) and during (2020) the COVID period are in Table 5. CRE loans were modified at a rate of over 5.5 percent per quarter in 2020, up from a rate of 1.5 percent pre-2020. Though modifications rose for all property types, the rise was particularly pronounced for lodging loans, for which the modification rate rose to over 12 percent per quarter in 2020, compared to roughly 2 percent pre-2020.

Credit rating downgrades also rose during the COVID period: quarterly downgrade rates rose from 2.8 percent pre-2020 to just under 6 percent in 2020. Loans secured against lodging properties again rose the most of all property types; lodging loans were downgraded at a rate of almost 22 percent per quarter in 2020, compared to just under 3 percent pre-2020.

Despite the high rates of downgrades, borrowers for the most part were able to remain current on their loans, possibly because of the extensive use of loan modifications.

[32] The interagency statement from bank regulators regarding loan modifications can be found at https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200407a.htm. Also note that short-term modifications made in response to the COVID-19 pandemic were not considered troubled debt restructurings and therefore did not need to be accounted for in the bank's allowance for loan and lease losses.

[33] This method is similar in spirit the procedure used in Adelino et al. (2013).

[34] Loans are also considered to be modified if there is a change in the origination date, which occurs when there is a substantial change in a loan's terms. In addition, we also denote loans as modified if there are changes in interest rates on fixed-rate loans (such modifications are rare).

Distress rates were at much lower levels compared to modifications and downgrades, even during COVID. They rose from a quarterly rate of just under 0.7 percent pre-2020 to just over 1 percent in 2020. Even loans backed by lodging properties—which saw high rates of both downgrades and modifications—only reached distress rates of about 3.6 percent during 2020. These low distress rates stand in sharp contrast to loan performance in the CMBS market, where overall delinquency rates surpassed 10 percent in June 2020 and delinquency rates for lodging and retail-backed loans about doubled that average.

### 5.2. *Recourse Loans Were Less Likely to Be Modified*

The first step in our analysis of the dynamic effects of recourse is to test whether recourse loans were less likely to be modified, downgraded, or distressed during the COVID period (that is, in 2020). We run the following regression:

$$\begin{aligned} M_{i,b,t} \times 100 \quad = \quad & \beta_1 \text{Recourse}_{i,b,t} + \beta_2 \text{Recourse}_{i,b,t} \text{xCOVID}_t \\ & + \gamma' \text{X}_{i,b,t} + \psi' \text{X}_{i,b,t} \text{xCOVID}_t + \varepsilon_{i,b,t}, \end{aligned} \tag{2}$$

where $M_{i,b,t}$ is an indicator for whether loan $i$ from bank $b$ is modified at time $t$, $\text{Recourse}_{i,b,t}$ indicates whether that loan has recourse, $\text{COVID}_t$ is an indicator for whether the loan is from 2020, and $\text{X}_{i,b,t}$ is a vector of loan-level controls and fixed effects. Each specification includes all of the controls and fixed effects from column (1) of Table 3 as well as year-quarter fixed effects. $\text{X}_{i,b,t}$ is expanded to include LTV and credit rating controls in some specifications. All controls, including LTV, are the current values instead of the values at origination that were used in Section 4. Analogous specifications are run with downgrade or distress indicators as dependent variables.

The coefficient of interest is the interaction between recourse and COVID ($\beta_2$), which we expect to be negative. We expect modification rates on recourse loans to be lower for two reasons. First, borrowers with recourse have less incentive to default when property values decline, as they have other assets at stake (Ghent and Kudlyak, 2011). Thus, even if one property does not generate enough income to service the debt on that property, the borrower may still make payments using other resources or returns from other assets rather than risk those assets. Second, banks may have less incentive to provide a modification on a recourse loan because they expect to be able to recoup any losses by filing a deficiency judgment post-liquidation.[35]

The coefficient on recourse may suffer from identification problems similar to those

[35] Recourse loans could also receive fewer modifications because they are less risky along some unobserved dimension and therefore less likely to need a modification. However, our results in Section 4 imply that the recourse loans likely have, if anything, riskier unobservables.

detailed in Section 4. However, as COVID is a large, exogenous shock to CRE, whose effects are arguably orthogonal to ex-ante risk assessments, any change in the estimated effect of recourse during COVID should identify the effect of recourse on the outcome variable.[36]

The results are presented in Table 6. The dependent variables are multiplied by 100, so the coefficients are estimates of the effect on a given performance variable in percentage points. In specifications 1, 4, and 7, we consider recourse without the addition of confounding factors such as the interest rate spread and LTV. In specifications 2, 5, and 8, we add in the LTV and interest rate spread. In specifications 3, and 6, we include the indicator for whether the internal risk rating is equivalent to that of an investment-grade credit (rated BBB or higher) and the loan expected loss (probability of default times loss given default).[37] All of these controls are also interacted with the indicator for whether the loan-quarter observation is from the COVID period, thus allowing the effect of controls to vary between the two periods.

The results in columns (1) to (3) of Table 6 imply that recourse loans are modestly less likely to be modified on average but were much less likely to be modified than non-recourse loans during COVID. In column (1), recourse lowers the likelihood of modification by just under 0.1 percentage points in normal times (although this is not statistically significant), relative to an average modification rate of 1.5 percent. However, during COVID, the modification rate on recourse loans was over 2.5 percentage points lower than for otherwise similar non-recourse loans, relative to an overall modification rate of 5.56 percent. The coefficient estimates become modestly more negative (and the pre-COVID estimate becomes statistically significant) in column (2), where we control for LTV and rate spreads, and in column (3), where we also add information on loan-level risk ratings.

In contrast to modifications, which rose significantly more for non-recourse loans during COVID, the rates of downgrades and delinquencies mostly rose in parallel for recourse and non-recourse loans. Indeed, the coefficients on the interaction between recourse and COVID are statistically insignificant in columns (4)–(8) when downgrades and delinquencies are the dependent variables. In short, although recourse loans received less accommodation from banks, their performance did not disproportionately suffer

[36]Recourse is endogenous in that recourse clauses may be included to offset unobserved risks. Consequently, even if the causal effect of recourse is a less frequent need for modification, this effect may be offset by the increased need for riskier loans to be modified. This bias is likely small during COVID, as it is a specific manifestation of an adverse outcome, and sensitivity to the COVID shock is often not aligned with perceived risks at origination. For example, loans in gateway cities were perceived as safer pre-COVID but were disproportionately affected by the pandemic.

[37]We do not include a specification with these controls for the distress regression as the probability of default is mechanically tied to whether a loan is delinquent.

during COVID, suggesting that recourse motivated borrowers to maintain payments.

To better understand the timing of the results, we show the predicted effects of recourse on these outcomes on a quarter-by-quarter basis in Figure 2. For this figure, we regress each outcome variable on indicators for whether the loan has recourse, including the same controls and fixed effects as in column (2) of Table 6 (that is, controlling for LTV and interest rate spreads, but not banks' internal risk measures). The analysis is run separately for each quarter and thus generates quarter-specific estimates of the effects of recourse on the different performance measures. For example, the top chart is a plot of the expected modification rate in a quarter if every loan had recourse (the dashed line) or if no loans had recourse (the solid line), holding all other characteristics fixed.[38] The gap between the lines is the quarterly estimate of the effect of recourse on whether the loan is modified. Other charts perform the same exercise except that the dependent variable is one of the other outcome measures (distress or downgrades).

Figure 2 makes apparent that modifications, downgrades, and distress all increased during COVID, with modification and downgrade rates peaking in 2020:Q2. The figure also clarifies the economic impact of recourse. If all loans had been non-recourse, we would have expected an overall loan modification rate of 12 percent in 2020:Q2, compared to a rate of 6 percent if all loans had been recourse. While modification rates dropped in 2020:Q3 and 2020:Q4, the relative difference between recourse and non-recourse loans remains stable, with estimated modification rates for recourse loans remaining at about half the level of non-recourse loans.

Figure 2 also clarifies our identification strategy. Broadly, there is little signal in the pre-COVID period, as the coefficients on recourse across loan performance measures are typically modest and frequently switch signs. Though non-recourse loans exhibited higher distress in the early aftermath of the financial crisis, there were no notably different levels or trends for recourse versus non-recourse loans leading into the pandemic. As recourse and non-recourse loans were on similar trends, and the pandemic presented an unexpected disruption in cash flows likely to be independent of at-origination recourse decisions, the interaction between recourse and COVID should cleanly identify the effect of recourse on loan performance.

To summarize, recourse loans received notably fewer modifications during COVID compared to observably similar non-recourse loans. The lower modification rate on recourse loans does not appear to reflect differences in stress, as changes in downgrades and delinquencies differed little by recourse status. Our interpretation is that borrowers

[38] Specifically, we run quarterly regressions estimating $M_t = X_t\beta_t + \varepsilon$, and plot the estimates $\overline{X_t}^R\hat{\beta}_t$ and $\overline{X_t}^{NR}\hat{\beta}_t$, where $\overline{X_t}^R$ is the vector of average loan characteristics, but with the element giving the recourse share reset to one (and likewise $\overline{X_t}^{NR}$ resets this share to 0).

with recourse had less bargaining power in loan modification decisions than those without recourse. We test this hypothesis further in the next subsection.

### 5.3. *Recourse Loans Receive More Lender-Friendly Modifications*

To further examine whether recourse provides lenders with bargaining power in loan modification negotiations, we test whether recourse loans receive more lender-friendly modifications when they do get modified. For this exercise, we limit our sample to loans that received a modification and then run regressions described in equation (2), except with an indicator for the type of modification as the dependent variable.

In Table 7, we provide information on the composition of modifications by recourse status both before (2012-2019) and during (2020) the COVID period.[39] The most common modification type before 2020 was an extension. Over 50 percent of all pre-2020 modifications involved an extension. The next most common modification type was an increase in the committed balance (or forbearance), which occurred in 27 percent of modifications. However, in 2020, forbearance became the most common modification type, representing just over 50 percent of all modifications. The share of modifications involving extensions dropped to 34 percent. The rates of other modification types remained similar before and during COVID, with the exception of new troubled debt restructurings (TDR), which declined. This decline is almost certainly due to the interagency regulatory guidance that short-term modifications due to COVID did not qualify as TDRs.

We evaluate the three most common types of modification in the regressions: forbearance (an increase in a committed balance), changes to interest only for previously amortizing loans, and extensions. Table 8 shows that modifications of recourse loans were less likely to include forbearance and more likely to involve a switch to interest-only amortization. Each dependent variable is multiplied by 100 so that the coefficients can be interpreted as percentage point effects on the frequency of a modification being of a particular type. The coefficient on the interaction term indicates that in 2020 recourse loans were 7 percentage points less likely to receive a forbearance and just over 7 percentage points more likely to switch to interest-only amortization when modified. These estimates are little changed by the inclusion of additional controls for loan risk. Differences in modification frequencies by recourse status are generally small during normal times and small for other types of modifications.

Overall, we interpret these results as further evidence of recourse providing lenders with bargaining power in loan modification negotiations. During the COVID period, recourse loan modifications were more likely to involve loans becoming non-amortizing

[39] Modification types are not mutually exclusive (for example, a loan could be extended and transition to interest only simultaneously), so these percentages add up to more than 100.

(interest-only payments), while non-recourse loan modifications were more likely to entail loans becoming temporarily negatively amortizing (interest payments applied to the loan balance). In other words, recourse loans saw a smaller decline in required payments.[40]

## 6. CONCLUSION

We examine the value of recourse in CRE loan contracts. We show that recourse loans receive loan rate spreads that are 20 basis points lower and LTVs that are almost 3 percentage points higher than otherwise similar non-recourse loans. These results indicate that banks value recourse as a substitute for property-level equity, and are willing to allow borrowers to more affordably achieve higher leverage when recourse is available.

We then demonstrate one way in which recourse is valuable to banks. Recourse loans were half as likely as non-recourse loans to receive a loan modification during the COVID-19 pandemic, and the modifications that were made to recourse loans were more lender-friendly. This dynamic occurred despite recourse loans facing similar rates of downgrades and distress, consistent with recourse increasing lenders' bargaining positions in loan renegotiations.

[40]These findings can be rationalized by the model of Glancy et al. (2022), as discussed in Appendix A. Recourse increases banks' recoveries from foreclosure, which limits borrowers' ability to negotiate sizable reductions in debt service payments, thereby discouraging borrowers from renegotiating loans they are capable of remaining current on.

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| | Loans (#) | Share of # | Share of $ | Orig. Value (Mil.$) | Orig. Amount (Mil.$) | Term (Years) | LTV (%) | Rate Spread (bps) | Prepay Penalty (%) | IO (%) | Floating Rate (%) | 1st Lien (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Full Sample** | | | | | | | | | | | | |
| Overall | 81,894 | 100 | 100 | 16 | 8 | 17 | 57 | 199 | 72 | 13 | 34 | 99 |
| Recourse | 64,408 | 79 | 45 | 9 | 5 | 19 | 56 | 194 | 76 | 7 | 32 | 99 |
| No Recourse | 17,486 | 21 | 55 | 44 | 21 | 9 | 59 | 216 | 54 | 36 | 42 | 97 |
| **Industrial** | | | | | | | | | | | | |
| Overall | 5,468 | 100 | 100 | 14 | 8 | 8 | 58 | 233 | 55 | 15 | 52 | 97 |
| Recourse | 4,340 | 79 | 49 | 9 | 5 | 8 | 58 | 234 | 59 | 10 | 50 | 98 |
| No Recourse | 1,128 | 21 | 51 | 34 | 19 | 7 | 60 | 230 | 43 | 35 | 62 | 97 |
| **Lodging** | | | | | | | | | | | | |
| Overall | 1,826 | 100 | 100 | 46 | 21 | 7 | 57 | 264 | 43 | 25 | 62 | 98 |
| Recourse | 1,201 | 66 | 37 | 22 | 12 | 7 | 57 | 257 | 39 | 18 | 65 | 97 |
| No Recourse | 625 | 34 | 63 | 92 | 39 | 6 | 57 | 275 | 51 | 39 | 56 | 99 |
| **Multifamily** | | | | | | | | | | | | |
| Overall | 47,967 | 100 | 100 | 11 | 6 | 23 | 56 | 175 | 83 | 8 | 21 | 99 |
| Recourse | 39,563 | 82 | 52 | 7 | 4 | 26 | 55 | 170 | 88 | 3 | 20 | 100 |
| No Recourse | 8,404 | 18 | 48 | 29 | 16 | 11 | 60 | 200 | 59 | 31 | 26 | 96 |
| **Office** | | | | | | | | | | | | |
| Overall | 9,391 | 100 | 100 | 38 | 18 | 7 | 60 | 228 | 57 | 25 | 56 | 98 |
| Recourse | 6,540 | 70 | 31 | 15 | 8 | 7 | 60 | 230 | 59 | 15 | 51 | 98 |
| No Recourse | 2,851 | 30 | 69 | 90 | 40 | 6 | 59 | 222 | 52 | 49 | 67 | 98 |
| **Retail** | | | | | | | | | | | | |
| Overall | 11,180 | 100 | 100 | 18 | 8 | 8 | 57 | 228 | 59 | 16 | 51 | 98 |
| Recourse | 8,512 | 76 | 51 | 9 | 5 | 8 | 57 | 226 | 61 | 11 | 51 | 99 |
| No Recourse | 2,668 | 24 | 49 | 45 | 16 | 8 | 58 | 232 | 52 | 31 | 52 | 98 |

Table 1: Summary Statistics for Loans at Origination by Recourse. *Notes:* This table reports summary statistics for loans at origination for the full sample and disaggregated by recourse status. We first present summary statistics for all loans that are secured by stabilized properties and then for the five largest property types in our sample. All averages are unweighted.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Quintile | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Across Lenders | | | | | |
| Full Sample | 14 | 45 | 61 | 80 | 93 |
| Industrial | 12 | 53 | 68 | 85 | 93 |
| Lodging | 15 | 42 | 60 | 78 | 97 |
| Multifamily | 8 | 47 | 63 | 82 | 94 |
| Office | 15 | 45 | 65 | 81 | 93 |
| Retail | 18 | 52 | 68 | 88 | 97 |
| Across States | | | | | |
| Full Sample | 56 | 63 | 68 | 74 | 83 |
| Industrial | 64 | 73 | 76 | 80 | 89 |
| Lodging | 49 | 64 | 73 | 79 | 86 |
| Multifamily | 49 | 58 | 67 | 75 | 85 |
| Office | 55 | 68 | 72 | 79 | 86 |
| Retail | 64 | 73 | 78 | 82 | 88 |

Table 2: VARIATION IN RECOURSE ACROSS LENDERS AND U.S. STATES. *Notes:* This table reports unweighted recourse shares at banks by quintile, both for the full sample and disaggregated by property type. Each quintile has about one-fifth of banks (top panel) or states (bottom panel). The banks and states in a given quintile can vary for each property type.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

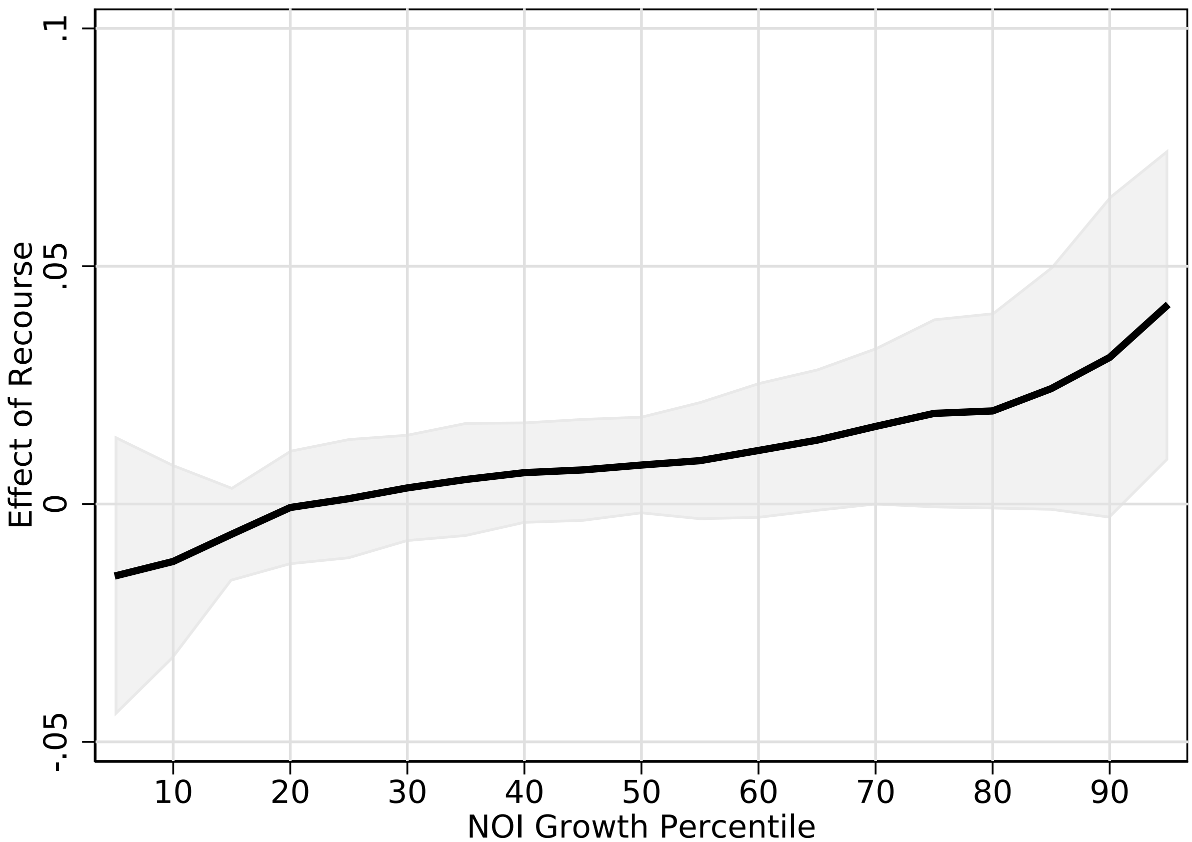


Figure 1: Effect of Recourse on NOI Growth by Percentile. *Note:* NOI Growth is defined as the annualized log difference in the last pre-2020 NOI observed and the first NOI observed. All specifications include controls for size, term, cross-collateralization, amortization, interest rate variability, lien priority, and prepayment penalties, as well as property type and origination year fixed effects. The shaded error is the 95 percent confidence interval. *Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Effect on Rate Spreads (percentage points) | | | | Effect on LTV (percentage points) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Recourse | -0.209*** | -0.211*** | -0.201*** | -0.533*** | 2.794*** | 2.880*** | 2.793** | 2.915 |
| | (0.0360) | (0.0355) | (0.0306) | (0.150) | (0.943) | (0.945) | (1.047) | (1.926) |
| LTV | | 0.000723* | -0.000938* | 0.00108*** | | | | |
| | | (0.000361) | (0.000486) | (0.000378) | | | | |
| Interest Rate Spread | | | | | | 0.413* | -0.505** | 0.414 |
| | | | | | | (0.216) | (0.226) | (0.248) |
| Borrower Rated BBB+ | | | -0.184*** | | | | -9.322*** | |
| | | | (0.0522) | | | | (2.271) | |
| Expected Loss | | | 0.0504*** | | | | 0.648*** | |
| | | | (0.00652) | | | | (0.112) | |
| ln(Origination Amount) | -0.167*** | -0.169*** | -0.166*** | -0.201*** | 3.023*** | 3.092*** | 2.842*** | 3.095*** |
| | (0.00732) | (0.00779) | (0.00725) | (0.0142) | (0.399) | (0.389) | (0.303) | (0.479) |
| ln(Maturity in Years) | -0.286*** | -0.286*** | -0.269*** | -0.303*** | 0.218 | 0.335 | 0.582 | 0.338 |
| | (0.0457) | (0.0458) | (0.0454) | (0.0422) | (0.637) | (0.605) | (0.638) | (0.635) |
| Cross-Collateralized | -0.111* | -0.113* | -0.107* | -0.112* | 2.971* | 3.017* | 2.771* | 3.017* |
| | (0.0596) | (0.0595) | (0.0579) | (0.0587) | (1.511) | (1.505) | (1.474) | (1.506) |
| IO Loan | -0.165 | -0.163 | -0.167 | -0.220 | -2.046*** | -1.978** | -2.364** | -1.972** |
| | (0.130) | (0.130) | (0.123) | (0.159) | (0.720) | (0.732) | (0.962) | (0.862) |
| Floating Rate | 0.547 | 0.547 | 0.577 | 0.586 | -0.0447 | -0.270 | 1.202** | -0.275 |
| | (0.388) | (0.388) | (0.377) | (0.396) | (0.151) | (0.206) | (0.461) | (0.387) |
| First Lien | -0.342*** | -0.352*** | -0.303*** | -0.336*** | 13.28*** | 13.42*** | 12.34*** | 13.42*** |
| | (0.0993) | (0.0993) | (0.101) | (0.0975) | (2.524) | (2.537) | (2.540) | (2.581) |
| Prepayment Penalty | 0.106 | 0.105 | 0.114 | 0.117 | 1.354*** | 1.310*** | 1.461*** | 1.309*** |
| | (0.0793) | (0.0795) | (0.0785) | (0.0796) | (0.383) | (0.394) | (0.423) | (0.443) |
| Industrial | 0.0903* | 0.0913* | 0.0908* | 0.107** | -1.347** | -1.384*** | -1.510*** | -1.386** |
| | (0.0511) | (0.0510) | (0.0492) | (0.0435) | (0.495) | (0.500) | (0.525) | (0.513) |
| Lodging | 0.438*** | 0.444*** | 0.422*** | 0.472*** | -7.841*** | -8.022*** | -8.237*** | -8.026*** |
| | (0.0598) | (0.0592) | (0.0602) | (0.0491) | (0.864) | (0.822) | (0.819) | (0.859) |
| Office | 0.113** | 0.114** | 0.110** | 0.136*** | -1.160 | -1.207 | -1.441 | -1.209 |
| | (0.0476) | (0.0477) | (0.0453) | (0.0429) | (0.782) | (0.780) | (0.889) | (0.784) |
| Retail | 0.0699 | 0.0723 | 0.0747 | 0.0910** | -3.268*** | -3.297*** | -3.230*** | -3.299*** |
| | (0.0500) | (0.0494) | (0.0477) | (0.0448) | (0.471) | (0.475) | (0.479) | (0.486) |
| N | 81,894 | 81,894 | 81,145 | 81,894 | 81,894 | 81,894 | 81,145 | 81,894 |
| R2 | 0.43 | 0.43 | 0.44 | 0.16 | 0.20 | 0.20 | 0.26 | 0.04 |
| Lender Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Orig. Year Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| CBSA × State Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| IV | - | - | - | Y | - | - | - | Y |

Table 3: Effect of Recourse on Rate Spreads and LTV. *Notes:* Columns 1–4 present coefficients from regressing loan rate spreads on an indicator for whether the loan has recourse, while columns 5–8 present coefficients from regressing LTV at origination on recourse. All specifications include controls for size, term, cross-collateralization, amortization, interest rate variability, lien priority, and prepayment penalties, as well as bank, property type, origination year, and CBSA-state fixed effects. Columns 2–4 and 6–8 additionally control for LTV or loan rate spreads, respectively. In addition, columns 3 and 7 layer in risk controls: an indicator for whether the internal risk rating is equivalent to that of an investment-grade credit (rated BBB or higher) and the loan expected loss (probability of default times loss given default). Column 4 instruments for both recourse and LTV with the average value for the recourse indicator and LTV of other loans within the same bank-state-year-property type. Column 8 instruments for recourse with the share of other loans within the same bank-state-year-property type that have recourse. Standard errors, in parentheses, are clustered at the bank level. *,**,*** indicate significance at the 10%, 5%, and 1% levels, respectively.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Effect on Rate Spreads (percentage points) | | Effect on LTV (percentage points) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| ATE | | | | |
| Recourse vs. Non-recourse | -0.299*** | -0.100*** | 2.733*** | 2.525*** |
| | (0.0238) | (0.0160) | (0.532) | (0.418) |
| N | 81,894 | 33,927 | 81,894 | 33,927 |
| Multifamily Excluded | N | Y | N | Y |

Table 4: Average Treatment Effects of Recourse Using a Propensity Score Match.
*Note:* The first-stage probit regression includes all the controls and fixed effects used in Table 3, except with lender and geography fixed effects replaced with continuous variables measuring the recourse share of loans for the particular lender or CBSA-state. Columns (1) and (3) are for the full sample. Column (2) and (4) exclude multifamily loans since those prevent the loan term being balanced in the treated and control group. All other controls are reasonably balanced in columns (1) and (3). All controls, including loan term, are reasonably balanced in columns (2) and (4).
*Source:* Y-14 H.2 Schedule.

| | Obs. (#) | Modified (%) | Downgraded (%) | Distressed (%) |
|---|---|---|---|---|
| **Full Sample** | | | | |
| Pre-COVID | 477,893 | 1.52 | 2.86 | 0.68 |
| COVID | 68,185 | 5.56 | 5.99 | 1.06 |
| **Industrial** | | | | |
| Pre-COVID | 47,222 | 1.43 | 2.74 | 0.80 |
| COVID | 7,547 | 4.03 | 2.70 | 0.86 |
| **Lodging** | | | | |
| Pre-COVID | 22,691 | 2.28 | 2.96 | 1.33 |
| COVID | 3,046 | 12.44 | 21.90 | 3.61 |
| **Multifamily** | | | | |
| Pre-COVID | 127,970 | 1.42 | 2.91 | 0.44 |
| COVID | 17,826 | 4.84 | 5.49 | 0.76 |
| **Office** | | | | |
| Pre-COVID | 96,999 | 1.90 | 2.93 | 0.80 |
| COVID | 13,361 | 6.17 | 4.34 | 0.73 |
| **Retail** | | | | |
| Pre-COVID | 123,651 | 1.31 | 2.91 | 0.61 |
| COVID | 19,794 | 5.31 | 6.85 | 1.28 |

Table 5: Summary Statistics for Loans that are Modified, Downgraded, or Distressed. *Notes:* This table reports the percentages of loans-quarter observations that are modified, downgraded, or distressed across the pre-COVID (2012-2019) and COVID (2020) time periods for the full sample and by property type.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Modified | | | Downgraded | | | Distressed | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Recourse | -0.0997 | -0.113* | -0.129* | -0.0701 | -0.132** | -0.266*** | -0.00186 | -0.0376 |
| | (0.0666) | (0.0671) | (0.0669) | (0.0669) | (0.0671) | (0.0687) | (0.0762) | (0.0750) |
| Recourse × COVID | -2.579*** | -2.772*** | -2.775*** | 0.0679 | -0.0819 | -0.0652 | -0.0330 | -0.0162 |
| | (0.387) | (0.389) | (0.388) | (0.298) | (0.299) | (0.300) | (0.210) | (0.208) |
| LTV | | 0.408*** | 0.168 | | 1.799*** | 0.0812 | | 1.093*** |
| | | (0.135) | (0.136) | | (0.145) | (0.151) | | (0.217) |
| LTV × COVID | | 4.300*** | 3.690*** | | 3.218*** | 0.604 | | 1.376*** |
| | | (0.587) | (0.592) | | (0.560) | (0.572) | | (0.514) |
| Interest Rate Spread | | 0.324*** | 0.221*** | | 0.0719** | -0.361*** | | 1.101*** |
| | | (0.0426) | (0.0414) | | (0.0350) | (0.0373) | | (0.0914) |
| Interest Rate Spread × COVID | | -0.640*** | -0.710*** | | -0.292** | -0.526*** | | 0.00779 |
| | | (0.152) | (0.150) | | (0.126) | (0.133) | | (0.174) |
| Borrower Rated BBB+ | | | -0.111** | | | -3.560*** | | |
| | | | (0.0454) | | | (0.0571) | | |
| Borrower Rated BBB+ × COVID | | | -0.867*** | | | -3.998*** | | |
| | | | (0.236) | | | (0.198) | | |
| Expected Loss | | | 0.288*** | | | 0.587*** | | |
| | | | (0.0244) | | | (0.0377) | | |
| Expected Loss × COVID | | | 0.0413 | | | 0.347*** | | |
| | | | (0.0566) | | | (0.0945) | | |
| N | 546,026 | 546,026 | 546,026 | 546,026 | 546,026 | 546,026 | 546,026 | 546,026 |
| R2 | 0.06 | 0.06 | 0.07 | 0.03 | 0.03 | 0.05 | 0.03 | 0.04 |
| Year-Quarter Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Lender Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Orig. Year Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| CBSA × State Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Property Type Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Loan-level Controls | Y | Y | Y | Y | Y | Y | Y | Y |
| Controls and FEs × COVID | Y | Y | Y | Y | Y | Y | Y | Y |

Table 6: Dynamic Regressions. *Notes:* Each column presents coefficients from regressing whether the loan is modified (columns 1–3), downgraded (columns 4–6), or distressed (columns 7–8) on an indicator for whether the loan has recourse, recourse interacted with whether the loan-quarter observation comes from the COVID period (i.e., 2020), and different sets of controls (also interacted with whether the loan-quarter observation comes from the COVID period). Specifications 1, 4, and 7 include the controls and fixed effects shown in the first specification of Table 3, along with year-quarter fixed effects. Specifications 2, 5, and 8 layer in LTV and the interest rate spread as controls. Specifications 3, and 6 layer in risk controls: an indicator for whether the internal risk rating is equivalent to that of an investment-grade credit (rated BBB or higher) and the loan expected loss (probability of default times loss given default). Standard errors are clustered by loan. *,**,*** indicate significance at the 10%, 5%, and 1% levels, respectively. *Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Obs. (#) | Forbearance (%) | To IO (%) | Extension (%) | TDR (%) | Write Down (%) |
|---|---|---|---|---|---|---|
| **Full Sample** | | | | | | |
| Pre-COVID | 7,092 | 26.75 | 15.58 | 52.51 | 2.51 | 1.41 |
| COVID | 3,674 | 50.03 | 17.04 | 34.10 | 0.68 | 1.06 |
| **Recourse** | | | | | | |
| Pre-COVID | 4,220 | 22.54 | 14.29 | 55.95 | 3.27 | 1.87 |
| COVID | 2,235 | 48.37 | 12.30 | 38.26 | 0.67 | 1.21 |
| **No Recourse** | | | | | | |
| Pre-COVID | 2,872 | 32.94 | 17.48 | 47.46 | 1.39 | 0.73 |
| COVID | 1,439 | 52.61 | 24.39 | 27.66 | 0.69 | 0.83 |

Table 7: Types of Loan Modifications by Recourse. *Notes:* This table reports the shares of different modification types during the pre-COVID (2012-2019) and COVID (2020) time periods. The top lines report statistics for the full sample, while the bottom lines disaggregate by recourse status. "Forbearance" denotes loans for which the committed balance increases. "To IO" denotes loans that switched from being amortizing to being interest only. "Extension" denotes loans for which the maturity date is extended. "TDR" denotes a troubled debt restructuring. "Write Down" denotes a fall in the committed balance in tandem with a positive cumulative charge-off. The types of modifications are not mutually exclusive, so percentages may add up to more than 100.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Forbearance | | | To IO | | | Extension | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Recourse | 0.300 | 0.0908 | 0.153 | 0.389 | 0.361 | 0.445 | -1.344 | -1.322 | -0.835 |
| | (1.303) | (1.308) | (1.305) | (0.970) | (0.977) | (0.978) | (1.336) | (1.333) | (1.306) |
| Recourse × COVID | -7.056*** | -7.335*** | -6.937*** | 7.235*** | 7.275*** | 7.200*** | -0.127 | 0.205 | -0.0557 |
| | (2.257) | (2.243) | (2.240) | (1.679) | (1.685) | (1.684) | (2.190) | (2.190) | (2.172) |
| LTV | | 11.48*** | 11.43*** | | -3.362* | -2.459 | | -13.35*** | -9.989*** |
| | | (2.919) | (2.942) | | (2.021) | (2.036) | | (3.025) | (2.987) |
| LTV × COVID | | 4.003 | 6.863 | | 2.402 | 2.906 | | 3.477 | 0.847 |
| | | (5.267) | (5.391) | | (3.484) | (3.560) | | (5.077) | (5.207) |
| Interest Rate Spread | | -0.252 | -0.0936 | | -1.056*** | -0.746* | | -2.526*** | -0.911 |
| | | (0.585) | (0.609) | | (0.406) | (0.426) | | (0.667) | (0.655) |
| Interest Rate Spread × COVID | | -3.343*** | -2.797*** | | 1.046 | 0.843 | | 5.387*** | 4.074*** |
| | | (1.079) | (1.079) | | (0.709) | (0.720) | | (1.129) | (1.078) |
| Borrower Rated BBB+ | | | -2.989** | | | 2.755*** | | | 2.861** |
| | | | (1.223) | | | (0.917) | | | (1.290) |
| Borrower Rated BBB+ × COVID | | | 2.061 | | | 0.350 | | | -4.829** |
| | | | (2.124) | | | (1.519) | | | (2.092) |
| Expected Loss | | | -0.273*** | | | -0.0881 | | | -1.051*** |
| | | | (0.0922) | | | (0.0645) | | | (0.0964) |
| Expected Loss × COVID | | | -0.609*** | | | 0.145 | | | 0.581*** |
| | | | (0.165) | | | (0.109) | | | (0.193) |
| N | 10,766 | 10,766 | 10,766 | 10,766 | 10,766 | 10,766 | 10,766 | 10,766 | 10,766 |
| R2 | 0.51 | 0.51 | 0.51 | 0.55 | 0.55 | 0.55 | 0.49 | 0.49 | 0.50 |
| Year-Quarter Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Lender Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Orig. Year Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| CBSA × State Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Property Type Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Loan-level Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Controls and FEs × COVID | Y | Y | Y | Y | Y | Y | Y | Y | Y |

Table 8: Dynamic Regressions for Types of Loan Modifications. *Notes:* Each column presents coefficients from regressing the type of loan modification on LTV, an indicator for whether the loan has recourse, recourse interacted with whether the observation comes from the COVID period (i.e., 2020), and controls and fixed effects (also interacted with whether the loan-quarter observations come from the COVID period). Specifications 1, 4, and 7 include the controls and fixed effects shown in the first specification of Table 3, along with year-quarter fixed effects. Specifications 2, 5, and 8 layer in LTV and the interest rate spread as controls. Specifications 3, 6, and 9 layer in risk controls: an indicator for whether the internal risk rating is equivalent to that of an investment-grade credit (rated BBB or higher) and the loan expected loss (probability of default times loss given default). "Forbearance" denotes loans for which the committed balance increases. "To IO" denotes loans that switched from being amortizing to being interest only. "Extension" denotes loans for which the maturity date is extended. Standard errors are clustered by loan. *,**,*** indicate significance at the 10%, 5%, and 1% levels, respectively.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

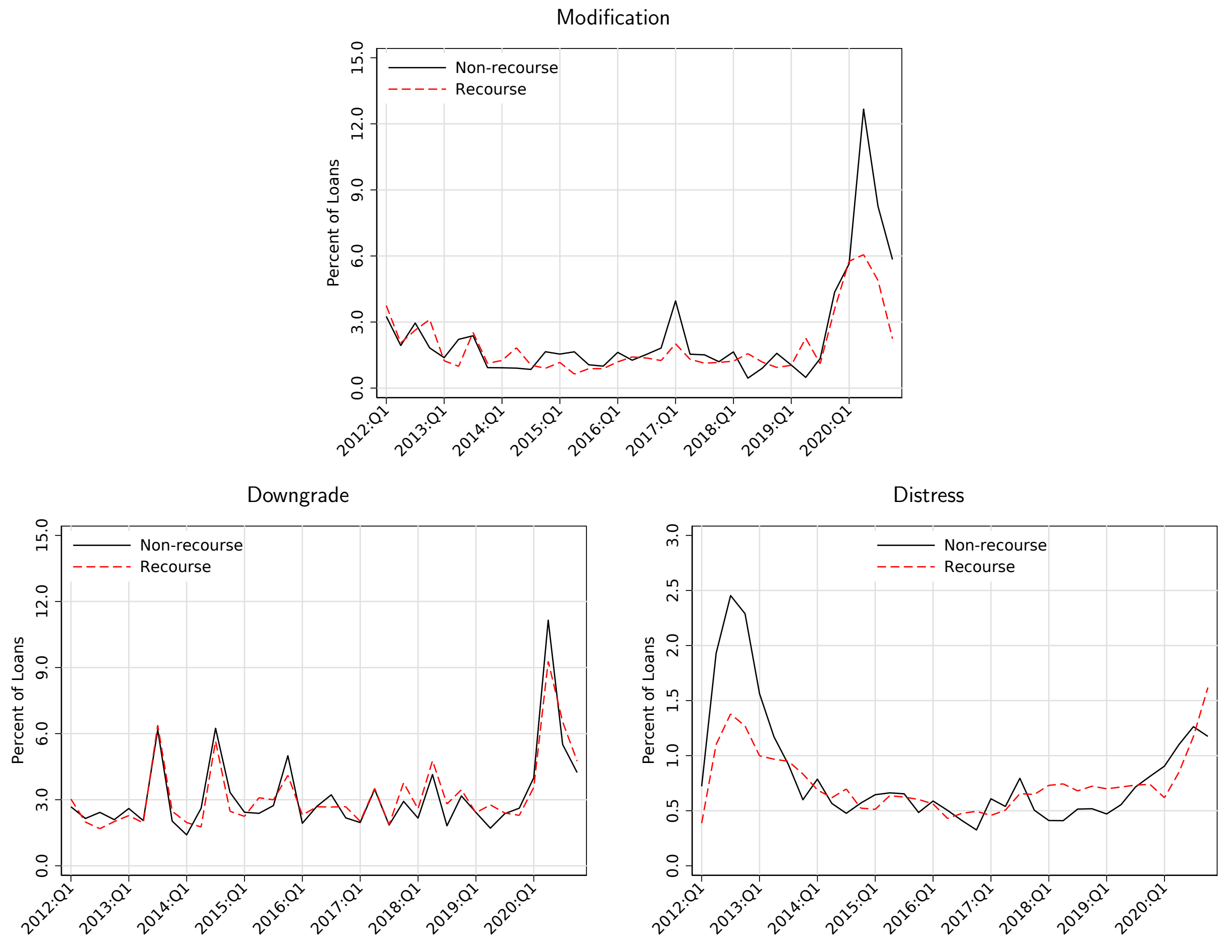


Figure 2: Average Predicted Effects. *Notes:* This figure shows predicted modification (top), downgrade (bottom left), and distress (bottom right) rates by recourse status and quarter, controlling for other observable characteristics. The estimates are from quarter-by-quarter regressions of the given dependent variable on the recourse dummy, with the controls and fixed effects from specification 2 in Table 6, run on a quarter-by-quarter basis. The solid black line shows the predicted rates were all loans non-recourse, while the dashed red line presents predicted rates were all loans recourse. The data from this figure are presented in Appendix Table B.7.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

# A. MODEL APPENDIX

We now interpret our estimates through the lens of Glancy et al. (2022)—a structural model of CRE loan underwriting where LTVs, spreads, and loan modifications endogenously respond to whether a loan has recourse. By calibrating the model to the estimates from Section 4, we can identify the structural parameters consistent with these estimates to better understand how recourse affects loan underwriting and modifications.

## *A.1. Model Set-up*

Glancy et al. (2022) presents a trade-off model in the spirit of Leland (1994), but with borrowers able to negotiate temporary loan modifications, and lenders able to claim outside assets as part of a deficiency judgment. Borrowers own a property yielding after tax net operating income (NOI) of $X_t$ at time $t$, where $X_t$ follows a geometric-brownian motion process:

$$\frac{dX_t}{X_t} = \mu d_t + \sigma dZ_t.$$

Incomes are taxed at a rate $\tau$, creating an incentive for borrowers to partially fund the investment with debt so as to realize the benefit of a tax shield. Borrowers take out perpetual, defaultable debt with a flow coupon payment of $C$ secured by the investment property.

Following Hackbarth et al. (2007), borrowers can make a take it or leave it offer to their bank to lower the payment at the time to an amount below the promised coupon $C$. If banks reject the modification or if negotiations otherwise break down (which happens at an exogenous rate $\lambda$) the loan enters foreclosure and banks recover the amount:[41]

$$\text{Recovery}(X_t) = (1-\alpha^F)\frac{X_t}{r-\mu} + (1-\alpha^D)\theta\frac{C}{r},$$

where $\alpha^F$ and $\alpha^D$ are the proportional deadweight costs of foreclosures and deficiency judgments, respectively; $\frac{X_t}{r-\mu}$ is the present value of future NOI discounted at the rate $r$; and $\theta$ is the amount of recourse available as a fraction of the value of promised debt payments ($\frac{C}{r}$). The two parameters related to recourse are $\theta$, which determines how much borrowers expect to lose from a deficiency judgment, and $\alpha^D$, which determines the fraction of the deficiency judgment lost to legal costs (as opposed to the amount actually recovered by banks).

Glancy et al. (2022) solve for the equilibrium in this model and provide closed form solutions for the loan contracts offered by banks and the contract chosen by borrowers. In

[41]Borrowers' payout in this situation is $-\theta\frac{C}{r}$ reflecting the loss from the deficiency judgment.

| Estimated Parameters | | Model Fit | | |
|---|---|---|---|---|
| Parameter | Estimate | Moment | Target | Model |
| $\theta$ | 0.070 | Effect of Recourse on LTV | 2.80pp | 2.80pp |
| $\alpha^D$ | 0.322 | Effect of Recourse on Spreads | -20bp | -20bp |
| $\tau$ | 0.107 | Average LTV, Non-Recourse Loans | 58% | 58% |
| $\sigma$ | 0.278 | Average Spread, Non-Recourse Loans | 2.16% | 2.16% |
| $\alpha^F$ | 0.197 | 30% Foreclosure Cost, Brown et al. (2006) | 30% | 30% |
| $r$ | 0.067 | Average Cap Rate, CBRE | 5.50% | 5.50% |
| $\mu$ | 0.010 | Rent Growth, An et al. (2016) | 1% | 1% |
| $\lambda$ | 0.043 | $\frac{\lambda_{bank}}{r}$ =Bank Delinquency-to-Mod Rate | .64 | .64 |

Table A.1: Calibration Results. *Notes:* The first two columns show the estimated parameter values, while the last three columns show the targeted moments from the data and the corresponding moments in the calibrated model. $\mu$ is directly set, and the remaining parameters are jointly calibrated.

this equilibrium, borrowers optimally choose their modification strategy, banks make zero profits, and borrowers optimally choose the contract (LTV and spread) that maximizes their expected after-tax return.

### *A.2. Calibration*

We calibrate $\theta$ and $\alpha^D$ to hit the effects of recourse on LTV and rate spreads in the OLS specifications shown in Table 3 (a 20bp decline in spreads and 2.8pp increase in LTV).[42] $\tau$ and $\sigma$ determine the demand for leverage and the risk of downward movements in property values, respectively, so we target the average LTV and spreads on non-recourse loans. Other parameters as calibrated as in Glancy et al. (2022), targeting rent growth, cap rates, foreclosure costs, and modification rates from the data or other literature. Table A.1 shows the calibrated parameters and model fit.

[42]Intuitively, $\theta$ determines the size of a deficiency judgment for recourse loans and thus the magnitude with which banks are willing to offer higher LTVs for loans with recourse. $\alpha^D$ measures the cost of achieving a deficiency judgment. When these costs are higher, borrowers are less prone to increase LTVs for recourse loans (preferring to take lower spreads instead).

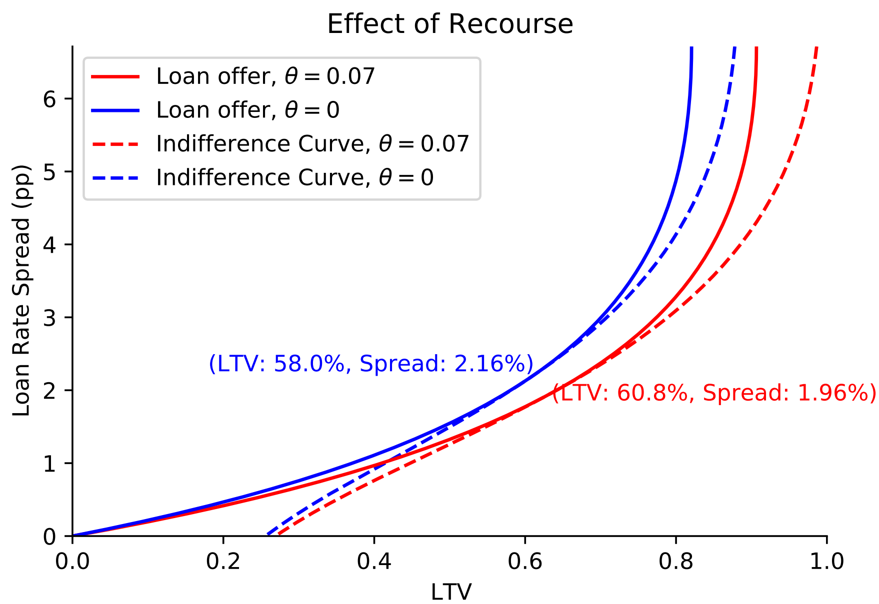


Figure A.1: Effects of Recourse on Loan Offers and Borrower Demand. *Notes:* Solid lines show loan offer curves (available spreads as function of LTV) for recourse loans (red) and non-recourse loans (blue). Dashed lines show borrower indifference curves corresponding to the chosen loan terms for recourse and non-recourse loans. These curves are derived in Glancy et al. (2022) and calibrated to match the effects of recourse identified in Section 4.

### *A.3. Effects of Recourse*

Figure A.1 plots the loan offer curves and indifference curves for recourse (red lines) and non-recourse (blue lines) loans based on the calibrated model. Recourse has two effects. First, it shifts out the supply curve; banks are willing to offer a higher LTV for any given loan rate spread when a loan has recourse. Second, recourse flattens investors' indifference curves; borrowers lose more from default, and are thus less willing to pay higher spreads in exchange for higher leverage. For the calibrated parameters, $\theta = .07$ and $\alpha^D = .32$, banks are willing to offer LTVs that are 6.3 percentage points higher for recourse loans (holding spreads constant at their level for non-recourse loans). However, borrowers do not choose to maintain spreads at that level, so instead LTV only rises by 2.8 percentage points and spreads fall by 20bp, as estimated in our regressions.

Figure A.2 shows that the model reproduces the four primary empirical findings in the paper. Each panel presents a heat map showing how a particular loan outcome changes with the amount of recourse (on the x-axis), and the loss from deficiency judgments (on the y-axis).

The top-left panel shows that loans with recourse receive lower loan rate spreads, as banks expect to face smaller losses due to modifications and foreclosures, and therefore compensate borrowers with more favorable loan pricing. Spreads fall more with recourse when $\alpha^D$ is high (that is, when recoveries from a deficiency judgment are lower). When $\alpha^D$ is high, recourse does little to bolster recoveries, instead it predominantly acts as a deterrent by making foreclosure costly to borrowers. In this case, borrowers prefer to ramp up leverage less, and instead take lower spread loans.

The top-right panel shows how LTVs at origination relate to the recourse variables. The effect of recourse on LTV is theoretically ambiguous; for high enough $\alpha^D$, recourse can lower LTVs by making borrowers more averse to default. The modest increase in LTVs for recourse loans demonstrated in Section 4 is thus consistent with moderate costs of deficiency judgments.

The bottom-left panel shows the threshold LTV at which loans are modified. Non-recourse loans are modified after property values fall to the point that current LTVs reach around 136 percent. For the values of $\theta$ and $\alpha^D$ in Table A.1, recourse borrowers do not default until LTVs rise to 148 percent. This result explains why borrowers can achieve a higher LTV and lower spreads with recourse. Despite the lower at-origination LTV, non-recourse borrowers still need a smaller decline in property values to hit the renegotiation threshold. Non-recourse borrowers need to pay for this higher renegotiation risk with higher spreads.

Finally, the bottom-right panel shows that recourse loans see a smaller decline in debt service cost at first modification, consistent with the comparatively smaller reductions in payments observed in the data. In the calibrated model, recourse loans see a 61% decline in debt service from modifications, while non-recourse borrowers see a 64% decline. The benefit of recourse in terms of dampening the size of modifications is more prominent when the costs of deficiency judgment are lower, as banks require larger payments to prevent them from choosing to foreclose (and reap the deficiency judgment.)

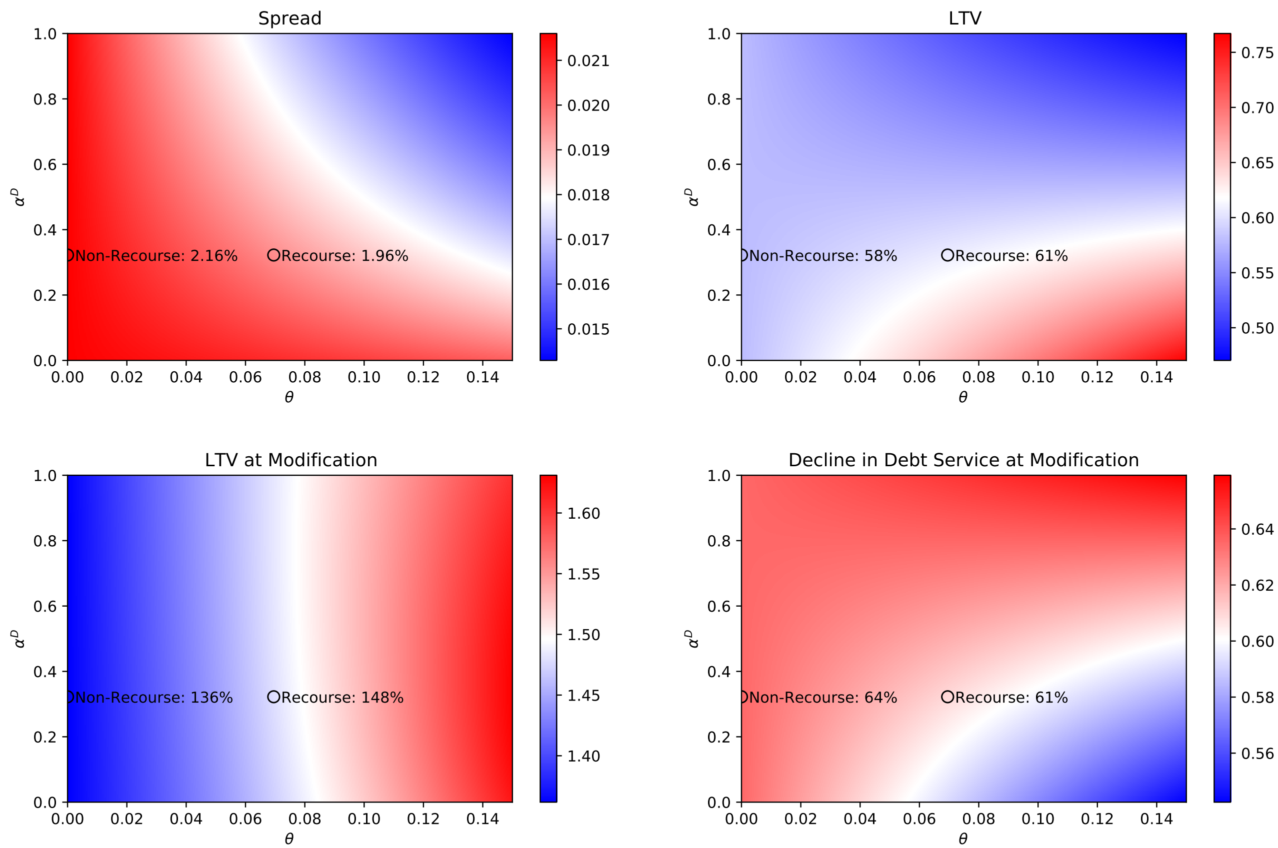


Figure A.2: Loan Outcomes by Recourse. *Notes:* Each chart plots a heat map showing how key loan outcomes depend on the amount of recourse ($\theta$) and the costs of deficiency judgments ($\alpha^D$). The labeled points report the outcome at the values of $\theta$ and $\alpha^D$ from the calibration discussed in Section A.2, giving the estimates for recourse and non-recourse loans for the parameterization consistent with the estimated effects in the OLS specifications reported in Table 3. The loan outcomes studied are the loan rate spread (top-left), the LTV at origination (top-right), the threshold LTV at which borrowers modify a loan (bottom-left), and the percentage decline in debt service costs at the time of first modification (bottom-right). All parameters besides $\theta$ and $\alpha^D$ are as in Table A.1.

# B. SUPPLEMENTAL TABLES

This section includes supplemental tables referenced in the text.

| | Loans (#) | Share of # | Share of $ | Orig. Value (Mil.$) | Orig. Amount (Mil.$) | Term (Years) | LTV (%) | Rate Spread (bps) | Prepay Penalty (%) | IO (%) | Floating Rate (%) | 1st Lien (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Transitional** | | | | | | | | | | | | |
| Overall | 45,883 | 100 | 100 | 21 | 11 | 7 | 65 | 273 | 30 | 59 | 72 | 96 |
| Recourse | 31,563 | 69 | 64 | 19 | 10 | 7 | 66 | 281 | 29 | 61 | 78 | 96 |
| No Recourse | 14,320 | 31 | 36 | 26 | 13 | 8 | 63 | 256 | 32 | 55 | 60 | 96 |

Table B.1: Summary Statistics for Loans Secured by Transitional Properties. *Notes:* This table presents summary statistics for loans at origination secured by transitional properties for the full sample and disaggregated by recourse status. All averages are unweighted.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Loans (#) | Share of # | Share of $ | Orig. Value (Mil.$) | Orig. Amount (Mil.$) | Term (Years) | LTV (%) | Rate Spread (bps) | Prepay Penalty (%) | IO (%) | Floating Rate (%) | 1st Lien (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Full Sample** | | | | | | | | | | | | |
| Overall | 55,748 | 100 | 100 | 18 | 9 | 17 | 55 | 197 | 79 | 14 | 32 | 99 |
| Full Recourse | 837 | 1 | 2 | 25 | 15 | 7 | 60 | . | 49 | 0 | . | 92 |
| Partial Recourse | 14,796 | 22 | 56 | 50 | 23 | 11 | 57 | 208 | 63 | 39 | 38 | 97 |
| No Recourse | 36,012 | 54 | 26 | 9 | 4 | 16 | 55 | 204 | 75 | 8 | 36 | 98 |
| No Recourse | 15,220 | 23 | 15 | 12 | 6 | 23 | 52 | 182 | 88 | 7 | 26 | 100 |
| **Industrial** | | | | | | | | | | | | |
| Overall | 3,663 | 100 | 100 | 17 | 9 | 8 | 56 | 220 | 66 | 17 | 49 | 98 |
| Full Recourse | 108 | 2 | 1 | 9 | 6 | 9 | 58 | . | 60 | 0 | . | 90 |
| Partial Recourse | 819 | 17 | 51 | 46 | 25 | 7 | 57 | 214 | 57 | 43 | 56 | 98 |
| No Recourse | 3,150 | 65 | 34 | 8 | 4 | 8 | 56 | 222 | 63 | 11 | 50 | 97 |
| No Recourse | 737 | 15 | 14 | 19 | 8 | 9 | 53 | 221 | 74 | 13 | 45 | 99 |
| **Lodging** | | | | | | | | | | | | |
| Overall | 1,125 | 100 | 100 | 50 | 23 | 7 | 56 | 247 | 52 | 28 | 63 | 97 |
| Full Recourse | 37 | 2 | 1 | 19 | 14 | 7 | 56 | . | 38 | 0 | . | 95 |
| Partial Recourse | 491 | 32 | 63 | 93 | 40 | 7 | 55 | 264 | 60 | 46 | 58 | 99 |
| No Recourse | 142 | 9 | 11 | 41 | 25 | 6 | 58 | 258 | 45 | 24 | 86 | 97 |
| No Recourse | 866 | 56 | 25 | 18 | 9 | 7 | 53 | 237 | 43 | 17 | 65 | 94 |
| **Multifamily** | | | | | | | | | | | | |
| Overall | 33,448 | 100 | 100 | 12 | 6 | 24 | 53 | 182 | 89 | 9 | 20 | 99 |
| Full Recourse | 147 | 0 | 1 | 25 | 15 | 7 | 64 | . | 46 | 0 | . | 92 |
| Partial Recourse | 7,680 | 21 | 52 | 29 | 16 | 13 | 58 | 195 | 65 | 32 | 24 | 96 |
| No Recourse | 11,702 | 31 | 22 | 9 | 4 | 28 | 51 | 172 | 96 | 3 | 18 | 100 |
| No Recourse | 17,817 | 48 | 26 | 7 | 3 | 24 | 53 | 187 | 90 | 4 | 22 | 100 |
| **Office** | | | | | | | | | | | | |
| Overall | 6,271 | 100 | 100 | 44 | 20 | 7 | 58 | 217 | 65 | 28 | 54 | 98 |
| Full Recourse | 188 | 2 | 3 | 44 | 24 | 7 | 62 | . | 52 | 0 | . | 92 |
| Partial Recourse | 2,286 | 28 | 69 | 110 | 47 | 6 | 58 | 214 | 62 | 58 | 64 | 98 |
| No Recourse | 4,712 | 58 | 20 | 12 | 7 | 7 | 59 | 221 | 63 | 14 | 50 | 97 |
| No Recourse | 953 | 12 | 9 | 27 | 15 | 8 | 57 | 212 | 64 | 22 | 58 | 98 |
| **Retail** | | | | | | | | | | | | |
| Overall | 7,939 | 100 | 100 | 19 | 7 | 8 | 56 | 215 | 67 | 16 | 47 | 99 |
| Full Recourse | 235 | 2 | 3 | 22 | 13 | 6 | 60 | . | 48 | 0 | . | 91 |
| Partial Recourse | 1,961 | 19 | 45 | 58 | 18 | 8 | 56 | 219 | 66 | 39 | 44 | 98 |
| No Recourse | 6,830 | 66 | 37 | 8 | 4 | 7 | 56 | 218 | 64 | 10 | 49 | 98 |
| No Recourse | 1,368 | 13 | 15 | 15 | 9 | 8 | 56 | 211 | 64 | 18 | 56 | 98 |

Table B.2: Full and Partial Recourse Summary Statistics. *Notes:* This table presents summary statistics for loans originated in 2015 or later across all such loans and disaggrgated by recourse status. We first present summary statistics for loans that are secured by all stabilized properties and then for the five largest property types in our sample. All averages are unweighted.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Effect on Rate Spreads (percentage points) | | | | Effect on LTV (percentage points) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Recourse | -0.108*** | -0.115*** | -0.115*** | -0.256*** | 2.757*** | 2.944*** | 2.792*** | 2.638 |
| | (0.0358) | (0.0343) | (0.0339) | (0.0813) | (0.870) | (0.838) | (0.895) | (1.790) |
| LTV | | 0.00231*** | 0.00114*** | 0.00249*** | | | | |
| | | (0.000346) | (0.000349) | (0.000350) | | | | |
| Interest Rate Spread | | | | | | 1.731*** | 0.858*** | 1.719*** |
| | | | | | | (0.302) | (0.284) | (0.327) |
| Borrower Rated BBB+ | | | -0.188*** | | | | -6.052*** | |
| | | | (0.0311) | | | | (1.415) | |
| Expected Loss | | | 0.0498*** | | | | 0.662*** | |
| | | | (0.00886) | | | | (0.115) | |
| ln(Origination Amount) | -0.141*** | -0.147*** | -0.141*** | -0.165*** | 2.607*** | 2.851*** | 2.802*** | 2.811*** |
| | (0.0106) | (0.0110) | (0.0103) | (0.0149) | (0.364) | (0.385) | (0.419) | (0.440) |
| ln(Maturity in Years) | -0.292*** | -0.289*** | -0.265*** | -0.297*** | -1.299*** | -0.793** | -0.472 | -0.813* |
| | (0.0515) | (0.0510) | (0.0492) | (0.0507) | (0.414) | (0.369) | (0.324) | (0.400) |
| Cross-Collateralized | 0.0239 | 0.0191 | 0.0232 | 0.0163 | 2.093 | 2.051 | 2.057 | 2.046 |
| | (0.0245) | (0.0239) | (0.0244) | (0.0249) | (1.415) | (1.406) | (1.394) | (1.390) |
| IO Loan | 0.00214 | 0.0103 | 0.00132 | -0.0104 | -3.560*** | -3.563*** | -3.759*** | -3.610*** |
| | (0.0225) | (0.0225) | (0.0210) | (0.0289) | (0.615) | (0.620) | (0.755) | (0.638) |
| Floating Rate | 0.0583 | 0.0581 | 0.0947 | 0.0714 | 0.0768 | -0.0241 | 1.009* | 0.00543 |
| | (0.120) | (0.120) | (0.107) | (0.124) | (0.265) | (0.379) | (0.544) | (0.362) |
| First Lien | -0.196** | -0.217** | -0.197** | -0.221** | 9.197*** | 9.535*** | 9.444*** | 9.526*** |
| | (0.0809) | (0.0819) | (0.0815) | (0.0827) | (2.173) | (2.224) | (2.147) | (2.243) |
| Prepayment Penalty | 0.0960 | 0.0940 | 0.103 | 0.0980 | 0.859* | 0.693 | 0.897** | 0.703 |
| | (0.0675) | (0.0671) | (0.0650) | (0.0672) | (0.504) | (0.472) | (0.440) | (0.502) |
| Industrial | 0.00810 | 0.00336 | 0.00172 | 0.00352 | 2.056*** | 2.042*** | 1.962*** | 2.043*** |
| | (0.0148) | (0.0149) | (0.0145) | (0.0157) | (0.441) | (0.451) | (0.469) | (0.450) |
| Lodging | 0.401*** | 0.411*** | 0.385*** | 0.417*** | -4.359*** | -5.053*** | -5.281*** | -5.038*** |
| | (0.0401) | (0.0399) | (0.0423) | (0.0377) | (0.572) | (0.534) | (0.578) | (0.523) |
| Office | 0.0219 | 0.0162 | 0.00822 | 0.0179 | 2.481*** | 2.443*** | 2.248*** | 2.448*** |
| | (0.0168) | (0.0171) | (0.0182) | (0.0173) | (0.374) | (0.378) | (0.439) | (0.374) |
| N | 33,606 | 33,606 | 33,342 | 33,606 | 33,606 | 33,606 | 33,342 | 33,606 |
| R2 | 0.32 | 0.32 | 0.35 | 0.11 | 0.18 | 0.18 | 0.21 | 0.04 |
| Lender Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Orig. Year Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| CBSA × State Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| IV | - | - | - | Y | - | - | - | Y |

Table B.3: Effect of Recourse on Rate Spreads and LTV, Excluding Loans on Multifamily Properties. *Notes:* Columns 1–4 present coefficients from regressing loan rate spreads on an indicator for whether the loan has recourse, while columns 5–8 present coefficients from regressing LTV at origination on recourse. All specifications include controls for size, term, cross-collateralization, amortization, interest rate variability, lien priority, and prepayment penalties, as well as bank, property type, origination year, and CBSA-state fixed effects. Columns 2–4 and 6–8 additionally control for LTV or loan rate spreads, respectively. In addition, columns 3 and 7 layer in risk controls: an indicator for whether the internal risk rating is equivalent to that of an investment-grade credit (rated BBB or higher) and the loan expected loss (probability of default times loss given default). Column 4 instruments for both recourse and LTV with the average value for the recourse indicator and LTV of other loans within the same bank-state-year-property type. Retail is the excluded property type category. Column 8 instruments for recourse with the share of other loans within the same bank-state-year-property type that have recourse. Standard errors, in parentheses, are clustered at the bank level. *,**,*** indicate significance at the 10%, 5%, and 1% levels, respectively.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | NOI Growth | NOI Volatility | > 10% Decline |
|---|---|---|---|
| | (1) | (2) | (3) |
| Recourse | 0.00313 | 0.00314 | 0.0106** |
| | (0.00829) | (0.00420) | (0.00472) |
| LTV | 0.000168 | -0.0000521 | -0.000470*** |
| | (0.000244) | (0.0000818) | (0.0000920) |
| ln(Origination Amount) | 0.000746 | -0.0126*** | -0.0163*** |
| | (0.00333) | (0.00161) | (0.00181) |
| ln(Maturity in Years) | -0.0135** | -0.0252*** | -0.0262*** |
| | (0.00502) | (0.00291) | (0.00327) |
| Cross-Collateralized | 0.0515** | 0.0637*** | -0.00270 |
| | (0.0242) | (0.00742) | (0.00835) |
| IO Loan | -0.00931 | 0.0177*** | 0.0223*** |
| | (0.0108) | (0.00508) | (0.00571) |
| Floating Rate | 0.00328 | -0.00372 | -0.0169*** |
| | (0.0131) | (0.00345) | (0.00388) |
| First Lien | 0.0111 | -0.00630 | -0.0311** |
| | (0.0244) | (0.0138) | (0.0156) |
| Prepayment Penalty | -0.00628 | -0.0234*** | -0.0245*** |
| | (0.00712) | (0.00410) | (0.00461) |
| Industrial | 0.0260*** | 0.0187*** | -0.0118* |
| | (0.00912) | (0.00604) | (0.00679) |
| Lodging | -0.00695 | 0.0110 | 0.0983*** |
| | (0.0112) | (0.00919) | (0.0103) |
| Multifamily | 0.0102* | 0.00907** | 0.0150*** |
| | (0.00566) | (0.00459) | (0.00517) |
| Office | -0.00239 | 0.0299*** | 0.0416*** |
| | (0.00892) | (0.00497) | (0.00559) |
| N | 51,303 | 51,303 | 51,303 |
| R2 | 0.05 | 0.07 | 0.09 |
| Lender Fixed Effects | Y | Y | Y |
| Orig. Year Fixed Effects | Y | Y | Y |
| CBSA × State Fixed Effects | Y | Y | Y |

Table B.4: Effect of Recourse on Ex-Post NOI Growth. *Note:* NOI Growth is defined as the annualized log difference in the last pre-2020 NOI observed and the first NOI observed. All specifications include controls for size, term, cross-collateralization, amortization, interest rate variability, lien priority, and prepayment penalties, as well as bank, property type, origination year, and CBSA-state fixed effects. Column (1) has annualized growth as the dependent variable. Column (2) has a measure of NOI volatility, which is the squared residual of NOI growth from column (1). Column (3) has an indicator for whether NOI growth declined by at least 10 percent. Standard errors, in parentheses, are clustered at the bank level. *,**,*** indicate significance at the 10%, 5%, and 1% levels, respectively. *Source:* Authors' calculations using the Y-14 H.2 Schedule.

| | Standardized differences | | Variance ratio | |
|---|---|---|---|---|
| | Raw | Matched | Raw | Matched |
| ln(Origination Amount) | –1.07 | 0.04 | 0.43 | 0.98 |
| ln(Maturity in Years) | 0.80 | 0.31 | 1.77 | 1.12 |
| Interest Only | –0.74 | 0.00 | 0.29 | 1.00 |
| First Lien | 0.15 | 0.00 | 0.31 | 1.00 |
| Floating Rate | –0.20 | –0.32 | 0.90 | 0.96 |
| Prepayment Penalty | 0.48 | 0.15 | 0.73 | 0.91 |
| Cross-Collateralized | –0.12 | –0.07 | 0.57 | 0.73 |
| Industrial | 0.01 | –0.15 | 1.04 | 0.65 |
| Lodging | –0.11 | 0.03 | 0.53 | 1.19 |
| Mixed | –0.03 | –0.06 | 0.73 | 0.60 |
| Multifamily | 0.27 | 0.22 | 0.95 | 0.99 |
| Office | –0.18 | –0.09 | 0.67 | 0.83 |
| Other | –0.12 | –0.05 | 0.67 | 0.86 |
| Retail | –0.06 | –0.06 | 0.89 | 0.90 |
| Mean Recourse By Geography | –0.06 | 0.01 | 0.85 | 1.04 |
| Mean Recourse by Lender | –0.03 | –0.03 | 0.93 | 0.93 |
| Orig Year = 2013 | 0.06 | 0.11 | 1.15 | 1.29 |
| Orig Year = 2014 | 0.10 | 0.04 | 1.24 | 1.09 |
| Orig Year = 2015 | –0.13 | –0.08 | 0.73 | 0.84 |
| Orig Year = 2016 | –0.15 | –0.11 | 0.68 | 0.76 |
| Orig Year = 2017 | 0.02 | 0.07 | 1.04 | 1.22 |
| Orig Year = 2018 | 0.09 | 0.10 | 1.33 | 1.41 |
| Orig Year = 2019 | 0.84 | 0.08 | 0.84 | 0.90 |
| Orig Year = 2020 | 1.51 | 0.08 | 0.48 | 1.11 |

Table B.5: Standardized Differences and Variance Ratios for the Full Sample Propensity Score Match. *Source:* Y-14 H.2 Schedule.

| | Standardized differences | | Variance ratio | |
|---|---|---|---|---|
| | Raw | Matched | Raw | Matched |
| ln(Origination Amount) | –0.92 | 0.02 | 0.48 | 0.93 |
| ln(Maturity in Years) | 0.01 | 0.09 | 1.13 | 0.73 |
| Interest Only | –0.62 | –0.01 | 0.49 | 0.99 |
| First Lien | –0.01 | 0.02 | 1.09 | 0.86 |
| Floating Rate | –0.10 | –0.10 | 1.02 | 1.03 |
| Prepayment Penalty | 0.15 | 0.09 | 0.98 | 1.00 |
| Cross-Collateralized | –0.03 | –0.03 | 0.92 | 0.90 |
| Industrial | 0.14 | –0.05 | 1.33 | 0.92 |
| Lodging | –0.09 | 0.03 | 0.72 | 1.13 |
| Mixed | –0.00 | –0.00 | 0.98 | 0.98 |
| Office | –0.11 | –0.00 | 0.90 | 1.00 |
| Other | –0.06 | –0.01 | 0.89 | 0.99 |
| Retail | 0.10 | 0.03 | 1.09 | 1.02 |
| Mean Recourse By Geography | –0.05 | –0.02 | 0.88 | 0.95 |
| Mean Recourse by Lender | –0.00 | –0.06 | 0.99 | 0.87 |
| Orig Year = 2013 | 0.01 | 0.02 | 1.02 | 1.04 |
| Orig Year = 2014 | 0.07 | 0.03 | 1.17 | 1.06 |
| Orig Year = 2015 | –0.01 | –0.05 | 0.98 | 0.88 |
| Orig Year = 2016 | –0.06 | 0.02 | 0.86 | 1.07 |
| Orig Year = 2017 | –0.03 | 0.07 | 0.92 | 1.23 |
| Orig Year = 2018 | 0.11 | 0.07 | 1.49 | 1.28 |
| Orig Year = 2019 | 0.29 | 0.04 | 0.93 | 0.92 |
| Orig Year = 2020 | 0.85 | 0.04 | 0.79 | 1.24 |

Table B.6: Standardized Differences and Variance Ratios for the Propensity Score Match Excluding Multifamily. *Source:* Y-14 H.2 Schedule.

| | Modification Rate (%) | | Downgrade Rate (%) | | Distressed Rate (%) | |
|---|---|---|---|---|---|---|
| | Non-recourse | Recourse | Non-recourse | Recourse | Non-recourse | Recourse |
| 2012 | | | | | | |
| Q1 | 3.25 | 3.75 | 2.68 | 3.03 | 0.72 | 0.39 |
| Q2 | 1.94 | 2.05 | 2.15 | 1.98 | 1.93 | 1.10 |
| Q3 | 2.96 | 2.63 | 2.42 | 1.69 | 2.45 | 1.38 |
| Q4 | 1.83 | 3.12 | 2.09 | 2.01 | 2.29 | 1.27 |
| 2013 | | | | | | |
| Q1 | 1.38 | 1.24 | 2.60 | 2.28 | 1.56 | 1.00 |
| Q2 | 2.21 | 0.99 | 2.05 | 1.95 | 1.17 | 0.97 |
| Q3 | 2.38 | 2.52 | 6.17 | 6.38 | 0.92 | 0.95 |
| Q4 | 0.93 | 1.13 | 2.03 | 2.48 | 0.60 | 0.83 |
| 2014 | | | | | | |
| Q1 | 0.92 | 1.26 | 1.40 | 1.96 | 0.79 | 0.69 |
| Q2 | 0.91 | 1.83 | 2.61 | 1.76 | 0.57 | 0.62 |
| Q3 | 0.85 | 1.05 | 6.24 | 5.66 | 0.48 | 0.70 |
| Q4 | 1.65 | 0.90 | 3.33 | 2.47 | 0.57 | 0.52 |
| 2015 | | | | | | |
| Q1 | 1.55 | 1.17 | 2.43 | 2.24 | 0.65 | 0.51 |
| Q2 | 1.65 | 0.64 | 2.38 | 3.09 | 0.66 | 0.64 |
| Q3 | 1.06 | 0.88 | 2.73 | 3.00 | 0.65 | 0.62 |
| Q4 | 1.00 | 0.89 | 5.00 | 4.11 | 0.48 | 0.60 |
| 2016 | | | | | | |
| Q1 | 1.62 | 1.19 | 1.93 | 2.31 | 0.59 | 0.56 |
| Q2 | 1.27 | 1.42 | 2.70 | 2.68 | 0.50 | 0.43 |
| Q3 | 1.53 | 1.37 | 3.22 | 2.67 | 0.41 | 0.48 |
| Q4 | 1.82 | 1.25 | 2.18 | 2.68 | 0.33 | 0.49 |
| 2017 | | | | | | |
| Q1 | 3.96 | 2.01 | 1.96 | 2.02 | 0.61 | 0.46 |
| Q2 | 1.54 | 1.31 | 3.47 | 3.52 | 0.54 | 0.51 |
| Q3 | 1.51 | 1.13 | 1.85 | 1.87 | 0.79 | 0.65 |
| Q4 | 1.20 | 1.17 | 2.92 | 3.77 | 0.50 | 0.65 |
| 2018 | | | | | | |
| Q1 | 1.65 | 1.22 | 2.16 | 2.58 | 0.41 | 0.73 |
| Q2 | 0.45 | 1.56 | 4.14 | 4.77 | 0.41 | 0.74 |
| Q3 | 0.91 | 1.18 | 1.82 | 2.81 | 0.52 | 0.68 |
| Q4 | 1.58 | 0.94 | 3.17 | 3.45 | 0.52 | 0.72 |
| 2019 | | | | | | |
| Q1 | 1.05 | 1.04 | 2.43 | 2.40 | 0.47 | 0.70 |
| Q2 | 0.49 | 2.27 | 1.71 | 2.77 | 0.56 | 0.72 |
| Q3 | 1.34 | 1.11 | 2.37 | 2.40 | 0.72 | 0.73 |
| Q4 | 4.36 | 3.59 | 2.62 | 2.29 | 0.81 | 0.74 |
| 2020 | | | | | | |
| Q1 | 5.65 | 5.76 | 4.00 | 3.56 | 0.91 | 0.62 |
| Q2 | 12.67 | 6.06 | 11.15 | 9.28 | 1.10 | 0.85 |
| Q3 | 8.25 | 4.89 | 5.51 | 6.54 | 1.26 | 1.17 |
| Q4 | 5.84 | 2.24 | 4.24 | 4.75 | 1.18 | 1.62 |

Table B.7: VALUES FOR FIGURE 2. *Notes:* This table presents the values for the lines plotted in Figure 2.
*Source:* Authors' calculations using the Y-14 H.2 Schedule.