The Value of Renegotiation Frictions: Evidence from Commercial Real Estate

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Motivation: Differences in Modification Patterns Across CRE Lenders

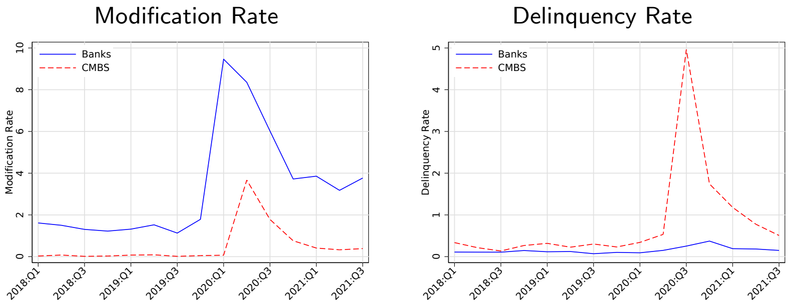


Figure: Bank and CMBS Modification and Delinquency Rates.

- Supply side reasons for these differences
  - CMBS: Mods restricted by REMIC rules and PSAs
  - Portfolio lenders (banks and life insurers): Encouraged by regulators to modify loans during pandemic
- Attribute these differences to there being differences in the degree of modification frictions between the lender types

▸ Institutional details ▸ Lender Heterogeneity in Modification Frictions in Other Markets

This Paper: Empirical Findings and Quantitative Results

Facts on modification and delinquency rates across lenders

- Banks modify loans earlier and more often than CMBS
- Modifications support performance of stressed loans but more mods at lower levels of distress

▸ Data ▸ LTVs/DSCRs ▸ Property Types ▸ Mod Types

Develop model of loan underwriting and renegotiation to match empirics

- High and low modification friction lenders $\implies$ difference in mod and delinquency rates
- Model can also rationalize cross-lender differences in spreads and LTVs at origination
  - Frictions $\uparrow$ debt capacity, attracting borrowers seeking higher leverage
- Perform a relevant policy counterfactual
  - Reducing CMBS modification frictions lowers welfare

Environment overview

Trade-off model adapted to CRE market

- Investors (borrowers)/lenders risk neutral (discount rate r)
- Property produces stochastic, after-tax cash flows X_t:

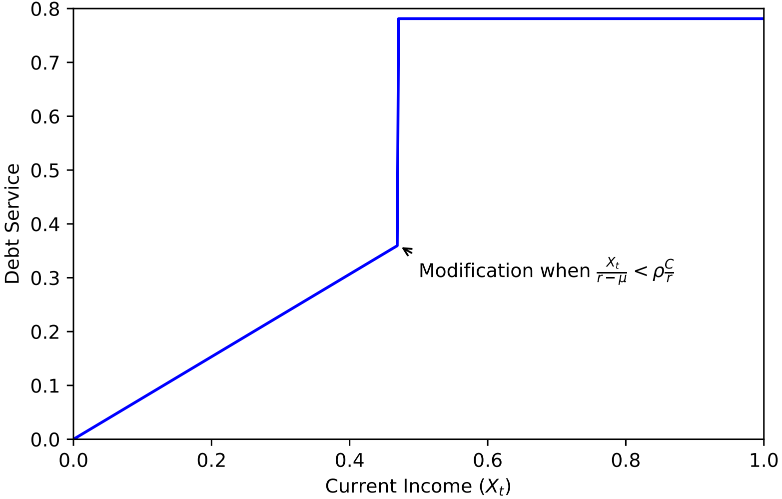
$$\frac{dX_t}{X_t} = \mu dt + \sigma dZ_t$$

- Financed with debt promising flow coupon of C
  - Investors earn flow return: $X_t - (1 - \tau)C$
  - Borrowers heterogeneous in demand for leverage τ
- Mods: Borrowers can make take-it-or leave it offer to lender, lender either accepts or forecloses (Hackbarth, Hennessy and Leland, RFS 2007)
- Heterogeneous lenders: extra elements to match data
  - Foreclosures out of modification region: Negotiations break down with arrival rate λ
  - Lenders can also have recourse θ on loans
    - Lowers loss given default (LGD) for lender, increases LGD for borrower (Glancy, Kurtzman, Loewenstein, Nichols, REE 2023)

▸ Modification Details ▸ Recourse Details

Modification Frictions and Strategic Renegotiation

Figure: Debt Service Payments by X_t



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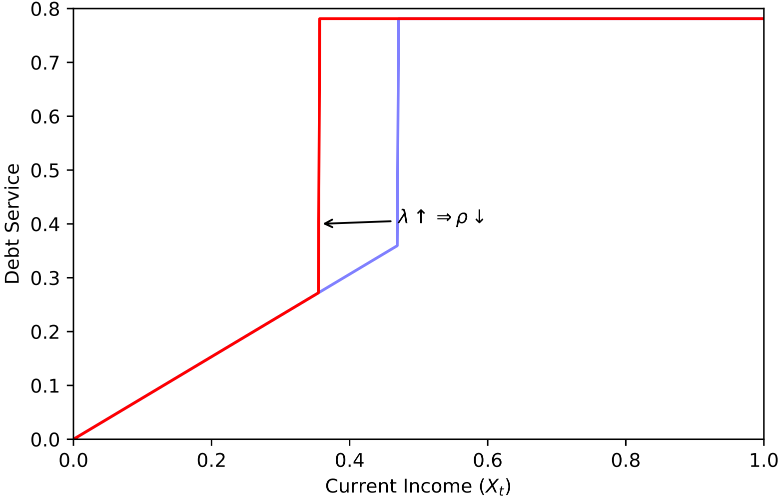
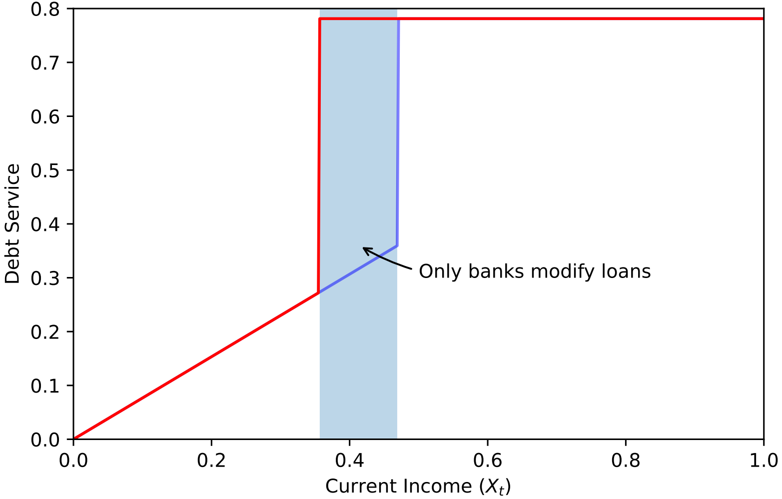


Modification Frictions and Strategic Renegotiation

Figure: Debt Service Payments by X_t



Credit Supply

Competitive lenders: loan size & rates s.t. loans price at par
$\Longrightarrow$ LTV concave in spreads, increasing in θ and λ.

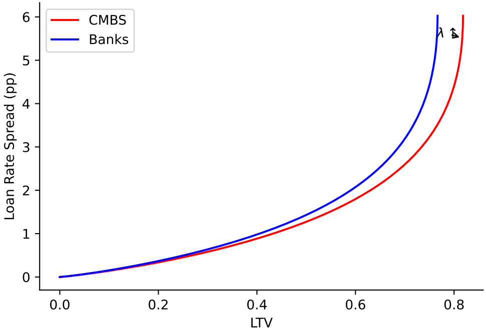
$$LTV(s) = \frac{s^{\frac{1}{\gamma}}(1-s)}{\chi^{\frac{1}{\gamma}}\rho}$$

where

- $LTV \equiv \frac{L}{X_0/(r-\mu)}$
- $s \equiv \frac{r^m - r}{r^m}$ reflects rate spreads
- ρ reflects strategic default incentives (the modification boundary)
- χ reflects loss given default
- $\frac{1}{\gamma}$ reflects risk of downward income movement

Derivation

Figure: Modification Frictions and Credit Supply

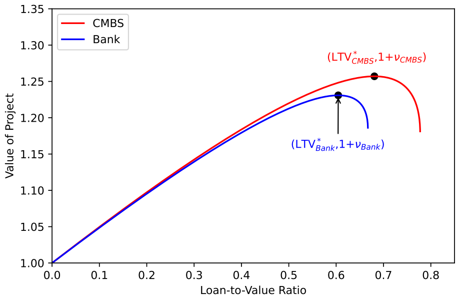


- Lower spreads for a given LTV from higher modification friction lenders

Selection of Loan Terms

- Borrowers face tradeoffs in determining their preferred lender: easier mods and lower risk of delinquency vs. more debt capacity

Figure: Values by Lender over LTVs for a High Demand for Leverage Borrower



- In equilibrium, borrowers which vary in demand for leverage (τ) endogenously sort into lenders depending on who is their preferred lender

Borrower Choice Details
Sorting and Aggregation

Calibration Strategy

Borrowers choose between 3 lenders (j) defined by (λ_j, θ_j):

- $(\lambda_H, 0)$: non-recourse, frictional modification (e.g. CMBS)
- (λ_L, θ): recourse, easy modification (e.g. most banks)
- $(\lambda_L, 0)$: non-recourse, easy modification (e.g. some banks, life insurers)

Moments for these parameters:

- Modification friction parameters calibrated to delinquency-to-modification rates of banks and CMBS
- Recourse parameters calibrated to moments from Glancy, Kurtzman, Loewenstein, and Nichols (REE, 2023)

Demand for leverage distribution

- Calibrated to CMBS LTV distribution
  - τ_i is beta distributed with shape parameters a & b, with support $[\underline{\tau}, \overline{\tau}] \rightarrow$ calibrate $a, b, \underline{\tau}, \overline{\tau}$
- Intentionally matching CMBS LTV distribution but not distributions of bank or life insurer LTVs or spreads

Other parameters $(\alpha^F, \sigma, \mu, r, \epsilon)$ from data or other literature

Calibration Results

Table: Calibration Results

Estimated Parameters		Model Fit		
Parameter	Estimate	Moment	Target	Model
Directly Set				
μ	0.010	Rent Growth, An et al. (2016)	1%	1%
$\underline{\tau}$	0.051	Min CMBS LTV	30%	30%
$\overline{\tau}$	0.564	Max CMBS LTV	75%	75%
λ_{Bank}	0.055	$\frac{\lambda_{\text{Bank}}}{r}$ =Bank Delinquency-to-Mod Rate	0.79	0.79
λ_{CMBS}	0.558	$\frac{\lambda_{\text{CMBS}}}{r}$ =CMBS Delinquency-to-Mod Rate	7.95	7.95
Jointly Estimated				
r	0.070	Average Cap Rate, CBRE	5.50%	5.50%
α^F	0.233	30% Foreclosure Cost, Brown et al. (2006)	30%	30%
σ	0.255	Average CMBS Spread	2.43%	2.43%
ϵ	17.624	Effect of 25bp shock on CMBS share	-37.5%	-37.5%
a	1.109	Average CMBS LTV	0.64	0.64
b	2.670	Dispersion in CMBS LTV	0.06	0.06
θ	0.084	Effect of Recourse on LTV	2.90	2.90
α^D	0.401	Effect of Recourse on Spreads	-19bp	-19bp

- Match targeted moments closely, even though some parameters have to be jointly estimated

Modification frictions | Recourse | Demand for leverage

Average LTV and Spreads by Lender

Table: Average LTVs and Spreads

Model		Data	
LTVs			
$(\lambda_H, 0)$	64	CMBS	64
(λ_L, θ)	58	Bank	58
$(\lambda_L, 0)$	52	Life	56
Spreads			
$(\lambda_H, 0)$	2.43	CMBS	2.43
(λ_L, θ)	1.89	Bank	2.27
$(\lambda_L, 0)$	1.83	Life	2.18

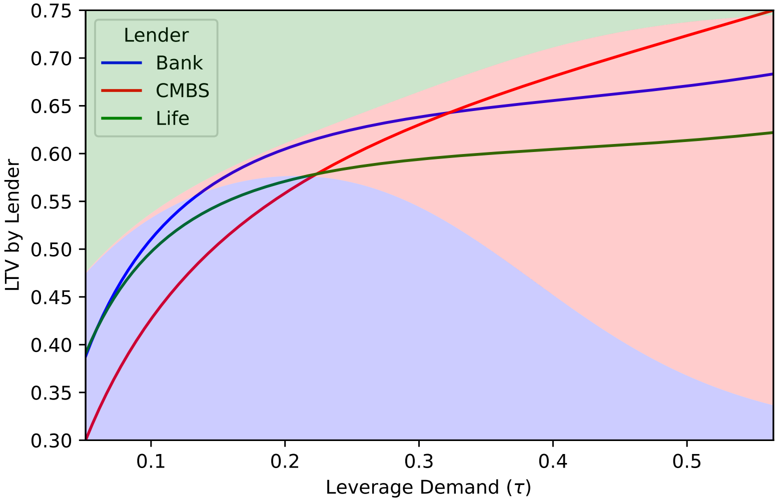
- CMBS have higher average LTVs and spreads in model and data
- Might be counterintuitive as CMBS offer lower spreads for a given LTV

Mechanisms

Sorting Drives Higher Average LTVs for CMBS

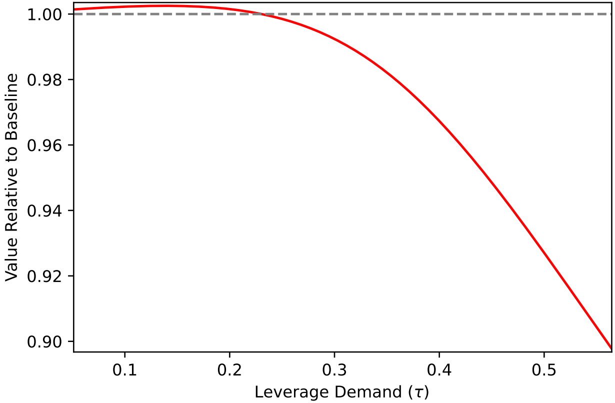
Higher demand for leverage borrowers prefer CMBS more on average due to their higher capacity

Figure: LTVs and Market Shares by τ



Welfare Implications of Lower CMBS Modification Frictions

Figure: Change in welfare from reducing modification frictions at CMBS to be closer to those of banks or life insurers ($\lambda_{CMBS} \downarrow$ by four-fifths)



- Heterogeneous effects, negative effects for borrowers that preferred CMBS

Welfare Value Functions | Relaxing Model Assumptions

Summary

- Stark differences in modification and delinquency rates across lender types
  - Attribute these differences to there being differences in the degree of modification frictions across lenders
- Build model consistent with empirics
  - Model can also rationalize cross-lender differences in LTVs and spreads at origination
    - High modification friction lenders provide more debt capacity, and so are preferred by higher demand for leverage borrowers
  - Perform a relevant policy counterfactual which shows the heterogeneous effects of lowering modification frictions at CMBS
    - Lowers welfare for the borrowers who value debt capacity, increases welfare (modestly) for those borrowers that prefer lower modification frictions

Appendix Slides

Institutional Background

Factors limiting CMBS modifications

- Tax considerations
  - CMBS pools are structured as real estate mortgage investment conduits (REMICs) to be exempt from federal income tax.
  - REMICs must hold a static pool of assets. Substantial modifications can be considered a new loan, jeopardizing the REMIC status.
- Pooling and Servicing Agreements (PSAs)
  - PSAs can place restrictions on servicers' modification options.
  - Investors want restrictions to preserve REMIC status, prevent conflicts of interest across tranches.

Balance sheet lenders less restricted in modifications.

- No PSA or REMIC restrictions for balance sheet loans.
- U.S. regulatory agencies have at times encouraged modifications.

$\Longrightarrow$ Differences in modifications reflect different servicing technologies.

▸ Back

Other Credit Markets

Numerous credit markets feature lenders differing in modification frictions

- Bank vs. CMBS commercial real estate loans Black, Krainer & Nichols (2017, 2020); Flynn, Ghent & Tchistyi (2022)
- Commercial and industrial loans vs. bonds Gertner & Scharfstein (1991); Hackbarth, Hennessy & Leland (2007)
- Portfolio vs. securitized residential mortgages Piskorski, Seru & Vig (2010); Agarwal et al. (2011); Adelino, Gerardi & Willen (2013)

Back

Data

Data sets:

- Bank loans: Y-14 CRE Schedule (H.2)
    - Quarterly data on loans over \$1 million, secured by stabilized commercial properties, by banks with over \$100 billion in assets.
- CMBS Loans: Trepp
    - Monthly data on securitized, non-agency CRE loans.

Identification of Modifications:

- Banks: Modifications inferred from changes in loan terms
    - Most common: Forbearance (balance$\uparrow$) & Extension (maturity$\uparrow$).
    - Others: Interest Only Switch, principle reduction, TDR.
- CMBS: Modification date and type directly reported.
    - Most common: Forbearance, "other," extension.

Back

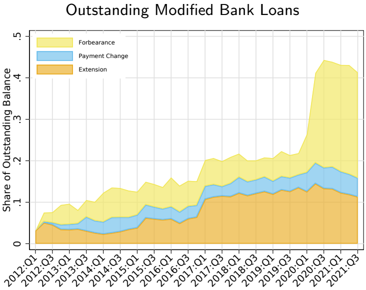
Banks modifications by property type

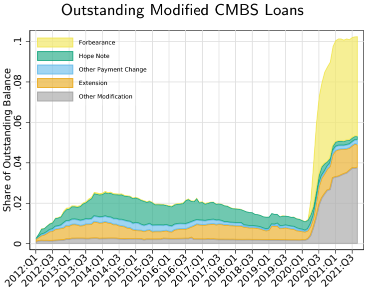
	2018:Q1–2019:Q4					2020:Q1–2021:Q3				
	Mod. Rate					Mod. Rate				
	All	Pay	Other	Delinq. Rate	Delinq. or Pay Mod.	All	Pay	Other	Delinq. Rate	Delinq. or Pay Mod.
Banks										
Industrial	1.17	0.49	0.68	0.09	0.58	4.89	3.97	0.93	0.06	4.02
Lodging	2.93	2.01	0.93	0.23	2.22	11.09	9.20	1.89	1.01	9.97
Office	1.59	0.73	0.86	0.11	0.83	6.14	5.02	1.12	0.14	5.14
Retail	1.21	0.50	0.71	0.11	0.60	4.65	3.29	1.36	0.21	3.48
CMBS										
Industrial	0.05	0.04	0.01	0.25	0.29	0.01	0.01	0.00	0.25	0.27
Lodging	0.04	0.02	0.02	0.29	0.31	3.76	2.40	1.36	4.11	6.43
Office	0.05	0.02	0.03	0.21	0.23	0.15	0.06	0.10	0.35	0.41
Retail	0.05	0.01	0.03	0.26	0.27	0.60	0.36	0.24	1.12	1.46

Table: Modification and Delinquency Rates.

Back

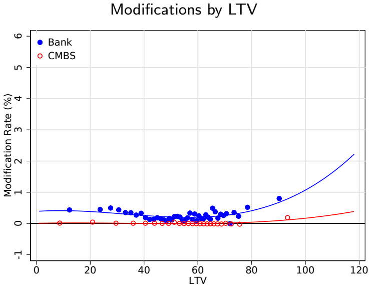
Cumulative View of Mods

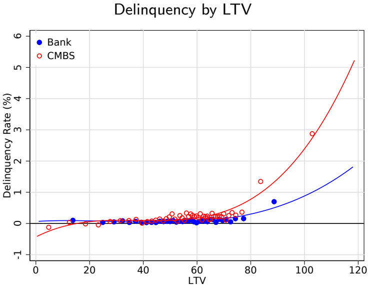




Back

Banks modify loans preemptively



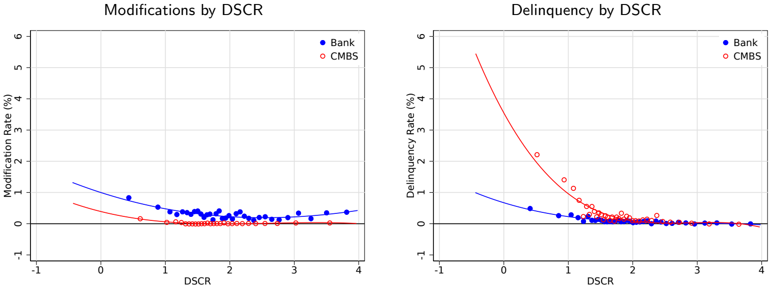


- Banks start modifying at lower LTVs.
- Banks have fewer delinquencies for stressed loans, but more for less-stressed loans.

Similar results by ▸ DSCR ▸ Regression Table

▸ Back

Banks modify at higher DSCRs



Back

Regressions Predicting Delinquency and Modification

	Delinquency	All Mods	Payment Mods	Delinquency	All Mods	Payment Mods
	(1)	(2)	(3)	(4)	(5)	(6)
CMBS	0.0594**	-0.968***	-0.386***	0.0741***	-1.522***	-0.864***
	(0.0289)	(0.0633)	(0.0464)	(0.0243)	(0.0533)	(0.0343)
CMBS × COVID	0.283***	-1.512***	-1.444***			
	(0.0462)	(0.102)	(0.0744)			
CMBS × LTV				0.0133***	-0.00369	-0.0105***
				(0.00103)	(0.00225)	(0.00145)
LTV	0.0202***	-0.00414**	0.00000742	0.0128***	-0.00267	0.00550***
	(0.000855)	(0.00187)	(0.00137)	(0.000904)	(0.00199)	(0.00128)
N	453,255	451,793	452,425	360,594	359,846	360,177
R2	0.03	0.05	0.05	0.02	0.03	0.03
Mean of Dep. Var. for Banks (%)	.11	1.51	.8	.09	1.14	.47
State × Qtr FEs	Y	Y	Y	Y	Y	Y
Property Type × Qtr FEs	Y	Y	Y	Y	Y	Y
Originator by Orig. Year FEs	Y	Y	Y	Y	Y	Y
Controls× COVID	Y	Y	Y	-	-	-
Sample	2012:Q1–2021:Q3	2012:Q1–2021:Q3	2012:Q1–2021:Q3	2012:Q1–2019:Q4	2012:Q1–2019:Q4	2012:Q1–2019:Q4

Back

Credit Supply

Competitive lenders $\implies$ loan size (L) & rates (r^m) s.t. loans price at par

- Available contracts: $\{(L, r^m) \mid L = D_H(X_0; \underbrace{r^m L}_{C})\}$

Solving $L = D_H(X_0; r^m L)$ for unlevered LTV ($\frac{L}{X_0/(r-\mu)}$) gives:

$$LTV(s) = \frac{s^{\frac{1}{\gamma}}(1-s)}{\chi^{\frac{1}{\gamma}}\rho}$$

where

- $s \equiv \frac{r^m - r}{r^m}$ reflects rate spreads
- ρ reflects strategic default incentives (the modification boundary)
- χ reflects loss given default

$$\chi \equiv \frac{\frac{C}{r} - D(X_n)}{\frac{C}{r}}$$
$$= 1 - (1-\alpha^D)\theta - (1-\alpha^F)\rho$$

- $\frac{1}{\gamma}$ reflects risk of downward income movement

$$\gamma = \left(\mu - .5\sigma^2 + \sqrt{(.5\sigma^2 - \mu)^2 + 2\sigma^2 r}\right)/\sigma^2$$

Back

Value of a given lender

Borrowers choose coupon payment C and lender $j \in J$ to maximize project value.

- j defined by degree of modification frictions and recourse (λ_j, θ_j)
- Value at optimal C conditional on j:

$$v(X_0) = (1 + \underbrace{\nu(\lambda_j, \theta_j; \mathbf{b}_i)}_{\nu_{i,j}}) \frac{X_0}{r - \mu}$$

Back Further details

Value of a given lender

C chosen to maximize $v(X_0; C) = E_H(X_0; C) + D_H(X_0; C)$:

$$v(X_0) = \max_C \{ \frac{X_0}{r-\mu} + \frac{\tau C}{r} - \left(\frac{\frac{X}{r-\mu}}{\rho \frac{C}{r}} \right)^{-\gamma} \Lambda \frac{C}{r} \}$$

where Λ reflects the dead weight loss from modification (and is too complicated to put on the slide).
Solving for the optimal C^* and substituting into $v(X_0; C)$:

$$v(X_0) = \frac{X_0}{r-\mu} \left[1 + \underbrace{\tau \frac{\gamma}{1+\gamma} \left(\frac{\tau}{(1+\gamma)\Lambda} \right)^{\frac{1}{\gamma}} \rho^{-1}}_{\equiv \nu} \right].$$

Back

Loan modifications

Borrower can make a take-it-or-leave-it offer to lower debt service payment to $S(X)$, bank chooses to accept offer or foreclose.

- Negotiations breakdown at rate λ, reflecting modification frictions

Two regions for X_t: above and below modification boundary X_n

- H region ($X_t \geq X_n$)
  - Borrower pays C
- L region ($X_t < X_n$)
  - Borrower pays $S(X) < C$
  - Foreclosure arrives at rate λ

Back Further details

Borrower Modification Strategy

Borrower needs to choose a modified debt service offer, $S(X)$, and renegotiation threshold, X_n.

Take it or leave it offer $\implies$ $S(X)$ makes lender indifferent to foreclosure:

$$S(X) = (1-\alpha^F)X + (1-\alpha^D)\theta C$$

Renegotiation Boundary from smooth pasting condition:

$$\frac{X_n}{r-\mu} = \rho(\lambda, \theta; \mathbf{b}_i)\frac{C}{r}$$

- $\mathbf{b_i}$: Exogenous borrower-specific parameters
- $\rho_\lambda, \rho_\theta < 0 \implies$ recourse and breakdown risk discourage renegotiation

Back Further derivations

Modification Outcome Derivation

Given $S(X)$, the values of debt and equity in H and L region are determined by the following ODEs:

$$
\begin{aligned}
rD_H(X) &= C + \mu X D_H'(X) + \frac{1}{2}\sigma^2 X^2 D_H''(X) \\
rD_L(X) &= S(X) + \mu X D_L'(X) + \frac{1}{2}\sigma^2 X^2 D_L''(X) \\
rE_H(X) &= X - (1-\tau)C + \mu X E_H'(X) + \frac{1}{2}\sigma^2 X^2 E_H''(X) \\
rE_L(X) &= X - (1-\tau)S(X) \qquad \text{(flow net income)} \\
&\quad + \mu X E_L'(X) + \frac{1}{2}\sigma^2 X^2 E_L''(X) \qquad \text{(Expected Gain from X changing)} \\
&\quad - \lambda(\theta\frac{C}{r} + E_L(X)) \qquad \text{(Expected Loss from negotiations failing)}
\end{aligned}
$$

Back Further derivations

Modification Outcome Derivation (cont.)

Debt service offer: $S(X)$ is such that $D_L(X) = R(X)$. Substituting $R(X)$ into the ODE defining $D_L(X)$ gives:

- $S(X) = (1-\alpha^F)X + (1-\alpha^D)\theta C$

X_n from smooth-pasting and super contact conditions
$\implies \frac{X_n}{r-\mu} = \rho(\lambda, \theta; \mathbf{b}_i)\frac{C}{r}$, where ρ is a complicated expression (too complicated for the slide) that reflects the renegotiation threshold

Back

Recovery Rate with Recourse

In foreclosure, lender recovers

$$R(X) = (1 - \alpha^F)\frac{X}{r - \mu} + (1 - \alpha^D)\theta\frac{C}{r}$$

▸ Back

Sorting and Aggregation

Discrete choice set up for lender selection:

- Fréchet(ϵ) unobserved preferences $\Longrightarrow$
- Probability i chooses (λ_j, θ_j): $P_{i,j} \equiv \frac{\nu_{i,j}^{\epsilon}}{\sum\limits_{k \in J} \nu_{i,k}^{\epsilon}}$

Lenders differ in willingness to make high LTV loans, so we consider the effects of sorting based on leverage demand. If $\tau_i \sim f(\tau)$, average LTV is:

$$\overline{\text{LTV}_j} = \int_{\underline{\tau}}^{\overline{\tau}} \underbrace{\text{LTV}_j(\tau)}_{\text{LTV given } j, \tau} \underbrace{\frac{P_j(\tau) f(\tau)}{\int P_j(\tau') f(\tau') d\tau'}}_{\text{Density Given Lender Selection}} d\tau$$

Other portfolio moments calculated analogously.

Back

Calibration Results

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r	0.070	Average Cap Rate, CBRE	5.50%	5.50%
α^F	0.233	30% Foreclosure Cost, Brown et al. (2006)	30%	30%
σ	0.255	Average CMBS Spread	2.43%	2.43%
ϵ	17.624	Effect of 25bp shock on CMBS share	-37.5%	-37.5%
a	1.109	Average CMBS LTV	0.64	0.64
b	2.670	Dispersion in CMBS LTV	0.06	0.06
θ	0.084	Effect of Recourse on LTV	2.90	2.90
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- Modification friction parameters set to match pre-pandemic delinquency-to-modification rates for banks and CMBS

Back

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- Recourse parameters calibrated to match the effects of recourse on LTVs and spreads from Glancy, Kurtzman, Loewenstein, and Nichols (2023)

Back

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b	2.670	Dispersion in CMBS LTV	0.06	0.06
θ	0.084	Effect of Recourse on LTV	2.90	2.90
α^D	0.401	Effect of Recourse on Spreads	-19bp	-19bp

- Demand for leverage distribution is calibrated to moments of the CMBS LTV distribution

Back

Modifications and LTV

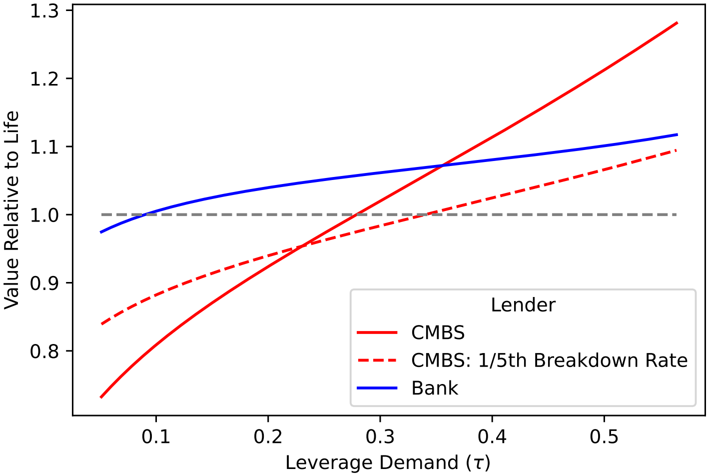
Effect of λ on LTV is theoretically ambiguous:

- Supply: High $\lambda \implies$ higher LTVs at lower rates
- Demand: High $\lambda \implies$ lower downside protection
- Sorting: High $\lambda \implies$ more high τ borrowers

Back

Welfare Implications of Lower CMBS Modification Frictions

Figure: Values by τ and Lender Type



Back

Relaxing Model Assumptions

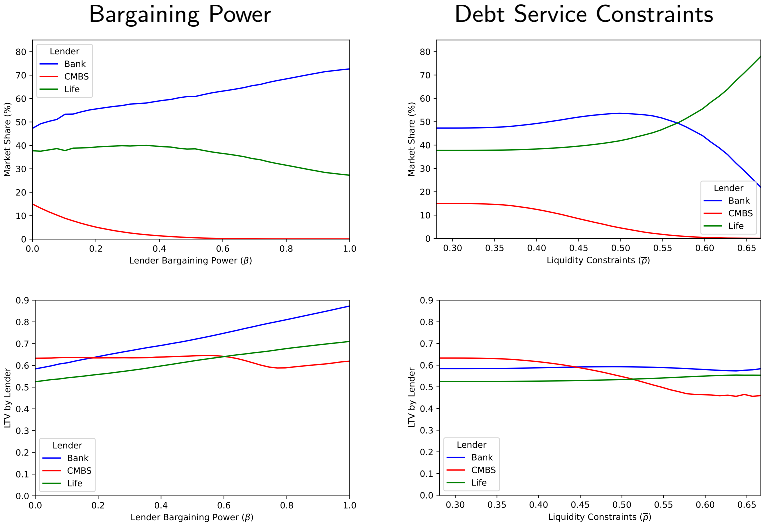
(1) Lender bargaining power

(2) Add constraints such that borrowers renegotiate for non-strategic reasons

$\Longrightarrow$ Little marginal value of CMBS

▸ Back ▸ Extensions Results

Model Extension Results



Back