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Safe Collateral, Arm's-Length Credit:

Evidence from the Commercial Real Estate Mortgage Market*

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Abstract

When collateral is safe, there are fewer opportunities for lenders to suffer economic losses. We develop a model to show how risky and safe collateral naturally pair with different types of lenders according to how informed the lenders are in states where borrowers are in financial distress. Our application is to the commercial real estate mortgage market where we compare loans funded by commercial mortgage-backed securities (CMBS) to bank loans. We model CMBS investors as lower cost providers of funding, but less informed, and vice-versa for banks. This leads to a separating equilibrium where only safe collateral is funded by CMBS and risky collateral is funded by bank lenders. This prediction is tested using the 2007-2009 shutdown of the CMBS market as a natural experiment, where suddenly collateral usually funded with CMBS were instead financed with bank loans. Our results show that loans with CMBS-like qualities that were "counterfactually" funded by banks were less likely to default or be renegotiated. We conclude that the securitization channel in this market, when available, funds safer collateral.

Keywords: collateral, securitization, commercial banking, commercial real estate

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1 Introduction

The use of collateral in credit contracts has long been an important tool for credit risk management. Incomplete payment by the borrower entitles the creditor to possession of a specific good belonging to the borrower.[1] Traditionally, the lien on the collateral has been owned and managed by the creditor. However, financial innovation in a number of credit markets has gradually unbundled loan origination and collateral management. Securitization, in particular, allows assets to be funded by capital market investors who explicitly outsource the collateral management function. It has become more common for certain collateral types to be funded by these arm's length creditors.

What types of collateral are best suited to funding by arm's length creditors? Debt contracts are risky because the borrower may fail to make the fixed payment (Lacker, 2001). Arm's-length creditors are typically less informed and more dispersed than, say, relationship lenders that may have repeated interaction with a borrower. This amplifies financing frictions and makes it very difficult for arm's-length creditors to make efficient liquidation decisions in the event of financial distress. Coordination problems can make agreement elusive among separate arm's-length creditors when attempting to renegotiate a contract. Rajan and Winton (1995) show that creditors that monitor their investments make the most efficient decisions, making better choices on when to proceed with a liquidation and when to renegotiate.

This paper focuses on the commercial real estate mortgage market as a setting for studying collateralized debt contracts. Real estate is an ideal form of collateral, because it is an "immovable" asset (Calomiris, Larrain, Liberti, and Sturgess, forthcoming).[2] Prior to the early 2000s, most

[1] A stylized fact of credit markets is that newer borrowers receive secured loans and established borrowers receive unsecured loans. This is supported by the theoretical results of Boot and Thakor (1994): prior to the first project success, a borrower must accept a secured loan with an above spot market interest rate; after project success, the borrower is awarded an unsecured loan with a below spot market rate.

[2] Creditors in emerging markets are often reluctant to lend against movable collateral (such as machinery, accounts receivable, and inventory), which results in lending being biased towards the use of immovable assets like real estate.

commercial real estate (CRE) was financed with loans from banks and other types of financial intermediaries. These institutions originated the loans with collateral liens on the properties and held the loans in portfolio. In the 2000s, larger commercial properties began to be financed by commercial mortgage backed securities (CMBS). Like the residential mortgage market, CRE loans can be bundled into pools, which are then used as the collateral backing the issuance of fixed-income securities. The performance of the loans in the CMBS market also performed very differently from loans in bank portfolios, as can be seen in Figure 1.[3] A key question that we want to examine in this paper is if the increase in CMBS delinquencies relative to those on CRE loans at banks reflect differences in the quality of the loans between the two markets or differences in how distressed loans are handled between the markets.

We focus on the role of loan renegotiation. Under a debt contract, the borrower makes a fixed payment but occasionally is in default. Optimal debt contracts cannot be contingent on ex post information if the borrower's circumstances are not verifiable by outside parties; otherwise, the borrower can falsely pretend to have suffered an adverse shock (Arrow, 1974). However, if the borrower's circumstances are observable to the lender, ex post renegotiation allows outcomes contingent on financial distress (Hart and Moore, 1997). For instance, loans can be restructured in response to declines in collateral value, even when the lender does not take the collateral. In contrast, securitization tends to use "renegotiation-proof" contracts, which prevents the lender from receiving reduced payment rather than the transfer of the collateral. Such contracts also prevent distortions to incentive constraints, which can occur if the borrower anticipates renegotiation proposals from the lender.[4] In this way, securitization separates cash-flow rights and control rights.[5]

[3]Our focus on commercial real estate is most closely related to Ghent and Valkanov (2013) and Downs and Xu (2014), who also examine the differences in portfolio and securitized CRE loans.

[4]In some models, the borrower hides output in the nondefault states in order to induce renegotiation.

[5]Our focus on one particular type of resolution – renegotiation and extension – is more closely related to the residential mortgage papers of Piskorski, Seru, and Vig (2010) and Agarwal, Amromin, BenDavid, Chomsisengphet, and Evanoff

Our paper also relates to the literature on creditor control rights and bankruptcy proceedings. In the commercial real estate mortgage market, the creditors are secured creditors. In the event of default, a secured creditor can seize the assets covered by the lien. The creditor's legal rights in this event are a contingent claim distinct from the promised repayment. However, the deadweight costs of the legal process can affect the liquidation decision.

Loans on income-producing commercial real estate property held in bank portfolios have been shown to differ significantly from securitized loans in terms of pricing, underwriting, and the behavior of the loan servicer in cases where the borrower falls into distress (Black, Krainer, and Nichols (forthcoming)). In particular, bank loans are far more likely to be given an extension than securitized loans. In this paper, we develop and test a simple model of securitization and renegotiation, based on Chemmanur and Fulghieri (1994). In the model, the decision to securitize a loan depends on the riskiness of the project and the likelihood that renegotiation will be required. Banks have a comparative advantage in renegotiation relative to relative to the special servicers responsible for working out distressed CMBS loans, which results in riskier loans being held in bank portfolios. This produces a separating equilibrium in which safer projects are securitized at lower interest rates and riskier projects are funded by banks at higher interest rates. The model implies a market segmentation in commercial real estate loans, with the following empirical implications:

1. Loans in bank portfolios will have a higher probability of being in financial distress than observably similar securitized loans.

2. The interest rate on loans in bank portfolios will be higher than those on observably similar securitized loans.

(2011).

3. Loans in bank portfolios will be renegotiated more often than observably similar securitized loans.

The primary challenge in testing these empirical implications is the simultaneity between funding choice and the negotiation of underwriting terms. This endogeneity can potentially mask the true nature of the sorting taking place in loan markets. For example, consider two properties differing in their exposure to CRE default risk. In a world without informational frictions we would expect both properties to receive funding and both loans to have the same risk-adjusted expected returns. This equilibration could be accomplished through some combination of loan pricing and adjustments to the underwriting terms. The probability of future distress and the potential renegotiation to mitigate that distress will inform pricing and underwriting. So long as we observe both loan rates and all the relevant underwriting terms, we can accurately assess the differences in risk between these two hypothetical loans. However, the empirical problem, common to much of the corporate finance and banking literature, is that we do not observe all the relevant underwriting terms. In this paper we highlight the implicit promise to renegotiate loan terms in response to financial distress (i.e., implication (3) from above).[6] These implicit features of the loan contract are generally unobservable to the researcher. Indeed, as we model in the paper, it is likely that borrower demand for renegotiation services is private information and, at least partially, unobservable to the lender as well.

We address the endogeneity problem by taking advantage of the shutdown of the CMBS market during the financial crisis beginning in 2007 and stretching into 2009. Over this period there was no new issuance of CMBS as originators were unable to hedge the risks associated with the warehousing of the loans for securitization. The collapse in the CMBS market came abruptly, as can

[6] We explore in a separate paper (Black, Krainer, and Nichols (forthcoming)) the extent to which this unobserved renegotiation option is priced into the loan at origination.

be seen in Figure 2. Further, the shock roiling all financial markets at that time was systemic and arguably did not originate in the CRE market. However, securitized loans were maturing over this period and needed to be refinanced. With CMBS no longer an option, property owners were forced to turn to banks and alternate sources of financing, including insurance companies and REITs. Thus, after the collapse of CMBS, we are able to observe side-by-side in the banks' portfolios both the typical bank loans and as well as loans that would normally be securitized. In effect, the 2007 collapse in the CMBS market serves as a natural experiment that allows us to observe the true nature of collateral-based sorting in the CRE market.

We develop two alternate empirical strategies to leverage the CMBS shutdown for our analysis. First, we estimate the probability of securitization using a combined data sample of CMBS and bank loans originated prior to 2007. Using the coefficients from this estimation, we calculate the out-of-sample probabilities of securitization for bank loans during the CMBS shutdown. We then show that the probability of securitization for new loans originated after the shutdown is negatively correlated with both default and extension. Thus, properties normally funded by arm's length finance, but "counterfactually" funded by the banks, are shown to be safer and less likely to experience any financial distress. Second, as a robustness test, we also match specific CMBS loans that resolved during the CMBS shutdown with specific bank loans originated shortly thereafter. Using this matching approach yields somewhat weaker results statistically, but is still supportive of our hypotheses. CMBS loans that matured and are identified as reappearing on bank balance sheets in a refinance are found to be safer and less likely to need renegotiation going forward.

The remainder of the paper is organized as follows. Section 2 presents our theoretical model of commercial real estate collateral and creditors. Section 3 provides a brief history of the CMBS shutdown. Section 4 discusses the data used in our analysis. Sections 5 and 6 presents the results of our two empirical approaches. Section 7 concludes.

2 A model of commercial real estate collateral and creditors

The model has three agents: commercial property owners (O), debt investors (I), and banks (B). Each of the agents' objective functions is laid out below. In this single-period model, owners enter the debt market seeking financing for a commercial real estate property. The property can be used as collateral for financing in a CMBS deal or by a bank. There is a large theoretical literature on the role of collateral in debt contracts due to information frictions or incomplete markets. The structure of our model is most similar to the Chemmanur and Fulghieri (1994) model of public debt (bonds) and bank debt (loans). The key difference between investors and banks is in their ability to evaluate properties in distress. Throughout the model, superscript I indicates debt funded by investors (securitized loans) and superscript B indicates debt funded by a bank (portfolio loans).

Collateral

Each owner has a commercial real estate property requiring an investment of one dollar (a normalization). If the property is successful, it will yield a cash flow of x. There are two kinds of properties: safe and risky. The share of safe properties is ϕ. A safe property (type S) repays the debt with probability p_S and a risky or unsafe property (type U) repays the debt with probability p_U. Let p denote the average success probability (given by $\phi p_S + (1-\phi)p_U$) across type S and type U properties. Safe properties have a lower probability of financial distress (i.e., a greater probability of success), $0 < p_U < p_S$. Each owner has private information about his or her property. In other words, property owners know whether the property is safe or risky, investors and banks only know the distribution of safe and risky properties in the population.

Of the properties in distress, a fraction δ are "good" and will still yield cash flow x. Other distressed properties will yield no cash flow. A property in distress must be evaluated by a creditor to determine whether it is good. The probability of an accurate determination of property quality is given by q, which is a function of the evaluation costs, c. If the distressed property is a good property and it is not liquidated, the creditor receives a fraction k of the cash flow. The liquidation value of any property is y.

Debt Investors

The investors in the model are the debt investors purchasing commercial mortgage-backed securities (CMBS). Investors make two decisions, working backward in the method of dynamic programming. Investors first determine their strategy in the event of financial distress (subscript D) and then determine the required interest rate. In other words, they first decide what evaluation cost (c^I) they will bear in the event of distress and then decide what interest rate (R^I) to charge:

$$\max_{c^I} \pi_D^I = y + \delta(kx - y)q^I(c^I) - c^I, \tag{2.1}$$

$$\max_{R^I} \Pi^I = p^I R^I + (1 - p^I)\pi_D^{I*} - 1. \tag{2.2}$$

In equation (2.1), investors choose c^I to maximize their profit in the event of property distress. In equation (2.2), investors choose the interest rate on securitized loans (R^I) to maximize expected profits. The assumption is that debt is competitively priced in the structured finance bond market.

Banks

We assume that banks can evaluate firms costlessly in the event of distress. Let $\bar{q}$ be the banks' probability of accurately determining the quality of a distressed property, which is greater than $q(c)$. This is an extreme assumption, but it simplifies the solution to the model. The basic intuition is that banks have a comparative advantage in evaluating a distressed property, perhaps due to greater information or greater flexibility. Therefore, the banks only decide what interest rate (R^B) to charge.

$$\pi_D^B = y + \delta(kx - y)\bar{q} \tag{2.3}$$

$$\max_{R^B} \Pi^B = (1 - p^B)\pi_D^{B*} + p^B R^B - 1 \tag{2.4}$$

In equation (2.3), banks always adopt the most accurate evaluation technology possible ($q = \bar{q}$). In equation (2.4), banks choose the interest rate on bank debt (R^B) to maximize expected profits. The highest interest rate that can be set by the bank in equilibrium is constrained by the fact that each owner has the alternative of financing the property in a CMBS deal with debt investors.

Commercial Property Owners

Let J^I and J^B denote the expected payoffs of a property owner who chooses to borrow as part of a securitized pool or borrow from a bank, respectively.

$$J^I(R^I, p) = p(x - R^I) + (1 - p)\delta q^I(c^I)(1 - k)x \tag{2.5}$$

$$J^B(R^B, p) = p(x - R^B) + (1-p)\delta\bar{q}(1-k)x \quad (2.6)$$

where R^I is the interest rate on a securitized loan and R^B is the interest rate on a bank loan.

A property owner's choice between a securitized loan and a portfolio loan depends on the relative magnitudes of J^I and J^B, which, in turn, depend on the property's success probability, p, $p \in (p_S, p_U)$, and the interest rate charged by investors and by the bank.

Equilibrium

An equilibrium consists of a choice of the debt contract by property owners (securitized debt versus bank debt), the level of resources to be devoted by investors to evaluating firms in financial distress, and the interest rates charged by investors and banks.

The equilibrium must satisfy the following conditions: a) Given the equilibrium choices and beliefs of the other players, owners' choices and banks' choices maximize their expected payoff. b) Given the equilibrium choices of banks and owners and given equilibrium beliefs, investors' choice of interest rate is the lowest that gives them nonnegative expected profits in equilibrium (e.g., competitive bond market); if a borrowing owner is in financial distress, the amount of resources investors devote to evaluating the project maximizes their expected payoff. c) The beliefs of all players are rational, given the equilibrium choices of others; along the equilibrium path, these beliefs are formed using Bayes's rule.

Under these conditions, there exists an equilibrium in which safe properties, S, are funded by investors and risky (unsafe) properties, U, are funded by banks. The equilibrium is characterized by the equilibrium interest rates charged by investors and banks:

$$R^{I*} = \frac{1 - (1 - p_S)\pi^{I*}}{p_S} \tag{2.7}$$

$$R^{B*} = R^{I*} + \frac{1 - p_U}{p_U}(\delta(1 - k)(\bar{q} - q^{I*})) \tag{2.8}$$

In this equilibrium, investors' expected profit equals zero due to competition in the bond market. Banks maximize profits by choosing the highest interest rate consistent with separation of properties and preventing debt investors from making positive expected profits when financing both safe and risky properties.

The intuition for the equilibrium is in the difference between safe and risky properties and the spread between the interest rates for CMBS debt and bank loans. Safe properties have a higher probability of success, so the owner chooses to borrow at lower rates from investors. Risky properties have a lower probability of success, so the owner borrows at higher rates from banks. Owners of risky properties are willing to pay higher interest rates to banks due to the higher likelihood of financial distress and the comparative advantage of banks in evaluating distressed properties.

3 The CMBS market shutdown

The model suggests that we should see significant market segmentation based on underlying risk in the funding of CRE properties. Historically we see evidence supporting the model's conclusion with significant segmentation in the CRE markets. Prior to the development of the CMBS market in the 1990s, insurance companies tended to target large, stabilized, investment-quality properties. Given these lenders' demand for stable long-term cash flows to offset their liabilities, insurance companies naturally preferred to target this segment of properties. The growth of the CMBS market largely came at the expense of the insurance company market and not from banks.[7] Since the securitization market for CRE loans started in the 1990s, its market share has expanded steadily over the 2000s until the financial crisis.

The CMBS market was one of the early casualties of the 2007 financial crisis. CMBS spreads had started to rise in the early spring of 2007. Banks and other originators of CMBS loans started to reduce their originations for securitization by the summer. However when CMBS spreads, along with MBS and other spreads on structured debt products, dramatically spiked in August, many CMBS underwriters still had substantial pipelines of loans in their warehouse facilities. The fall of 2007 and first few months of 2008 saw a trickle of new CMBS issuance as the originators and underwriters tried to reduce these loan inventories. In several cases underwriters reportedly had to re-purchase the lower rated tranches of the CMBS deal in order to move the loans out of the warehouse. Several banks were forced to transfer risker CMBS loans onto their balance sheet, booking significant losses. By the fall of 2007 no new CRE loans for securitization were being underwritten and there would not be another new CMBS deal until the fall of 2009.

Typically a CMBS warehouse facility would only hold loans for a few months or less prior to the issuance of a pool backed by the loans. The banks that provided financing for these warehouses could hedge their risk using total return swaps. Contingent on this process was the ability to anticipate the eventual spread the new CMBS deal would be priced at as well as the anticipated time it would take to structure, rate, and then place the various tranches of the CMBS deal. Once the market had shut down, the uncertainty around the spread of a new CMBS deal and the time it would take to bring a deal to market discouraged any firm from being the first to test the market

[7] Insurance companies are still significant players in the CRE market, originating loans both for their own portfolios and to sell into the CMBS market for securitization. They have shifted some of their CRE exposure away from their whole loan portfolio by investing in higher rate CMBS securities.

for new issuance. The market did not return to normalcy until after the first (and only) new CMBS issuance financed by the Term Asset-Backed Securities Loan Facility (TALF) in November 2009. The structure and the impact of the TALF program is discussed in detail in Campbell, Covitz, Nelson, and Pence (2011).

During the CMBS market shutdown many property owners turned to alternative funding sources. This included insurance companies, banks, and REITs. The insurance companies and banks were able to expand their portfolio of loans on income-producing properties while reducing their exposure to other CRE market segments, such as construction loans. The ability of healthy firms to find alternative financing, even during the crisis, is evidence that the main issue was was the securitized funding channel, and not the underlying collateral. Despite the sharp drops in CRE property prices over this period, funding from non-securitized sources for CRE remained available. However the model we developed above suggested that the different funding channels served different distinct portions of the market. If banks are focused on providing adjustable-rate loans with terms of five years and less on properties with higher a priori risk, they may not be the best source of financing for a stable investment quality property looking for a fixed rate ten year loan. As a result a significant portion of maturing CMBS loans may have turned to lenders that are better positioned to serve that market segment, such as insurance companies and REITs. However it is unlikely that these sources were able to completely fill the shortfall in credit availability caused by the the CMBS market shutdown, allowing banks to also increase their market share by refinancing maturing CMBS loans. We use the pool of bank loans originated during the CMBS market shutdown to explore the behavior of CMBS-like loans in bank portfolios.

4 Data and descriptive statistics

The unique contribution of this paper is our use of a database that includes information on both CRE loans securitized in CMBS and CRE loans held on bank balance sheets. This involves combining two separate databases, which cover different markets and span different time periods. Data on bank portfolio loans are collected from Schedule H.2 the FR Y-14Q regulatory report, described in more detail below. These data are quarterly and begin in 2012:Q1. The CMBS data from Morningstar LLC are monthly and extend back into the 1990s. In the merged database we have to both adjust the CMBS data to a quarterly frequency and limit our analysis to loan observations after 2012:Q1. As a result the Y-14 bank data are left-censored while the CMBS data are not. When we present data on loans as of a given year of origination, such as the bank loans originated in 2008 and 2009 when the CMBS market was shut down, we are limited only to those bank loans still on the bank balance sheet as of 2012Q1. Despite this limitation, the ability to observe securitized and portfolio CRE loans side-by-side, and then to compare their performance over the same time period, provides us with the ability to directly test our hypotheses developed above.

4.1 Bank Loans

Schedule H.2 of the FR Y-14Q is a loan-level data collection of commercial real estate loans on bank balance sheets that supports the annual Comprehensive Capital Analysis and Review (CCAR) stress tests. These data contain the most detailed information on commercial real estate loans the Federal Reserve has ever collected.[8] The reporting panel has expanded from the original 19 firms in the stress tests to include all bank holding companies with $50 billion or more in consolidated assets, 33 firms as of 2014:Q4. Participating firms with material CRE portfolios must complete

[8]The collection is actually at the credit facility level, however in most cases the credit facility contains a single loan. We refer to the data as loan-level in the text for simplicity.

Schedule H.2 of the FR Y-14 regulatory reporting form for Wholesale Risk, which includes granular data on commercial real estate loans. The loan-level characteristics include measures observed both at origination and throughout the history of the loan. This includes origination date, loan balance, property type, loan rate, interest rate type (fixed versus floating), maturity, loan-to-value, and loan purpose (construction, income-producing, owner-occupied). To be included in the data collection the loans must have a minimum size of $1 million. The data provide a quarterly snapshot of the loan portfolio of the initial participating banks beginning in the first quarter of 2012. The schedule is updated quarterly on a ongoing basis and includes measures of loan status such as extensions, delinquencies, and transition to non-accrual status. For the bulk of our analysis, we also restrict our sample of Y-14 loans to banks that were also active originators of loans for securitization. This excluded loans originated from smaller banks, which may be targeting different segments of the CRE market.

4.2 Securitized Loans

The CMBS data used in this paper are from Morningstar LLC. This compilation of loan-level data includes every CRE loan in publicly-issued (including 144A) CMBS deals over the period of our sample. The collection pulls the information from the Commercial Real Estate Finance Council Investor Reporting Package (CREFC IRP), which standardizes the information provided by loan servicers to the trustees of CMBS pools.[9] The database is a structured collection, with linked databases for loan, property, tranche, reserves, and much additional data. It includes loan level credit characteristics including the vacancy rate on the property, net operating income (NOI), loan-to-value (LTV), and other key components. Morningstar also tracks loan performance, with detailed

[9] See http://www.crefc.org/irp

information on delinquency and, to a lesser extent, loss-given-default. The data are collected at a monthly frequency starting in the mid-1990s. For the bulk of our analysis we restrict our sample to CMBS loans originated by banks participating in the Y-14 data collection. This excluded loans originated by insurance companies and conduit lenders.

The summary statistics for our data set are shown in Table 1. This table demonstrates that there are clear differences in loan characteristics across the two different lender types. The most obvious of these differences is in the interest rate type. CMBS investors appear to have an overwhelming preference for fixed-rate loans as opposed to adjustable-rate (99%). Banks, by contrast, have much less of their portfolio in fixed-rate loans (23%). While less extreme, there are also differences in key risk factors between bank and CMBS lenders. LTV and debt yield (the ratio of NOI to loan balance) at origination are, on average, at safer levels in the bank portfolios. However given the endogeneity of underwriting, one cannot assume that the bank loans are safer due to their lower LTVs and higher debt yields. Lenders will demand larger equity positions from riskier borrowers, and may allow greater leverage for safer borrowers.

5 CRE loan performance after the CMBS market collapse in 2007

In our empirical analysis we investigate the hypothesis that the market for CRE loans is characterized by the sorting equilibrium described in Section 2. The model describes an equilibrium where safe collateral is funded by the CMBS market and risky collateral, which is more likely to require renegotiation, receives bank funding. Simply comparing empirical default and renegotiation rates across these two types of funding sources cannot definitively answer this question because of the potential endogeneity between the securitization outcome and the loan characteristics used to predict default and renegotiation rates. In our model, banks charge higher rates to compensate for the riskier loans they fund in equilibrium. But in the data, it could be true that banks also impose stricter underwriting terms or loan covenants as part of their risk management. For example, banks may require lower LTVs at origination to help offset the high amount of collateral-specific risk ex ante. But ex post, bank loans could appear (misleadingly) to be safer than CMBS loans in the wake of an aggregate shock to all collateral values like the one experienced during the 2008 financial crisis. Similarly, we cannot definitively tell whether bank loans are more likely to be renegotiated than CMBS loans as a result of the contracting environment laid out here, or because banks simply have different preferences for loan renegotiation than CMBS investors or face different legal constraints. Ideally, we would answer these questions by conducting an experiment where, controlling for observable characteristics, we would compare default and renegotiation rates on the loans retained in bank portfolios to counterfactual bank default and renegotiation rates on loans that were securitized.

One way to make progress on this identification problem is to exploit variation over time in the total market share of CRE loans funded by the CMBS market. As noted in Section 3 the CMBS market grew steadily through the early 2000s until the eve of the financial crisis in 2007, whereupon the share of new CRE loans funded by CMBS plunged to zero (Figure 2). In our analysis we treat the collapse of securitization markets as an exogenous event. That is, the severe liquidity shortages in 2007-2008 affected all asset-backed securities markets (e.g., Gorton and Metrick (2012)), but the conditions leading to the crisis did not originate in commercial real estate. This exogenous event, then, serves as a natural experiment where we can get a view of performance for loans that would normally be securitized, but in fact were not due to the problems in that funding channel. It turns out that our sample of CRE loans backed by income-producing properties is very well-suited for this exercise. The CRE properties in our sample are long-lived assets supported by short-maturity loans. Borrowers with loans maturing during the financial crisis had few options. Either they could refinance their maturing loans into new loans that would be held by a bank or some other non-CMBS investor, or they could default. Figure 2 suggests that for new originations during the crisis and shortly after, banks were the overwhelming choice of ultimate funding.

The key to this empirical analysis is to identify loans in the post-crisis period that would normally have been securitized, but were not because of the unexpected collapse of the CMBS market. One approach we take is to estimate a probability of securitization model on loans originated in the pre-2007 period and then generate fitted probabilities from this model for the post-2007 new loan originations that appeared in the banking sector. The models are similar in specification to the models explored in Black, Krainer, and Nichols (2014). The basic results are in in Table 2. Note that the some of the coefficient estimates in Table 2 hint at the potential problems with endogeneity that we face when relating securitization and other outcomes to loan characteristics. As outlined earlier in the paper, our theory points to a partitioning of the CRE loan market. In equilibrium, riskier borrowers who may need to take advantage of loan renegotiation will prefer bank loans. They pay higher rates for bank loans, but benefit in states of the world where renegotiation can help avoid inefficient default. But in Table 2 we see that the coefficient on LTV at origination is positive, indicating that at least in terms of this risk factor, the bank borrowers appear to be safer. This could be evidence that bank lenders, contrary to our narrative, actually do prefer safer loans at origination. But this finding could also reflect banks attempting to mitigate borrower risk by requiring lower origination LTVs. As a robustness check we use several different proxies for securitization when exploring differences in default and renegotiation in the post-CMBS collapse period.

With pre-crisis model estimates in hand from Table 2, we then generate fitted probabilities of securitization for loans originated during and after the financial crisis. To begin, we restrict our attention to fixed-rate loans that were retained in the bank portfolios. The distributions of the fitted probabilities are in Figure 4. First of all, we can see that our sample restriction to include only fixed-rate loans has a large impact on the distribution of the securitization probabilities In all the years plotted in the Figure, well more than half of the loans retained in the portfolio were not expected to be retained (by the model). However, we can also observe a drift in the distribution of fitted securitization probabilities over time. By 2009, average probabilities of securitization for this subsample of loans are falling. We interpret this result as being due to adjustments in other loan terms that the banks were gradually enforcing in the aftermath of the collapse in securitization. Fixed-rate loans are always more likely to be securitized than adjustable-rate loans. What Figure 4 shows is that the power of the fixed-rate indicator alone became a steadily less reliable indicator of securitization as the weakness in that market persisted. This time-variation in loan characteristics is evidence for the way that banks shape loan contracts and offer a different type of intermediation than CMBS investors.

We have demonstrated that the loan characteristics differ according to the eventual holder of the loan: bank or CMBS investor. Further, we have demonstrated that bank and CMBS investor shares of total CRE loan origination changed significantly as the financial crisis occurred and the recession set in. Finally, we showed that the composition of bank portfolios also changed in the immediate wake of the shut-down in securitization. We can now argue that the financial crisis served as an interruption to the status quo in CRE loan markets, and the ex ante probability of securitization can be used as a way to identify loans that would have been securitized in the absence of the crisis.

All the empirical work from this point on is restricted to data on loans originated post-2007 and retained in bank portfolios, including both fixed-rate and adjustable-rate loans. To test our hypotheses about CRE market segmentation amongst funding sources, we estimate logit models of default and extension using only loans in the bank portfolios but using our securitization proxies as explanatory variables. We use several proxies, including the fitted securitization probability based on the model in column (i) of Table 2, a dummy variable indicating securitization probability in the 75th percentile of the loan distribution, and a simple securitization proxy of whether the loan is a fixed-rate loan or not. The results are found in Tables 3 and 4. In Table 3 we base our definition of default (extension) on whether the loan was in default (or extended) as of 2012:Q1. In Table 4 we consider loans that were reported as current in 2012:Q1 but then subsequently transitioned to default or were extended. All specifications include vintage effects to control for time-specific heterogeneity in loan performance associated with a particular origination year. Specifications iii and vi of Table 4 include a full set of vintage, property, and lender fixed effects. All estimates include robust standard errors.

Focusing first on the default models in the upper panel of Table 3, the securitization proxies generally have the expected negative sign, implying that loans were less likely to default that were relatively more likely to have been securitized but were not. However, the standard errors in these regressions are large and the estimated effects are not significant. Thus, the evidence for our story of sorting in the CRE loan market is only weakly corroborated in the default regressions. By contrast, the loan extension models in Table 3 all show a strong and significant negative relation between loan extension and the securitization proxies. This differential implies that higher renegotiation probabilities of the loans considered likely to be portfolio loans may also be masking risk differences. If banks are preempting default through the renegotiation channel, we would probably see higher default rates in the traditional bank loan portfolio. Loan extensions prior to maturity are not randomly occurring events, but are forms of remediation that banks use to limit losses and avoid inefficient default costs.

To summarize, the basic results here are consistent with the theory of safe collateral being funded by the arm's-length investors in the CMBS market and the riskier, information-sensitive collateral being funded by banks. When the CMBS market shut down and safe collateral could no longer be funded with CMBS, we see generally lower default rates and significantly lower renegotiation rates for loans with CMBS-like attributes.

6 Loan performance of matched CMBS refinanced loans

In this section we explore an alternative strategy of identifying CMBS-like loans in bank portfolios during the CMBS shutdown. Instead of using the imputed probability of securitization from the combined CMBS/bank database, here we attempt to identify specific properties secured by CMBS loans that resolved during the CMBS market shutdown and match them with specific bank loans that were originated at approximately the same time and observable in the Y-14.

The initial set of CMBS loans used in this analysis consists of all CMBS loans that resolved, i.e. either paid-off or were liquidated, in 2007, 2008, or 2009. The properties securing these loans are then run through a matching algorithm (described in Table 5) based on property type, zip code, and when available, property value and property size. These fields were based on the property level schedule provided in the Morningstar CMBS data, not the loan level schedule. This was done to account for CMBS loans secured by multiple properties. The CMBS loans are compared with bank loans that were originated within 90 days of the resolution of the CMBS loan. The bank data in the Y-14 is reported at the credit facility level, not the property level. This prevents us from successfully matching new bank loans where multiple CMBS properties are refinanced within the same credit facility.[10] When there is more than one bank loan originated within this time period with the same property type and in the same zip code as the CMBS property, we match the one with the closest reported property size, property value, or date of origination, depending on data availability.

This matching algorithm does have several significant limitations. The left-censoring of the bank loans is the most significant. We only observe loans that are still on the books in 2012, when the bank loan collection begins. We lose any loans that had been originated and then resolved, either through liquidation, prepayment, or sale. Any CMBS loan refinanced into a bank portfolio with a term of less than five years is not available in 2012 to be matched. Any CMBS loan refinanced into a bank portfolio, and later sold into a CMBS pool prior to 2012 is also not available to be matched. This left censoring suggests that whatever match rate we achieve with this process should be viewed as a lower bound of the actual share of resolving CMBS loans that were refinanced into bank portfolios. We also do not attempt to use borrower names in this matching process, as they are often not reported consistently between lenders. In future work we do intend to extend this process to include borrower names. We also intend to extend this process into the post-crisis period to estimate the propensity of CMBS loans refinancing into bank portfolios once the CMBS market re-opens.

This process generated 373 properties with resolved CMBS loans matched to new bank financing.[11] The relatively small number of resolved CMBS loans that we can link to bank originations suggests that CMBS borrowers may have used non-bank financing, such as insurance companies and REITs, to finance many of these properties. Table 6 compares the characteristics

[10] Results produced when matching the CMBS loan level data instead of the property level data produces a similar magnitude of matching, with similar results.

[11] The results are similar when we replicate the analysis excluding matches where we only have information on property type and location.

of the loans that we can identify where one of the underlying properties was refinanced at a bank in the Y-14 panel with other CMBS loans that resolved over this period. From our inital match of 373 properties, we have 359 CMBS loans and 356 bank loans. There is some evidence that banks accepted only higher quality loans. Fewer of the CMBS/Bank loan refinancings were resolved via liquidation than the other loans, 2.6% versus 7.3%. The occupancy rate at resolution for CMBS/Bank refinancings was also slightly higher, 93.4% versus 90.2%. However the LTV and debt-service coverage ratios were very similar. CMBS/Bank refinancings were more likely to be smaller, with the average current net operating income for loans which had properties refinanced into bank portfolios being half that of other resolved CMBS loans. While the average loan size is larger, this is in part due to small number of very large loans that were identified as CMBS/Bank refinancings. When we compare the median loans sizes, $2.8 million for CMBS/Bank refinancings and $3.3 million for other resolved CMBS loans, we see the same pattern of smaller loans going to bank financing. In addition the smaller average NOI for CMBS/Bank refinancings suggest they are secured by smaller properties. Finally CMBS/Bank refinancings are dominated by multifamily loans, which account for over 70% of the matched loans. The concentration in multi-family loans may be a function of the left-censoring. We observe in the bank loan data that multi-family loans often have longer terms than other CRE mortgages. This suggests that the concentration may be due to fewer of the CMBS multi-family loans that refinanced into bank portfolios had resolved prior to 2012, and are thus available for matching.

We extend this simple analysis by estimating a series of logit models of the probability that a resolved CMBS loan is refinanced by a bank in our sample. Table 7 reports these results. As we see in the first column large loans and loans that were originated with higher LTV were both less likely to be refinanced by banks. This is consistent with what we observe about loan sizes;

bank loans tend to be smaller than CMBS loans. It also reinforces the notion that the higher loan averages for bank refinancings we see in Table 6 are likely a product of a few outliers. It also seems that the banks were very sensitive to how highly leveraged the loans were that they were refinancing, avoiding loans that had entered the CMBS market with higher LTVs.

The remaining two columns of Table 7 introduce additional risk factors and controls. In the second column we see evidence that the banks were more likely to accept CMBS loans for refinancing if the current occupancy rate on the property was higher. We also see that when the CMBS loan had to go through the resolution process all the way to to liquidation, the odds of the property being refinanced by a bank fell. These two effects suggest that the banks were screening for quality in an attempt to target the higher quality loans. The final column introduces property type controls. While not shown, the coefficient for the multifamily indicator is larger and significant. Once we introduce property type controls, the loan balance is no longer significant, as multifamily loans are in general smaller than those for other property types. We also introduce an indicator for when the originator of the CMBS loan is also in our bank sample. We wanted to test for the possibility that a bank that had underwritten the original CMBS loan might leverage that familiarity with the property when targeting it for refinancing. However the coefficient is insignificant.

We also compared the matched CMBS/Bank refinancings with other bank loans originated over these same three years. Over this period in our sample there were an additional 21,237 bank loans originated. It is important to note that both sets of loans have the same survival bias. They include only loans that are still active and in the banks' portfolios as of 2012:Q1. Loans that have either already been resolved, or sold into CMBS pools, prior to 2012:Q1 will not be included in this analysis. This may result in a bias in some of the results.

Table 8 compares the characteristics of the CMBS/Bank refinancings to other bank originations. As we saw above, the CMBS/Bank refinancings are dominated by multifamily loans. Multifamily loans constitute a significant, but much smaller, share of all other bank originations over this period. The differences in the risk measures between the two types of loan produce mixed signals. On the one hand the CMBS/Bank refinancings have slightly lower LTVs and higher occupancy rates. Yet they also have lower debt yields and higher interest rates. The endogeneity between pricing and underwriting makes interpretation of these signals difficult. A low LTV could signal a riskier borrower for which the lender has demanded a larger equity position, or it could simply reflect a less leveraged and hence less risky property. Looking at both realized performance between 2012:Q1 and 2015:Q3 we see that the CMBS/Bank refinancings had significantly lower rates of default and extension. This is consistent with the hypothesis that the CMBS market had previously attracted more stable properties with lower idiosyncratic risk, and the higher rate of default in the CMBS market during the crisis reflected the higher leverage and less flexible loss mitigation strategies available to special servicers.

We then re-estimate the models from the previous section using an indicator variable for CMBS/Bank refinancings instead of the probability of default. The results for the models of the loan status as of 2012:Q1 are reported on Table 9. The LTV, occupancy, and loan balance are all as of 2012Q1. The coefficients for the risk drivers, the current LTV and the current occupancy are similar, with loans with higher leverage and lower occupancy being more likely to have experienced distress and either defaulted or been extended. The impact of loan balance switches sign, negative and significant in the default models and positive and significant for the extension models. This pattern may reflect banks greater incentive to modify larger loan exposures. While not shown the property effects show that loans on retail properties are significantly more likely to have been extended by 2012Q1 and multifamily loans are both less likely to have been default or been extended by 2012Q1. The signs of the CMBS/Bank refinance indicator in the default models are negative for all but one specification, but are also insignificant. The CMBS/Bank refinance indicator is also negative for the extension models, and the coefficients are just outside the 10% significance range. While these results are much weaker than those in the previous section, they are not inconsistent with our hypothesis that under normal market conditions CMBS loans are secured by more stable properties. Further analysis will examine the changes in the share of seasoned loans in new CMBS originations post-financial crisis.

Our final specifications modeling the loan performance from 2012:Q1 to 2015:Q3 for those loans current as of 2012:Q1 are shown in Table 10. The LTV, occupancy, and loan balance are all as of 2012:Q1. The results show that the LTV measure is significant and positive for both default and extension models. Loans that were more highly leveraged at the beginning of this period were more likely to experience distress and either default or require extension by 2015:Q3. The occupancy as of 2012:Q1 is significant and negative only for the default measure and the loan balance is significant and negative only for the extension measure. This result echoes what we saw before, suggesting that banks may have a greater incentive to modify larger loans, controlling for collateral performance. While not shown the property effects show that all property times are less likely default than loans on offices, the reference category. In particular hotel and multi-family loans are significantly less likely default than retail and industrial loans.

The results for the CMBS/Bank refinance indicator are more robust that those using the loan status as of 2012:Q1. The coefficient is negative for all specifications and significant for the first two sets of specifications. Once the lender and property effects are introduced, the CMBS/Refi indicator remains negative, but is no longer significant. These results support our hypothesis that the CMBS loans, even once they migrate to the bank portfolio, still have lower levels of credit risk and requires fewer loan extensions.

7 Conclusion

We develop in this paper a theoretical model that explains the separation in the commercial real estate market that we documented in our earlier work between the securitized CMBS market and banks' CRE portfolios. The model suggests that differences in monitoring costs and the private information of property owners are sufficient to generate a separating equilibrium with riskier loans going to bank portfolios.

Previous empirical analysis on the separation of the CMBS and bank CRE portfolios were limited by the endogeneity of the loan origination process. A loan originated for CMBS will have fundamentally different underwriting terms from one originated for a bank portfolio. This paper used the period of the shutdown in the CMBS market to overcome the endogeneity challenge.

We document that banks did move into the segment traditionally served by CMBS during the shutdown of the CMBS market. This did involve the banks' negotiating loan terms that were a better match for their internal business, in particular a shift from fixed to adjustable rate. We find that loans in the banks' portfolios that strongly resembled CMBS loans and that were originated during the shutdown of that market were less likely to default or require extensions, consistent with our theoretical results. We develop a second empirical approach that involved matching specific CMBS loans that resolved during the CMBS shutdown with newly originated bank loans. While these results are less statistically significant, they do provide some support for our theory.

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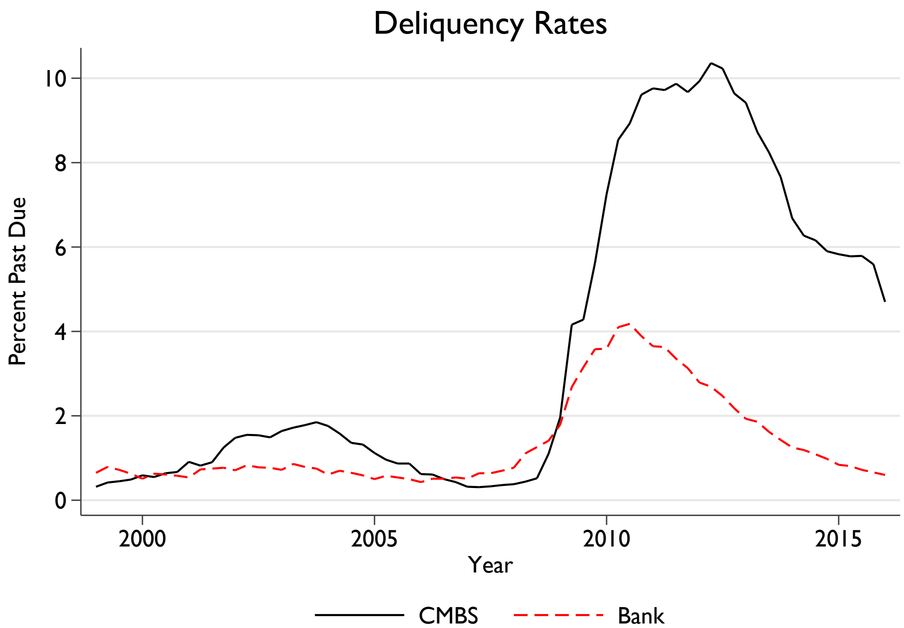
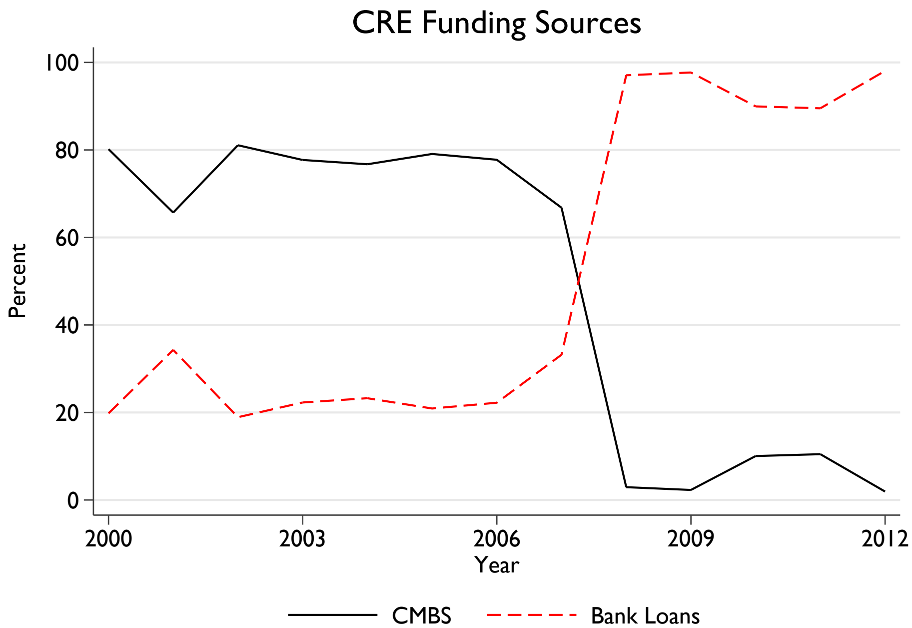
Figure 1:



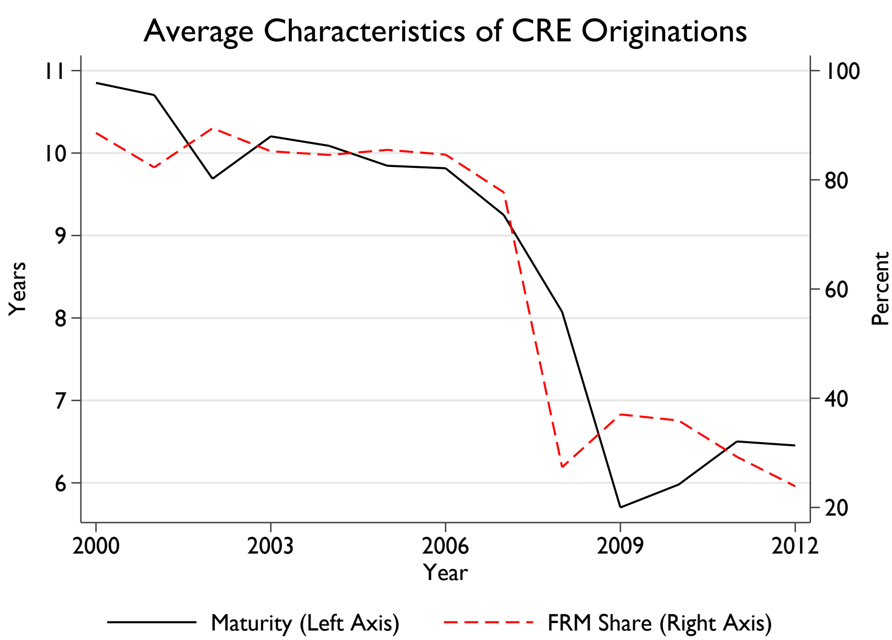
Note: Delinquency rate is based on share of outstanding loans that are 30 days or more past due for the CMBS series and the Bank series. Source: Citi Research - Securitized Products and bank Call Reports.

Figure 2:



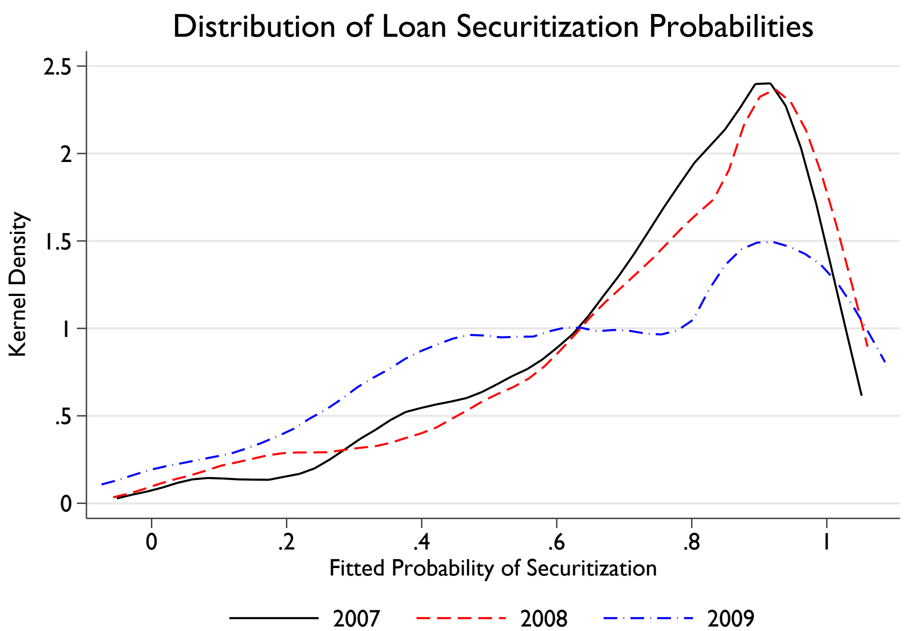
Source: Morningstar CMBS Data, accessed October, 2016. FR Y-14Q Schedule H.2.

Figure 3:



Source: Morningstar CMBS Data, accessed October, 2016. FR Y-14Q Schedule H.2.

Figure 4:



Note: Model estimated on pre-2007 data containing both FRMs and ARMs. The density estimate is taken over the subset of the estimation sample that are fixed-rate loans orginated for bank portfolios. Source: Analysis based on data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 1: Characteristics of commercial real estate loans at origination

The characteristics of the commercial real estate (CRE) loans at origination. Amounts shown are averages of the sample of CRE loans in CMBS and in bank portfolios. The full sample includes the pre-crisis and post-crisis periods. Statistics are also shown for these two subsamples.

	(i) Number of loans	(ii) Fixed rate (0/1)	(iii) Debt yield	(iv) LTV	(v) Loan term (years)	(vi) Loan amount
Full Sample Period						
Bank Portfolio	25,817	23.4%	12.9%	60.0%	8.3	5.5
CMBS	20,281	99.4%	11.6%	69.1%	9.8	16
Pre-Crisis (2007 and earlier)						
Bank Portfolio	10,575	29.7%	12.1%	61.9%	10	3.6
CMBS	19,448	99.0%	11.5%	69.3%	9.9	15.5
Post-Crisis (2008 and later)						
Bank Portfolio	15,242	19.0%	13.5%	58.2%	7.1	6.9
CMBS	833	98.9%	12.7%	63.9%	8.6	38

Source: Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 2: Likelihood of securitization for commercial real estate loans prior to the crisis

This table shows the estimated coefficients in the prediction model for estimating the likelihood of securitization for commercial real estate loans. The dependent variable is a dummy variable that takes the value of 1 for securitized loans. Estimation sample is based on all loans originated prior to 2007. The sample consists of all CRE loans originated by large banks active in origination for CMBS market. The model is estimated with a logit specification. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<.1.

	(i)	(ii)	(iii)	(iv)
Loan balance at origination	0.487***	1.062***	1.232***	1.364***
	(0.028)	(0.047)	(0.314)	(0.391)
Fixed interest rate	6.616***	7.830***	10.326***	11.992***
	(0.136)	(0.268)	(1.407)	(2.141)
Debt yield at origination	1.764***	4.545***	31.970	57.925***
	(0.533)	(1.039)	(19.607)	(14.919)
LTV at origination	2.858***	3.485***	10.097**	13.505***
	(0.224)	(0.371)	(4.070)	(3.760)
Maturity	0.014	-0.137*	0.116	-0.286
	(0.037)	(0.072)	(0.345)	(0.226)
Unemployment rate at origination			1.164***	1.319***
			(0.134)	(0.275)
Year-over-year change in house prices			-43.941***	-55.231***
			(5.740)	(13.877)
Constant	-13.755***	-21.672***	4.693	20.070
	(0.625)	(1.224)	(10.999)	(14.357)
Property type fixed effects	no	yes	yes	yes
Bank fixed effects	no	yes	yes	yes
MSA fixed effects	no	no	no	yes
Observations	37,146	17,590	12,447	9,020
Pseudo R-squared	0.499	0.688	0.847	0.899

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 3: Likelihood of default or extension for commercial real estate loans as of 2012Q1

This table shows the estimated coefficients in the prediction model for estimating the likelihood of default or extension for commercial real estate loans after the crisis. The dependent variables of default (Panel A) and extension (Panel B) are based on whether the loan was in default or extended as of 2012Q1. In Panel A, the dependent variable is a dummy variable that takes the value of 1 for loans that were in default (nonperforming). In Panel B, the dependent variable is a dummy variable that takes the value of 1 for loans that were extended. Fitted probabilities of securitization are computed from model (i) in Table 2. High securitization probability is a dummy variable indicating that the probability of securitization is in the 75th percentile. Estimation sample is based on all loans originated after 2006. The sample consists of all CRE loans originated by large banks active in origination for CMBS market. The model is estimated with a logit specification. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<.1$.

Panel A:

	Loan Default								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Securitization probability	-0.229	-0.237	-0.068						
	(0.428)	(0.390)	(0.336)						
High securitization probability				-0.062	-0.257	0.068			
				(0.484)	(0.564)	(0.518)			
Fixed interest rate							-0.431	-0.453	-0.343
							(0.394)	(0.374)	(0.377)
Loan balance (log)		-0.186*	-0.201*		-0.184	-0.206*		-0.220**	-0.217*
		(0.113)	(0.107)		(0.115)	(0.123)		(0.109)	(0.114)
Current LTV		2.597***	2.405***		2.609***	2.393***		2.583***	2.403***
		(0.827)	(0.769)		(0.813)	(0.732)		(0.809)	(0.743)
Current occupancy		-1.483**	-2.121***		-1.501***	-2.129***		-1.477**	-2.120***
		(0.591)	(0.477)		(0.579)	(0.454)		(0.599)	(0.466)
Constant	-6.134***	-3.669**	-2.587	-6.194***	-3.735**	-2.529	-6.104***	-3.109**	-2.274
	(1.182)	(1.536)	(1.837)	(1.163)	(1.497)	(1.926)	(1.183)	(1.560)	(1.993)
Vintage effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Property type fixed effects	no	no	yes	no	no	yes	no	no	yes
Bank fixed effects	no	no	yes	no	no	yes	no	no	yes
N	5179	5179	5047	5179	5179	5047	5179	5179	5047
Pseudo R-squared	0.050	0.111	0.139	0.049	0.110	0.139	0.052	0.114	0.141

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 3 cont.: Likelihood of default or extension for commercial real estate loans as of 2012Q1

Panel B:

	Loan Extension								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Securitization probability	-1.003**	-1.047**	-1.058***						
	(0.476)	(0.437)	(0.407)						
High securitization probability				-1.282**	-1.354**	-1.232**			
				(0.543)	(0.534)	(0.500)			
Fixed interest rate							-1.013***	-1.046***	-1.279***
							(0.374)	(0.388)	(0.344)
Loan balance (log)		-0.004	0.012		-0.013	0.007		-0.089	-0.069
		(0.091)	(0.108)		(0.069)	(0.090)		(0.097)	(0.110)
Current LTV		1.281***	1.303***		1.288***	1.265**		1.205***	1.210***
		(0.469)	(0.492)		(0.477)	(0.505)		(0.445)	(0.458)
Current occupancy		-0.533	-0.765*		-0.576	-0.794*		-0.495	-0.810*
		(0.425)	(0.433)		(0.393)	(0.439)		(0.460)	(0.438)
Constant	-0.333	-0.569	-0.372	-0.512***	-0.585	-0.447	-0.386*	0.714	0.831
	(0.227)	(1.060)	(1.115)	(0.190)	(0.664)	(0.811)	(0.199)	(1.129)	(1.138)
Vintage effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Property type fixed effects	no	no	yes	no	no	yes	no	no	yes
Bank fixed effects	no	no	yes	no	no	yes	no	no	yes
N	5179	5409	5409	5179	5409	5409	5179	5409	5409
Pseudo R-squared	0.196	0.204	0.219	0.194	0.202	0.215	0.200	0.208	0.228

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 4: Likelihood of default or extension for commercial real estate loans after 2012Q1

This table shows the estimated coefficients in the prediction model for estimating the likelihood of default or extension for commercial real estate loans after the crisis. The dependent variables of default (Panel A) and extension (Panel B) are based on whether the loan transitioned to default or extension after 2012Q1 (between 2012Q1 and 2015Q3). In Panel A, the dependent variable is a dummy variable that takes the value of 1 for loans that transitioned into default (nonperforming). In Panel B, the dependent variable is a dummy variable that takes the value of 1 for loans that transitioned into an extension. Fitted probabilities of securitization are computed from model (i) in Table 2. High securitization probability is a dummy variable indicating that the probability of securitization is in the 75th percentile. Estimation sample is based on all loans originated after 2006. The sample consists of all CRE loans originated by large banks active in origination for CMBS market. The model is estimated with a logit specification. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<.1$.

Panel A:

	Loan Default								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Securitization probability	-0.350	-0.363*	-0.307*						
	(0.245)	(0.218)	(0.186)						
High securitization probability				-0.235	-0.351	-0.350			
				(0.379)	(0.416)	(0.425)			
Fixed interest rate							-0.555**	-0.552***	-0.479***
							(0.231)	(0.174)	(0.163)
Loan balance (logs)		-0.081	-0.127		-0.084	-0.131		-0.122	-0.156
		(0.158)	(0.160)		(0.155)	(0.158)		(0.149)	(0.152)
Current LTV		1.796***	1.791***		1.810***	1.794***		1.764***	1.774***
		(0.419)	(0.380)		(0.433)	(0.387)		(0.406)	(0.368)
Current occupancy		-0.990***	-0.855***		-1.004***	-0.852***		-0.975***	-0.859***
		(0.136)	(0.214)		(0.156)	(0.220)		(0.127)	(0.214)
Constant	-4.483***	-3.501	-2.719	-4.561***	-3.515	-2.709	-4.464***	-2.840	-2.262
	(0.535)	(2.890)	(3.012)	(0.463)	(2.797)	(2.974)	(0.503)	(2.778)	(2.889)
Vintage effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Property type fixed effects	no	no	yes	no	no	yes	no	no	yes
Bank fixed effects	no	no	yes	no	no	yes	no	no	yes
Observations	5179	5179	5179	5179	5179	5179	5179	5179	5179
Pseudo R-squared	0.016	0.041	0.057	0.014	0.040	0.057	0.019	0.044	0.059

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 4 cont.: Likelihood of default or extension for commercial real estate loans after 2012Q1

Panel B:

	Loan Extension								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)			
Securitization probability	-0.869***	-0.970***	-1.026***						
	(0.268)	(0.213)	(0.203)						
High securitization probability				-1.000***	-1.112***	-1.099***			
				(0.137)	(0.139)	(0.153)			
Fixed interest rate							-0.962***	-0.939***	-1.027***
							(0.224)	(0.230)	(0.181)
Loan balance (logs)		0.122*	0.110*		0.106**	0.087**		0.036	0.028
		(0.074)	(0.064)		(0.042)	(0.035)		(0.067)	(0.055)
Current LTV		0.639***	0.737***		0.658***	0.695***		0.551***	0.640***
		(0.130)	(0.134)		(0.154)	(0.140)		(0.124)	(0.127)
Current occupancy		-0.552	-0.391		-0.577	-0.397		-0.502	-0.409
		(0.418)	(0.390)		(0.361)	(0.364)		(0.438)	(0.385)
Constant	-0.226*	-2.016**	-1.418*	-0.388***	-1.932***	-1.213***	-0.252**	-0.721	-0.203
	(0.117)	(0.902)	(0.725)	(0.134)	(0.378)	(0.257)	(0.115)	(0.768)	(0.571)
Vintage effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Property type fixed effects	no	no	yes	no	no	yes	no	no	yes
Bank fixed effects	no	no	yes	no	no	yes	no	no	yes
Observations	5179	5179	5179	5179	5179	5179	5179	5179	5179
Pseudo R-squared	0.028	0.037	0.045	0.025	0.034	0.040	0.037	0.041	0.050

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 5: Sequential Matching Algorithm

This table presents the series of conditions used to match properties securing CMBS loans that were resolved, either paid or liquidated, between 2007 and 2009 with bank loans (that were still active in our sample as of 2012Q1) that were originated between 2007 and 2010.

Restrictions	Match 1	Match 2	Match 3	Match 4	Match 5
Same Property Type	Yes	Yes	Yes	Yes	Yes
Bank Origination w/ 3-mo CMBS resolution	Yes	Yes	Yes	Yes	Yes
Same Zipcode	Yes	Yes	Yes	Yes	Yes
Bank Property Value within 25% of CMBS	Yes	No	Yes	No	No
Bank Property Size within 25% of CMBS	Yes	Yes	No	No	No
Choose Bank Loan with minimum value	Ratio of Size2+Value2	Ratio of Size2	Ratio of Value2	One-to-one match	Days to resolution
Count	9	30	106	9	219

Table 6: Characteristics of CMBS/Bank Refis and Other CMBS Resolutions

CMBS/Bank refis are defined using the matching algorithm in Table 5. Other CMBS Resolutions include all other CMBS loans that either paid off or were liquidated between 2007 and 2009. The average is reported for the continuous variables with the standard deviation in parentheses.

Variable	CMBS/Bank Refis	All Other CMBS Resolutions
Count	353	16,056
Percent Liquidated	2.6%	7.3%
Percent ARM	3.4%	2.6%
Percent Originated by Banks Active in Both Markets	42.5%	37.8%
Percent Multifamily	79.0%	34.4%
Net Coupon Rate	7.1% (0.9)	7.3% (1.8)
Debt Service Coverage Ratio at Resolution	1.68 (1.05)	1.61 (0.93)
Debt Service Coverage Ratio at Origination	1.48 (0.35)	1.49 (0.83)
LTV at Securitization	67.9 (13.8)	68.6 (11.2)
Net Operating Income at Resolution (millions)	$0.3 (1.4)	$0.6 (3.6)
Occupancy Rate at Resolution	93.4% (10.0)	90.2% (13.8)
Original Loan Amount (millions)	$14.8 (94.2)	$9.2 (43.3)

Source: Morningstar CMBS Data, accessed October, 2016.

Table 7: Logit models of CMBS loans refinancing into bank loans

CMBS/Bank refis are defined using the matching algorithm in Table 5. The sample includes all other CMBS loans that either paid off or were liquidated between 2007 and 2009. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Variable	(i)	(ii)	(iii)
Loan Balance (logs)	-0.193***	-0.167**	-0.0256
	(0.066)	(0.0662)	(0.0673)
LTV at Securitization	-0.137**	-0.159**	-0.248***
	(0.0561)	(0.0619)	(0.0561)
Occupancy Rate at Resolution		0.294***	0.374***
		(0.0878)	(0.117)
DSCR at Resolution		-0.0755	-0.0420
		(0.0767)	(0.0680)
Loan Liquidated		-0.733**	-0.740**
		(0.178)	(0.368)
CMBS Lender Active in Both Markets			0.108
			(0.131)
Constant	-4.450***	-4.442***	-5.478***
	(0.144)	(0.147)	(0.249)
Vintage effects	Yes	Yes	Yes
Property effects	No	No	Yes
N	13,883	13,883	13,883
Pseudo R-squared	0.0140	0.0230	0.116

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 8: Characteristics of CMBS/bank refis and other bank originations

CMBS/Bank refis are defined using the matching algorithm in Table 5. Other bank originations include all other income producing bank loans originated between 2007 and 2010. Both samples are limited to those still in bank portfolios as of 2012:Q1. The average is reported for the continuous variables with the standard deviation in parentheses. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Variable	CMBS/Bank Refis	All Other Bank Originations
Count	373	22,055
Percent ARM	70.8%	67.9%
Percent Originated by Banks Active in Both Markets	73.5%	67.6%
Percent Multifamily	80.1%	29.4%
Net Coupon Rate	5.0% (1.8)	4.4% (2.0)
Debt Yield 2012Q1	17.0% (10.9)	18.9% (12.7)
LTV at Origination	57.6 (16.7)	59.5 (21.3)
Current LTV	54.9 (17.7)	57.1 (21.4)
Current Occupancy Rate	87.3% (24.4)	81.9% (28.4)
Current Loan Amount (millions)	$3.92 (7.04)	$5.24 (13.76)
Percent in Default as of 2012Q1	2.34%	2.97%
Percent Extended as of 2012Q1	0.82%	2.08%
Percent in Default After 2012Q1	0.76%	3.09%
Percent Extended After 2012Q1	12.6%	22.7%

Source: FR Y-14Q Schedule H.2.

Table 9: Logit models of loan default and loan extension as of 2012Q1

Notes: All models based on sample of bank portfolio loans originated between 2007 and 2009. Loans are flagged as being in default if they have transitioned from current status to nonperforming by 2012Q1. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

		Default			Extension	
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
CMBS/Refi indicator	-0.198	-0.064	0.339	-0.847	-0.821	-0.691
	(0.387)	(0.390)	(0.399)	(0.582)	(0.583)	(0.587)
Loan Balance (logs)		-0.106**	-0.131**		0.278***	0.273***
		(0.051)	(0.052)		(0.044)	(0.044)
Loan-to-Value		0.517***	0.474***		0.0791*	0.092**
		(0.043)	(0.043)		(0.047)	(0.045)
Occupancy		-0.343***	-0.314***		-0.149***	-0.162***
		(0.030)	(0.032)		(0.041)	(0.044)
Constant	-3.748***	-3.896***	-3.949***	-3.890***	-4.003***	-3.957***
	(0.098)	(0.102)	(0.147)	(0.093)	(0.096)	(0.139)
Vintage effects	Yes	Yes	Yes	Yes	Yes	Yes
Property effects	No	No	Yes	No	No	Yes
Lender effects	No	No	Yes	No	No	Yes
N	16,528	16,528	16,528	21,593	21,593	22,593
pseudo R-sq	0.012	0.0767	0.116	0.006	0.019	0.049

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.

Table 10: Logit models of loan default and loan extension, 2012Q1 to 2015Q3

All models based on sample of bank portfolio loans originated between 2007 and 2009. Loans are flagged as being in default if they are current as of 2012:Q1 and subsequently transitioned to nonperforming. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

		Default			Extension	
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
CMBS/Refi indicator	-1.481**	-1.423**	-0.983	-0.673***	-0.655***	-0.176
	(0.713)	(0.713)	(0.717)	(0.190)	(0.191)	(0.204)
Loan Balance (logs)		-0.012	-0.079		0.221***	0.102***
		(0.056)	(0.056)		(0.022)	(0.025)
Current Loan-to-Value		0.376***	0.324***		0.145***	0.127***
		(0.051)	(0.051)		(0.023)	(0.023)
Current Occupancy		-0.154***	-0.101**		-0.010	0.023
		(0.045)	(0.046)		(0.025)	(0.027)
Constant	-3.650***	-3.725***	-3.125***	-0.915***	-0.981***	-0.489***
	(0.111)	(0.114)	(0.159)	(0.039)	(0.040)	(0.067)
Vintage effects	Yes	Yes	Yes	Yes	Yes	Yes
Property effects	No	No	Yes	No	No	Yes
Lender effects	No	No	Yes	No	No	Yes
N	12,092	12,092	12,092	12,092	12,092	12,592
pseudo R-sq	0.005	0.0272	0.066	0.0510	0.070	0.228

Source: Analysis based on combined data from Morningstar. Morningstar CMBS Data, accessed October, 2016 and FR Y-14Q Schedule H.2.