IS CONDUIT LENDING TO BLAME? ASYMMETRIC INFORMATION, ADVERSE SELECTION, AND THE PRICING OF CMBS LOANS

Xudong An*
Department of Finance
San Diego State University

Yongheng Deng
Institute of Real Estate Studies
National University of Singapore

Stuart A. Gabriel
Anderson School of Management
University of California, Los Angeles

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*An is Assistant Professor of Finance, San Diego State University; 5500 Campanile Dr, San Diego, CA 92182-8236; E-mail: xan@mail.sdsu.edu . Deng is Professor of Finance and Real Estate, National University of Singapore; SDE 1, Level 4, 4 Architecture Dr., Singapore, 117566; Email: ydeng@nus.edu.sg. Gabriel is Arden Realty Chair and Professor of Finance, UCLA Anderson School of Management; 110 Westwood Plaza, Entrepreneurs Hall Suite 412, Los Angeles, CA 90095-1481; Email: stuart.gabriel@anderson.ucla.edu.

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Abstract

While portfolio lenders often faced a decision to hold for investment or sell newly–originated commercial mortgages, conduit lenders originated loans exclusively for sale into securitization markets. In so doing, conduit lenders may have alleviated a "lemon's problem" in selection of loans for sale in secondary markets, resulting in reduced mortgage risk premia and improved pricing of conduit commercial mortgage loans. In this paper, we investigate the adverse selection hypothesis, via modeling and empirical evaluation of pricing of conduit- versus portfolio-backed commercial mortgage backed securities (CMBS) and loans.

We construct an information economics model of conduit lending. Theoretical results indicate that conduit lending helped to resolve asymmetric information problems so as to mitigate "lemon's discounts" in sales of portfolio loans in CMBS markets. Our empirical analyses of 141 CMBS deals and 16,760 CMBS loans show that upon controlling for well-established determinants of loan pricing, conduit loans enjoyed a 30 bps pricing advantage over portfolio loans in the CMBS market. Empirical results are robust to alternative model specifications. Results suggest the importance of mitigation of lemon's problems associated with loan sales to re-structuring of securitization markets.

I. INTRODUCTION

In the wake of ongoing disruption to the real estate capital markets, analysts and policymakers alike have sought to better understand the collapse of mortgage derivatives. Much attention has been paid to the emergent abuses to securitization, including those associated with security design, excess leverage, opaqueness, and inadequate underwriting and ratings algorithms. Analysts similarly have argued that "conduit lending", a process whereby mortgage lenders originated loans expressly for pass-through to securitization markets, was conspicuous among deconstructing forces. Specifically, critics claim that direct pass-through of loans to securitization markets damped originator incentives to screen loans, resulting in lax underwriting and elevated default risk. Those concerns have been cited among flaws of the "originate-to-distribute" mortgage business model (see Bernanke 2008, Mishkin 2008, European Central Bank, 2008, Ashcraft and Schuermann 2008, Keys, et al 2008, Purnanandam 2009).

While conduit lenders may have contributed to moral hazard in loan origination, those same entities may have mitigated problems of adverse selection in lender choice of loans to pass-through to securitization markets. Unlike portfolio lenders, conduit lenders did not face the decision of whether to sell or hold newly–originated loans. Accordingly, conduit lending may have alleviated both adverse selection in choice of loans for securitization and related under-pricing of loans for sale in the secondary market. In this respect, conduit lending may have reduced mortgage risk premia and improved pricing efficiency of mortgage loans. In this paper, we investigate this hypothesis, via modeling and empirical evaluation of the pricing of conduit- and portfolio-backed commercial mortgage backed securities (CMBS) and loans.

To do so, we first develop an information economics model to show how conduit lending helped to resolve issues of asymmetric information associated with sales of portfolio loans in securitization markets. In our model, conduit loan originators directly deliver newly-originated commercial mortgages to security issuers, so as to avoid problems of adverse selection as arise when portfolio lenders selectively liquidate loans held in their portfolios. In a portfolio loan sale, the information-advantaged portfolio lenders may adopt an algorithm to liquidate lower quality loans. With that expectation, buyers of those portfolio loans may apply a "lemon's discount" to their pricing. Such a "lemon's discount" may cause the price of portfolio loans to fall below their fair market value and result in high quality loans being driven out of the market. In contrast, conduit lenders originated loans exclusively for sale in the secondary market and hence did not face the sell versus hold for investment choice decision. Accordingly, they lacked the opportunity to utilize private information in selection of loans for sale and thus a "lemon's discount" would not have been applied to loans in the conduit pool. From this perspective, conduit lending may have mitigated related "lemons pricing" of loans in the secondary market and facilitated loan sales.

Our model also helps explain a puzzle in the pricing of CMBS loans. As seen in table 1, over the course of the 1994-2000 sample period, CMBS investors paid substantially higher prices for CMBS backed by conduit loans, as evidenced in the substantially lower spreads over Treasuries at issuance among conduit CMBS deals relative to portfolio CMBS deals.[1]

This theory is consistent with growth over time in the prevalence of conduit loans in CMBS deals. In the aftermath of the advent of commercial mortgage securitization in the early 1990s, loans backing CMBS were largely contributed by thrifts and life insurance companies, who originally intended to retain those loans in portfolio. However, in the wake of CMBS market growth, conduit lending emerged whereby originators funded mortgages with the express intent of directly selling those loans into securitization markets. Conduit lending constituted less than 5 percent of all CMBS loans in 1992. However, the share of conduit loans grew to 75 percent by 1998 and reached 100 percent by 2001.

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[1] Here the spread is defined as the difference between the coupon paid to investors by the deal and comparable maturity Treasury securities rate.

Our theoretical approach derives from Ackerlof's "Market for Lemons" (Akerlof 1970). However, here we follow Riley (2001) to specify the profit functions of loan purchasers and solve for the equilibrium loan price via profit maximization. Theoretical findings indicate a substantial "lemon's discount" associated with portfolio loans. Further, that discount varies with the portfolio originator's loan holding costs. Specifically, model results show that investors in CMBS require a yield premium of 23 basis points given an assumed portfolio loan retention cost of 2 percent. We also show that portfolio loans traded in the CMBS market constitute the lower quality spectrum of all portfolio loans originated and that the share of portfolio loans traded in the CMBS market is a negative function of the level of information asymmetry.

In our empirical analysis, we test theoretical predictions. To do so, we first study the pricing of 141 CMBS deals brought to market during the 1994 - 2000 period. Estimates of a reduced-form pricing model conform to theory; in that regard, results indicate that portfolio-backed CMBS deals were priced 33 bps lower than conduit deals, after controlling for CMBS pool characteristics, debt service coverage ratio (DSCR), and other well-established determinants of CMBS pricing, including slope of the Treasury yield curve, interest rate volatility, the Sharpe ratio, corporate bond credit spreads, and CMBS market capitalization.

We sought to assess the robustness of the CMBS deal-level results via a loan-level analysis of commercial loan pricing. Here our sample included 13,655 conduit loans and 3,105 portfolio loans sold into securitization markets during the 1994 - 2000 period. Our findings indicate a conduit pricing differential of 34 bps after controlling for credit quality and other well-established loan pricing determinants, including loan-to-value ratio (LTV), amortization term, collateral property type, property location, prepayment constraints, characteristics of the affiliated CMBS pool, CMBS market cap, and the like. Moreover, we find that the "lemon's discount" is lower for multifamily loans, which often have lower holding costs than retail, office and industrial loans. Consistent with more stringent regulation and often higher holding costs of commercial banks, we also find the "lemon's discount" to be higher among bank originated loans than for non-bank loans. Overall, results of both the deal-level and the loan-level analyses are highly supportive of our theoretical predictions.

Our findings are consistent with those of Downing, Jaffee and Wallace (2009), who show that residential mortgage-backed securities (RMBS) sold by Freddie Mac to bankruptcy remote special purpose vehicles (SPVs) for derivative securitization were characterized by lower credit quality than those retained by Freddie in portfolio. The authors argue that their findings are consistent with the notion that Freddie Mac used private information to deliver "lemons" to securitization markets. While Downing, Jaffee and Wallace provide a structural approach to the pricing of RMBS, their paper does not solve the asymmetric information model. In contrast, in application to commercial mortgages, we present and solve a formal information economics model so as to demonstrate and quantify the "lemon's effect".

Results of our analysis also largely confirm findings evidenced in the broader empirical literature on mortgage and bond pricing (see, for example, Nothaft and Gabriel 1989, Fama and French 1989, Rothberg, Blume, Keim and Patel 1991, Collin-Dufresne, Goldstein and Martin 2001, Titman, Tompaidis and Tsyplakov 2004, Longstaff, Mithal and Neis 2005, among others). For example, our findings suggest that CMBS market liquidity, slope of the Treasury yield curve, amortization term, prepayment constraints, and mortgage pool diversification all negatively impact commercial mortgage spreads, whereas corporate bond spread, CMBS loan maturity, and share of hotel loans in the CMBS pool are all positively related to spreads. In addition, we find that the lagged risk-adjusted return in commercial property markets has a strong negative impact on CMBS spreads.

Paper findings have important implications for the future of the mortgage derivatives market. Clearly, structural failings associated with the "originate-to-distribute" model require further business and policy scrutiny. At the same time, conduit-related efficiency gains in securitization markets, associated with mitigation of problems of adverse loan selection, should be reflected in re-design of securitization markets. As suggested by results above, pricing advantages associated with securitized conduit loans may help to support substantially more favorable lending terms in origination markets.

The paper proceeds as follows: the next section briefly describes the rise of conduit lending and explains the intuition of our model. Section 3 presents our information economics model whereas section 4 discusses our empirical modeling and results. Concluding remarks are provided in section 5.

II. COMMERCIAL MORTGAGE SECURITIZATION AND CONDUIT LENDING

Commercial mortgage debt markets recorded substantial growth over the course of recent decades. By early 2008, commercial mortgage debt outstanding (inclusive of multifamily loans) reached $3.38 trillion, up from $500 billion a decade earlier. Of that number, about $0.92 trillion were held by CMBS issuers[2].

Prior to the advent of securitization markets, commercial mortgage lenders, including banks and thrifts, life insurance companies, pension funds, and other private entities originated loans for commercial real estate investment with the intention of holding those loans in portfolio. In 1984, Solomon Brothers originated $970 million mortgages on three office buildings and offered securities to the public based on the projected mortgage cash flows. Later, in the wake of the severe real estate downturn of the early 1990s, the Resolution Trust Corporation (RTC), sought to liquidate substantial loan portfolios of failed thrifts via large scale securitization of commercial real estate loans.

Securitization is the process whereby debt assets are pooled, packaged and derivative securities issued against those assets. With respect to commercial mortgages, for example, an investment bank might purchase commercial mortgages from loan originators, place those loans in a trust and then issue commercial mortgage-backed securities (CMBS) against the trust. CMBS representing claims on the cash flows generated by the underlying commercial mortgage assets would then

[2] Commercial Mortgage Securities Association. Compendium of Statistics, June 26, 2008.

be sold to investors. Commercial mortgage securitization gained quickly in popularity. Issuance of CMBS grew from $2 billion in 1989 to some $630 billion in 2006, before falling back to less than $100 billion in 2008.

Early on, loans backing CMBS issues were mostly originated by thrifts and life insurance companies for the purpose of retention in their "held for investment" asset portfolios. Those originators would sell their loans to CMBS issuers either to liquidate nonperforming loans or to remove performing loans from their balance sheet, so as to reduce capital reserve requirements or to allow investment in other assets.[3]

As commercial mortgage securitization became prevalent, a new form of lending, conduit lending, emerged as an important market completing element of the commercial mortgage market. In this case, the originator, usually an investment bank or a mortgage bank, originated commercial mortgages with the express intent of directly selling those loans into secondary markets. In this case, the conduit lender simply passed the originated loans through to security issuers. In this case, it was no longer the lender, but rather investors on Wall Street, who funded the commercial mortgages. The originator simply acted as a "conduit".

The rise of conduit lending greatly changed the landscape of commercial mortgage lending. With the separation of loan origination, servicing and holding functions, commercial mortgage origination became more standardized. Indeed, with ongoing enhancements to market liquidity, conduit lending became the dominant source of CMBS loans. Conduit loans grew from less than 5% of CMBS issuance in 1992 to about 75% of total CMBS issuance in 1998. Since 2001, no single CMBS deal has been backed exclusively by portfolio loans.

A priori, one would expect both portfolio and conduit lenders to avail themselves to liquidity provided by CMBS markets. Indeed, controlling for credit quality and anticipated performance, there should be no reason to observe a price

[3]The RTC asset pools labeled "N-Series" and "S-Series" largely consisted of non-performing and sub-performing loans originally held in thrifts' and banks' portfolios. Alternatively, the $1.3 billion securitization of Canadian Confederation Life Insurance's portfolio of U.S. commercial mortgages in 1995 was comprised of performing assets and for other business purposes.

differential between portfolio and conduit commercial real estate loans. Below, we develop an information economics model to demonstrate why conduit lending became the preferred source of CMBS loans and why conduit CMBS loans are priced higher than portfolio CMBS loans. As a starting point for that model, we assume that loan investors know that originators possess private information regarding loan quality and that portfolio lenders use that information in determining which loans to sell. Accordingly, investors apply a "lemon's discount" to portfolio loans. In the case of portfolio loans, not all loans are traded and those that are traded are priced lower than their fair market value. In contrast, investors know that conduit originators have no opportunity to use private information as they do not face a sell-retain choice but instead pass all loans to the secondary market.[4] In this case, no lemon's discount is applied; rather, investors pay the fair market price and all loans are traded. As shown below, conduit lending becomes the preferred mode of loan sales to the secondary market as it mitigates lemons pricing and facilitates loan transactions.

III. A "MARKET FOR LEMONS" MODEL

We examine the pricing of both commercial mortgage loans (sold in the secondary market) and commercial mortgage-backed securities backed by those loans. Suppose we are studying N loans in a mortgage pool and the quality of loan i ($i = 1,2,...,N$), or equivalently, the real value of loan i is characterized by $\tilde{\theta}_i$. For simplicity, we assume that $\tilde{\theta}_i$ is uniformly distributed over $[\underline{\theta}, \overline{\theta}]$, where $\underline{\theta}$ and $\overline{\theta}$ represent the respective values of the worst and best performing loans in the mortgage pool.[5] We denote $\overline{\theta} = (1+\phi)\underline{\theta}$, where ϕ is the percentage difference in value

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[4] For example, Fannie Mae has the Designated Underwriting and Servicing (DUS) lenders who deliver all the multifamily loans originated as conduit loans to Fannie Mae.

[5] The uniform distribution is just for mathematical simplicity. However, the analysis can be readily extended to any distributions with no substantive change in our findings.

between the best and worst performing loan. Our focus in on how investors differentially price pools of portfolio vs conduit loans.

3.1 Pricing of portfolio loans

For portfolio loans, the loan seller knows $\tilde{\theta}_i$ ($i = 1,2,...,N$), while the loan purchaser (investor) knows only that $\tilde{\theta}_i$ is uniformly distributed over $[\underline{\theta}, \overline{\theta}]$, but not the value of $\tilde{\theta}_i$. This reflects the information asymmetry between portfolio lender selling the loan and the loan purchaser – the purchaser believes that the seller has private information regarding loan quality that is utilized when deciding whether to sell the loan.

To hold a loan in portfolio, the lender incurs costs associated with regulatory requirements for capital reserves and deposit insurance if the loan is funded with deposits (Calem and LaCour-Little (2004). Assume that the cost is expressed as a percentage of the loan value, δ. In other words, for a loan of value $\tilde{\theta}_i$, the cost is $\delta\tilde{\theta}_i$. Since the seller knows $\tilde{\theta}_i$, a trade occurs only when the offer price for that loan (p_i) is at least as high as the net value of the loan to the seller, i.e.,

$$p_i \geq (1-\delta)\tilde{\theta}_i. \qquad (1)$$

When a trade happens, the investor pays p_i to receive a value of the loan $\tilde{\theta}_i$. If the investor pays too low a price, i.e., $p_i < (1-\delta)\tilde{\theta}_i$, there will be no trade. Therefore, the investor's profit function can be expressed as

$$\Pi_i = \begin{cases} \tilde{\theta}_i - p_i, & \text{if } p_i \geq (1-\delta)\tilde{\theta}_i \\ 0, & \text{otherwise} \end{cases} \qquad (2)$$

Given that $\tilde{\theta}_i$ is uniformly distributed over $[\underline{\theta}, \overline{\theta}]$, we can thus obtain the probability of a trade occurrence as follows

$$F(p_i) = \frac{\frac{p_i}{1-\delta} - \underline{\theta}}{(\overline{\theta} - \underline{\theta})} \qquad (3)$$

Equation (3) suggests that a higher offer price implies a higher probability of a trade taking place. However, Equation (2) tells us that a higher offer price indicates a lower profit when a trade occurs. The risk-neutral investor's objective is to choose an optimal p_i^* to maximize the expected profit, i.e.,

$$p_i^* = \arg\max_{p_i} \left\{ N \cdot F(p_i) \cdot E[\tilde{\theta}_i - p_i \,\middle|\, p_i \geq (1-\delta)\tilde{\theta}_i] + N \cdot (1 - F(p_i)) \times 0 \right\} \quad (4)$$

Since we have

$$\begin{aligned} E[\tilde{\theta}_i - p_i \,|\, p_i > (1-\delta)\tilde{\theta}_i] &= \int_{\underline{\theta}}^{\frac{p_i}{1-\delta}} (\tilde{\theta}_i - p_i) \cdot \frac{1}{\frac{p_i}{1-\delta} - \underline{\theta}} d\tilde{\theta}_i \\ &= \frac{1}{2}[\underline{\theta} + \frac{2\delta - 1}{1-\delta} p_i] \end{aligned} \quad (5)$$

from Equations (3) and (5), we can further simplify Equation (4) as

$$p_i^* = \arg\max_{p_i} \left\{ N \cdot \frac{\frac{p_i}{1-\delta} - \underline{\theta}}{(\overline{\theta} - \underline{\theta})} \cdot \frac{1}{2}[\underline{\theta} + \frac{2\delta - 1}{1-\delta} p_i] \right\}. \quad (6)$$

Solving equation (6) results in

$$p_i^* = \frac{(1-\delta)^2}{1-2\delta} \underline{\theta} \quad (7)$$

Note that the right-side term of Equation (7) does not vary over i. In other words, the investor pays the same price for each of the portfolio loans traded. This is consistent with the assumption that investors do not have the information to distinguish "good" loans from "bad" loans.

3.2 Portfolio loans traded and the "Lemon's discount"

It is important to note that not all loans in the mortgage pool trade at the investor's bidding price p^*. To identify which loans are traded, we insert p^* into equation (1) and get:

$$\tilde{\theta}_i \leq \frac{(1-\delta)}{1-2\delta} \underline{\theta} \quad (8)$$

which means that trades only occur in the cases of those loans that have a quality in the range of $\left[\underline{\theta},\theta^*\right]$, $\theta^* = \frac{(1-\delta)}{1-2\delta}\underline{\theta}$. Here θ^* is the highest quality portfolio loans traded.

The share of portfolio loans traded is thus:

$$S^* = \frac{\theta^* - \underline{\theta}}{\overline{\theta} - \underline{\theta}} = \frac{\frac{(1-\delta)}{1-2\delta}\underline{\theta} - \underline{\theta}}{(1+\phi)\underline{\theta} - \underline{\theta}} = \frac{\delta}{(1-2\delta)\phi} \tag{9}$$

Further, we compare the fair value and the investor's bid of these traded loans: the fair value of these loans is:

$$\overline{p} = E\left[\tilde{\theta}_i \middle| \tilde{\theta}_i \le \theta^*\right] = \frac{2-3\delta}{2(1-2\delta)}\underline{\theta} \tag{10}$$

and the discount is:

$$L = \frac{\overline{p} - p^*}{\overline{p}} = \frac{\delta(1-2\delta)}{2-3\delta} \tag{11}$$

Note that in practice, the cost δ of retaining the loan in portfolio is far less than 50%, and therefore the discount is always greater than zero.

We summarize the above results in the following theorem.

Theorem 1: In a loan sale where the seller (portfolio lender) has superior information about the quality of the loan, information-disadvantaged buyers (investors) bid a price lower than their fair market value of portfolio loans to be traded, i.e. they apply a "lemon's discount" of $L = \frac{\delta(1-2\delta)}{2-3\delta}$. Consequently, the proportion of portfolio loans traded is $S^* = \frac{\delta}{(1-2\delta)\phi}$, and those loans represent the lower quality spectrum of loans originated by the seller.

Proof: As seen from equations (11) and (9), given that $\delta < .5$, which is always true.

Several points from Theorem 1 are noteworthy. First, the "lemon's discount" arises because investors assume that the seller (portfolio lender) will utilize private information regarding loan quality to sell "lemons", which is a typical adverse selection problem. However, even if the "adverse selection" does not occur, i.e., the seller does not exercise his private information in trading of loans, the "lemon's discount" still exists. In the case shown above, the seller does choose to sell the worst quality loans and the investor's bid is lower than the fair value of those "lemons". Second, the "lemon's discount" is high (low) when the portfolio lender's portfolio retention cost is high (low), as $\frac{\partial L}{\partial \delta} > 0$. The intuition is that when loan purchasers know that the lender has high portfolio holding costs and thus has some incentive to liquidate loans hold for investment, they will bid down the prices of those loans. In fact, we plot the relationship between the "lemon's discount" and the lender's retention costs in figure 1.

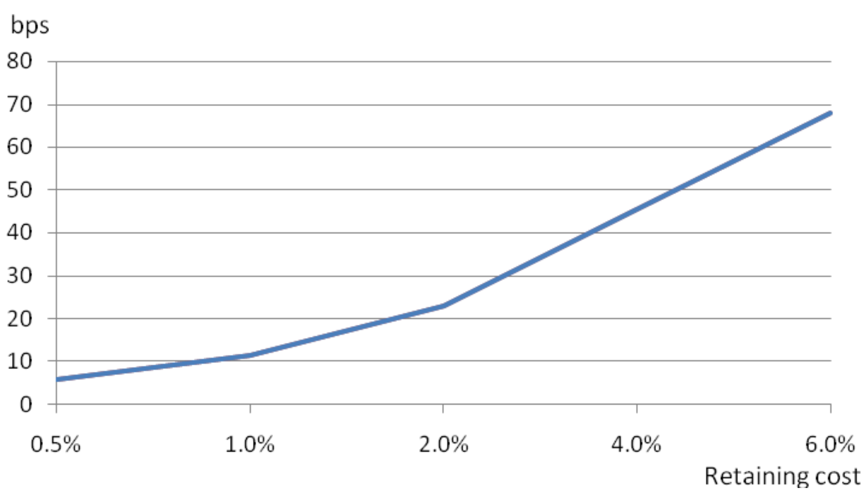

Figure 1: The 'lemon's discount" varies positively with seller's loan retention costs. Here, we assume that a typical commercial mortgage loan carries an 8% interest rate and a 10 year term. Based on that, we calculate the "lemon's discount" according to theorem 1 and then convert it into yield differentials. As shown in figure 1, when the cost of retaining the loan in portfolio is 2 percent of loan balance, investors require a yield premium of 23 basis points on loans sold into the CMBS market. The yield premium rises to 68 bps when the cost of retaining the loan in portfolio is 6 percent.

Third, the share of loans sold into the secondary market increases with to the cost to the originator of retaining loans in portfolio, as $\frac{\partial S^*}{\partial \delta} > 0$. This is consistent with our intuition that the seller is more likely to liquidate loans held in portfolio when retention costs are high. Further, the share of loans traded declines with increases in the loan quality dispersion, as $\frac{\partial S^*}{\partial \phi} < 0$. Again, this is consistent with the notion that investors are more hesitant to trade when information asymmetry is high.

In figure 2, we assume a 2 percent portfolio retention cost and calculate the share of portfolio loans sold when the loan quality dispersion increases from 110% to 150%, representing the interest rate differentials between high quality and low quality mortgage loan ranging from 2 percent to 10 percent.

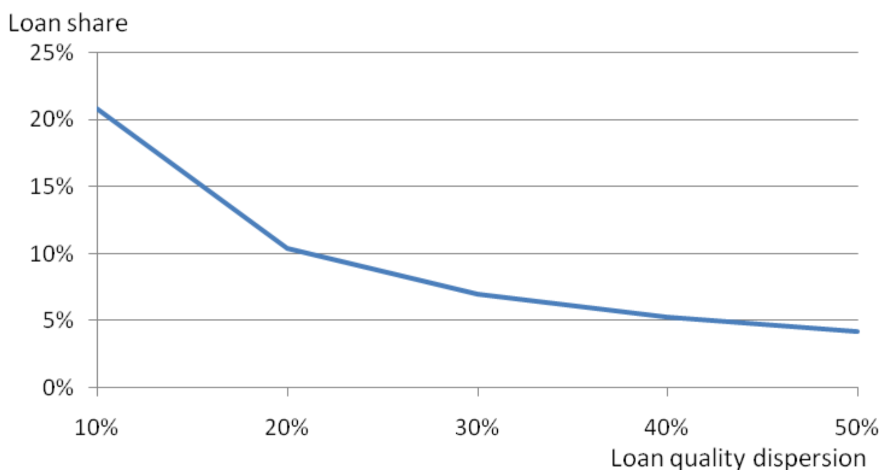

Figure 2: Shares of portfolio loans traded varies w.r.t. loan quality dispersion

We further verify that in the trade, the investor's bid is higher than the seller's valuation as:

$$p^* - p^s = p^* - (1-\delta)\overline{p} = \frac{(1-\delta)\delta}{2(1-2\delta)}\underline{\theta} > 0 \quad (12)$$

under the condition that $\delta < .5$, which is always true. Figure 3 describes the share of loans traded as well as the bid price, the fair price, and seller's valuation for those traded loans.

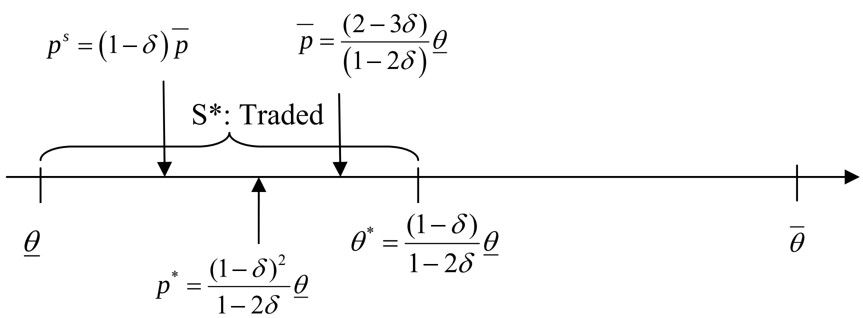

Figure 3: Trading and pricing of portfolio loans

3.3 Pricing of Conduit Loans

As discussed earlier, conduit loans are originated for the sole purpose of securitization as the lender/originator simply passes all newly-originated loans through to investors in the secondary market. As a result, the seller may not possess private information on loan quality and regardless has no opportunity to utilize asymmetric information in selection of loans for sale into the secondary market. The buyer accordingly has no reason to attach a "lemon's discount" to loans offered for sale. Consequently, the value of the conduit loans for both the originator and the seller can be expressed as

$$P^* = E[\theta_i] = \frac{(2+\phi)}{2}\underline{\theta} \qquad (13)^{6}$$

As a result, Equation (13) represents the equilibrium price for conduit loans.

In this case, all the loans are traded, so

$$S^* = 1 \qquad (14)$$

Figure 2 depicts the spectrum of loans traded and the trading price.

[6] We implicitly assume that the seller of conduit loans is also risk-neutral like the investors.

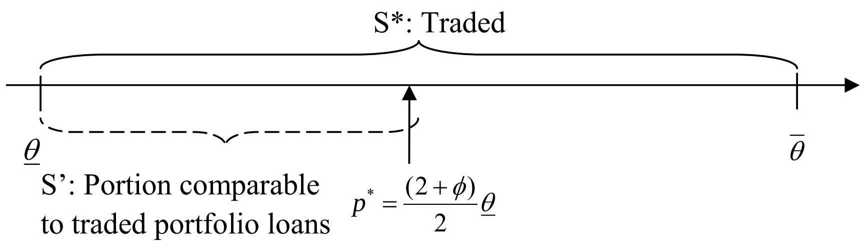

Figure 4: Trading and pricing of conduit loans

3.4 Comparing Portfolio and Conduit Loans

As discussed below, we do not observe the portfolio lender's choice of which loans to sell into the secondary market and hence are not able to compare the quality of portfolio loans sold with those retained by the originator. However, we do observe all portfolio land conduit loans that are sold into the CMBS market. Accordingly, in the spirit of Bond (1982), we use portfolio and conduit loans sold into the CMBS market to test the "lemon's effect".

According to figure 3, portfolio loans sold into the CMBS market represent the lower quality portion of the CMBS loan distribution. In comparing portfolio and conduit loans traded in the CMBS market, we have the following corollaries:

Corollary 1: The portfolio loans we observe in the CMBS market have lower quality than the conduit loans, assuming that the two types of loans are originated with the same underwriting standard. The quality differential reflects the dispersion in loan quality as well as originator's cost of retaining loans in portfolio.

Proof: By putting equation (9) and equation (14) together, we obtain the above results.

Notice that we emphasize the assumption that the two types of loans are originated with the same underwriting standard. This is to assure that the $\overline{\theta}$ and the $\underline{\theta}$ are the same for the two types of loans in figures 3 and 4. Further, when we compare portfolio loans traded in the CMBS market with conduit loans of identical quality, i.e. compare part S* in figure 3 with part S' in figure 4, we find that pricing of the two loan types differs due to the "lemon's discount" for portfolio loans.

Corollary 2: Equivalent quality portfolio loans are priced lower in the CMBS market than comparable conduit loans and the discount of those portfolio loans is $L = \frac{\delta(1-2\delta)}{2-3\delta}$**.**

Proof: Based on equations (7), (9) and (13), the price of the S' proportion of conduit loans is just their fair value, which is the same as the fair value of the S* proportion of portfolio loans $\overline{p}$***, while the price of the S* portion of portfolio loans is just the investor's bid price*** p^****. Therefore, the discount of the portfolio loans is given by equation (11).***

The first implication of these two corollaries is that by pooling loans and passing them through to CMBS pools, conduit lenders avoid the "lemon's discount" in loan pricing; further, they help assure that all loans are traded at their fair value. In contrast, portfolio lenders face "lemon's discount" on the loans sold into the secondary market; further, the share of loans traded is reduced due to information asymmetry. Under these conditions, conduit lending ultimately becomes the dominant source of CMBS loans.

Second, when we look at portfolio loans and conduit loans in the CMBS market, there are really two primary differences: 1) as shown in theorem 2, the *quality* of loans traded is different; and 2) as suggested in theorem 3, loan *pricing* varies across portfolio and conduit product even when we look at comparable quality loans. As a result, the price of portfolio loans we observe in the CMBS market may be substantially lower than that of conduit loans, as we observe in table 1.

IV. Empirical Analysis

4.1 Comparing the pricing of portfolio and conduit loans

Accordingly to corollary 2, upon controlling for loan quality differentials, portfolio loans in CMBS pools should be priced lower than conduit loans in CMBS pools. Therefore, we should observe that conduit CMBS loans have a lower spread to Treasuries than portfolio CMBS loans in the secondary market, all things equal. Below, we seek to specify and empirically control for well-identified determinants of commercial mortgage loan pricing, so as to identify conduit effects.

4.1.1 Loan characteristics that affect the pricing of CMBS loans

Loan-to-value (LTV) and debt service coverage ratio (DSCR)**:** The debt-to-asset ratio has long been considered an important predictor of corporate default (see, for example, Altman and Frydman, Altman and Kao 1985). Similarly, in the real estate literature, there exists considerable evidence that LTV and DSCR of commercial mortgage loans are important predictors of default risk (see, for example, Episcopos, Pericli and Hu 1998, Archer et al 2001, Goldberg and Capone 2002, Ciochetti et al 2002, Seslen and Wheaton 2005, Yildirim 2008, and An, Deng and Sanders 2009). We anticipate that increases in LTV should positively affect spreads on CMBS loans, whereas increases in DSCR should have the opposite effect.

Amortization and maturity term: Episcopos, Pericli and Hu 1998, Ciochetti et al (2002) and An (2007) have found that commercial mortgage loans with amortization or loans with longer amortization term have lower default risk than interest only or shorter amortization term loans. An (2007) also has found that commercial mortgage loans with longer maturity terms have lower default risk than those with shorter maturity terms. We similarly control for these effects in the pricing of our sampled CMBS loans.

Property type: Existing literature (see, for example, Vandell et al 1993, Ciochetti et al 2002, Ambrose and Sanders 2003 and An 2007) has shown that commercial mortgage default varies systematically with collateral property type. Typically, multifamily loans are the least risky, followed by retail and office loans. Industrial and hotel loans are viewed as the most risky of commercial property collateral. Accordingly, we control for collateral property type and anticipate like differentials in the pricing of CMBS loans.

Property location**:** As would be anticipated, prior research (see, for example, Follain et al 1997, Ambrose and Sanders 2003, Archer et al 2001, Ciochetti et al 2002, An 2007 and Yildirim 2008 and An, Deng and Sanders 2009) has provided evidence of substantial geographic variation in commercial mortagage prepayment and default risk.. Historically, research has attributed lower default risk to property in the Pacific region, whereas loans in East South Central and West South Central have been characterized by elevated default risk. We control for geographic location of loans in the pricing of CMBS loan pools.

Prepayment constraints: The presence of prepayment risk should damp the pricing of commercial mortgages. As such, any constraint on the borrower's ability to prepay the loan should reduce the lender required prepayment premium. In addition, Ambrose and Sanders (2003) and An, Deng and Sanders (2009) have found that the presence of prepayment constraints also affects the probability of commercial mortgage loan default.

Diversification**:** Harding, Sirmans and Thebpanya (2004) have found that geographic concentration positively affects CMBS bond spread. Moreover, Harding, Sirmans and Thebpanya (2004) and An, Deng and Sanders (2008) have found that loan size and geographic diversification are important to rating agencies CMBS subordination structure.

4.1.2 Economic and debt market conditions that affect the pricing of CMBS loans

Corporate bond credit spread: The corporate bond credit spread (defined **as** the interest rate spread between corporate bonds rated Aaa and Baa) is often used to proxy the market price of default risk. Fama and French (1989) find that credit spreads widen when economic conditions are weak. In the mortgage application, we hypothesize that the default option embedded in the mortgage contract should vary directly with economy-wide credit risk. Accordingly, the corporate bond credit spread should positively affect CMBS spreads. NOTE CHANGES FROM PRIOR DRAFT

Slope of the yield curve: There exists substantial evidence on the role of the term structure in the determination of mortgage bond spreads (see, for example, Bradley, Gabriel and Wohar (1995), Ambrose and Sanders (2003), and Titman, Tompaidis and Tsyplakov (2005)). On one hand, an increase in the slope of the yield curve suggests some future strengthening in economic activity, a reduced likelihood of put option exercise in the form of loan default, and a lower default premium. On the other hand, a steeper yield curve imparts a higher probability of a short rate increase and Merton (1974) has shown that the value of risky debt is a negative function of the instantaneous risk-free rate. In addition, a steeper yield curve also implies a higher likelihood of decline in the long-term risk-free rate, which is positively related to prepayment risk and the value of the call option premium. From the latter perspective, a steeper Treasury yield curve should be positively related to commercial mortgage spreads.

Interest rate volatility: Mortgage put and call option values increase with interest rate volatility. In fact, in a contingent claims framework, the debt claim has elements similar to a short position on a put option. This prediction is intuitive and well established in the literature; increased interest rate volatility implies increases in the probability that mortgage termination option values are in the money. Accordingly, mortgage spreads should increase with volatility.

***Liquidity*:** A number of studies have found that pricing of corporate bonds varies inversely with market liquidity (for example, Longstaff, Mithal and Neis 2005 and Chen, Lesmond and Wei 2007). We conjecture that this is also true for commercial mortgage loans. We proxy market liquidity via the dollar capitalization of the CMBS market.

***Past commercial property market return*s**: Investors may interpret past returns as indicative of future performance. Accordingly, we hypothesize that stronger past commercial property returns are associated with a contraction in commercial mortgage debt spreads.

4.1.3 The reduced-form pricing model

To assess our theoretical prediction that, upon controlling for quality differentials, portfolio loans in the CMBS market are priced lower than conduit loans, we estimate the following reduced form pricing model:

$$Y_{it} = D_i\alpha + X_i\beta + Z_t\gamma + \varepsilon_{it} \qquad (17)$$

Here Y_{it} is the mortgage spread (defined as the net coupon paid to CMBS investors minus comparable maturity Treasury rate) for the i^{th} commercial mortgage sold at time t. Z_t is a set of economic and debt market factors that affect CMBS loan pricing as discussed above. As those terms are typically time-varying, a subscript t is attached. X_i is a vector representing the aforementioned CMBS loan characteristics. D_i is the categorical variable representing conduit loans and is the focus variable of our analysis. All things being equal, we expect a significant negative coefficient associated with D_i, representing the absence of adverse loan selection in the pricing of conduit relative to portfolio loans.

4.2 Data

We test modeled hypotheses using an exceptionally rich CMBS and commercial mortgage loan database acquired through CMBS.COM, which is a major data provider on all CMBS issued in US. [7] CMBS.COM provides detailed information on each CMBS deal at deal-, tranche- (bond-), loan- and property-levels. For each CMBS deal, we observe the weighted average coupon (WAC) paid to investors. In a typical CMBS deal, a number of CMBS tranches (bonds) are issued with different exposures to default risk, subordination levels, and expected duration. The coupons paid to investors vary in accordance to those risk characteristics (An,

[7] The company was sold in 2005 to Standard & Poor's and later to Backshop.

Deng and Sanders (2008)). The average of all the coupons weighted by cutoff balance is the WAC[8].

In addition to pricing information, the CMBS deal-level data includes detailed information including issuance date, issuer, trustee, and manager of the deal as well as the deal dollar balance, weighted average DSCR, weighted average LTV, weighted average maturity (WAM), and prepayment constraints. Also, the database includes information on the composition of property types, geographies, loan sizes and like information on underlying loans.

The database further permits identification of loan pricing and lending terms on all mortgage loans included in the aforementioned CMBS deals. Accordingly, for each commercial loan included in the CMBS database, our loan-level database includes information on origination date, origination balance, origination LTV, coupon rate, maturity, amortization term, property location, lender, prepayment constraint, and the like. Further, for each loan, we also observe a net coupon rate, which is the coupon paid to CMBS investors recorded in the data. As discussed below, this information is applied in additional loan level assessment of conduit versus portfolio loan pricing.

Data on corporate bond yields and the term structure of interest rates is obtained from the Federal Reserve. That information is used to construct corporate bond credit spreads, a proxy for the slope of the Treasury yield curve, and interest rate volatility. We also obtain data (SOURCE) on CMBS issuance and CMBS debt outstanding (market cap) to proxy CMBS market liquidity. Finally, we use National Council of Real Estate Investment Fiduciaries (NCREIF) data to construct a Sharpe Ratio measure of volatility-adjusted excess returns in commercial real estate by property type.

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[8] Sometimes called net WAC to distinguish it from the gross WAC, which is just the weighted average of interest rates of all loans in the deal. The difference between gross WAC and net WAC is the fee earned by CMBS issuers, servicers and other players such as the rating agencies.

4.3 Results of a CMBS deal level analysis

In the secondary market, pricing usually is reported at the CMBS deal level. Those deals are typically comprised of a large number of individual commercial mortgages; in our dataset, CMBS deals average 149 mortgages. Accordingly, we first conduct a CMBS deal level analysis to investigate whether investors pay higher prices, all things equal, for conduit CMBS loans than for portfolio CMBS loans.

There are a total of 718 CMBS deals in our database, among which 357 are conduit deals and 45 are portfolio deals.[9] For comparison purposes, we focus on conduit and portfolio deals issued during the 1994 - 2000 period, when both portfolio loans sales and conduit loans sales were active. We exclude year 1998 because no portfolio deals are observed for that year. This leaves 118 conduit deals and 23 portfolio deals as in table 2. Table 2 shows the distribution by year of conduit and portfolio deals in our sample. As is evident, with the rise in securitization markets during the latter half of the 1990s, the proportion of deals comprised of conduit loans increased over time.

Table 3 reports descriptive statistics for the CMBS deals. Deal rate spreads, defined as the deal WAC minus comparable maturity Treasury bond rate, range from 66 bps to 509 bps, with an average of 233 bps. On average, the weighted DSCR (debt-service coverage ratio) of the 141 deals is 1.43, with a range from 1.04 to 2.32. About 29% of the loans in the included CMBS deals are multifamily loans, whereas office, retail, and industrial loans comprise 15, 29, and 6 percent of the total, respectively. We compute measures of loan diversification of each deal, including a Herfindahl Index of loan size, the geographic diversification entropy measure and weights of the 5 largest loans in the deal. The geographic diversification entropy measure is calculated as $geo\_div = -\sum_{i=1}^{5} p_i \times \log_6 p_i + \left(1 - \sum_{i=1}^{5} p_i\right) \times \log_6 \left(1 - \sum_{i=1}^{5} p_i\right)$,

where p_i is the proportion of loans in the top five concentrated states in the deal. The highest value this measure can take on is 1, indicating that geographic

[9] Other deal types include fusion deals, franchise deals, single borrower deals, large loan deals, etc.

diversification is evenly divided among different states. We also calculate the standard deviations of LTV and DSCR of all loans in each deal, as reported in the table.

Table 4 reports the general least square (GLS) estimates of our reduced form model in equation (17). Log deal balance at CMBS deal cutoff is used as a weight to correct potential heteroskedasticity. In model 1, we only include a conduit dummy, which provides a simple comparison of the spreads of the two groups of deals. In model 2, we add controls for market conditions that may affect CMBS loan pricing. As expected, the CMBS market cap has a significant inverse effect on CMBS loan pricing, consistent with the notion that lower liquidity premia are required as the market becomes larger.[10] Similarly as expected, the corporate bond credit spread and the interest rate volatility term are positively related to the CMBS deal spread. The slope of the yield curve enters with a significant negative sign. This result is consistent with findings from Bradley, Gabriel and Wohar (1989) and Kau and Peters (2005). The lagged commercial real estate Sharpe Ratio does not enter the analysis with a significant coefficient. Upon controlling for the well-established risk characteristics, conduit deals are associated with a 26 bps lower spread than are portfolio deals.

In model 3, we add CMBS pool characteristics as additional control variables. Variables representing property type compositions are mostly significant and of the expected sign. For example, consistent with the fact that multifamily and anchored retail loans are perceived to be less risky than other loan types, higher shares of multifamily and anchored retail loans are associated with lower required investor spreads. Further, findings indicate that share of hotel loans in the pool serves to boost the CMBS spread, as loans to hotel operators are generally viewed as relatively higher risk. Contrary to expectations, the prepayment constraint has a positive impact on CMBS spreads. This finding is consistent with that of An, Deng and Sanders (2009) and perhaps reflects the borrower use of default as a methodology of loan termination

[10] We also run the regression with annual CMBS issuance instead of CMBS market cap. The results are qualitatively unchanged.

in the case of binding mortgage contract prepayment constraints.[11] As would be expected, the more geographically diversified the pool, the lower spread is required by CMBS investors. Also, our Herfindahl measure of pool concentration by loan size is marginally significant and of the expected positive sign. Finally, upon controls for a large set of market conditions and CMBS pool characteristics, conduit deals are shown to enjoy a 33 bps pricing advantage.

The above deal-level regression results strongly suggest that investors pay significantly lower prices for portfolio loans than for conduit loans in the CMBS market. In that regard, empirical findings provide empirical support for our theoretical propositions. That notwithstanding and in order to assess robustness of findings, we below presents results of loan level analysis. Those tests allow more precise controls for loan underwriting and risk characteristics.

4.3 A Loan Level Analysis

In this section, we apply individual loan-level data to assess the effects of conduit lender status on pricing of loans in commercial mortgage-backed securities markets. We focus on loans to the four major property types, including multifamily, office, retail and industrial properties. Further, we restrict our sample to fixed-rate commercial loans. This leads to an exceptionally rich sample of 16,760 loans originated over the 1994-2000 period and included in the 141 CMBS deals evaluated above.

As reported in table 5, unadjusted spreads to Treasuries on conduit loans (210 bps) were 47 bps lower than those associated with portfolio loans (257 bps). The median, minimum and maximum of spreads are all lower for conduit loans than those for portfolio loans.

Table 6 reports the termination (cutoff) year breakout of conduit and portfolio loans. As would be expected, that distribution is roughly similar to the distribution of CMBS conduit and portfolio deals shown in table 2.

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[11] Similarly, in the subprime mortgage market, Quercia, Stegman and Davis (2005) and Rose (2008) find evidence that prepayment penalties increase mortgage foreclosure risk.

Table 7 provides descriptive statistics on the loan-level sample. As indicated, the average spread of the 16,760 sampled conduit and portfolio loans over the 1994-2000 period was 220 bps. Average LTV was 69 percent, substantially lower than that of residential mortgages. Most of the commercial mortgage loans are balloon loans – about 83 percent of loans had amortization terms of 20 - 30 years while about 81 percent of loans had maturity terms of less than 10 years. Loans are from 10 regions all across the nation, including Midwest/Eastern, Midwest/Western, Northeast/Mid-Atlantic, Northeast/New England, Southern/Atlantic, Southern/East Coast, Southern/West Coast, Western/Mountain, Western/Northern Pacific and Western/Southern Pacific. About 74 percent of the loans (months) were covered by at least one form of prepayment constraint (lock out, yield maintenance or prepayment penalty). Bank of America was the largest contributor of CMBS loans. Over 14 percent of loans in our sample were originated by Bank of America, either as portfolio loans or as conduit loans. Wachovia, GE Capital, JPMorgan Chase, Lehman Brothers, Wells Fargo, GMAC, Nomura and CITI Group are among the top 10 originators of the commercial mortgage loans in our sample.

We estimate a reduced-form model in the form of equation (17) at the loan level. Our dependent variable is the price paid by investors in the secondary market as represented by the net spread. Our explanatory variables again include the variable of focus, the conduit dummy, and other controls representing market conditions and loan characteristics. Among the loan characteristics, controls for LTV, amortization term, maturity term, loan (property) location and prepayment constraint were included in the model.[12] An important issue here is that CMBS investors are purchasing claims on the entire CMBS pool, and thus asset correlations and diversification matter. To

[12] We use LTV instead of DSCR because only a small proportion of our observations contain DSCR close to the CMBS deal cutoff point. For that small sample, we run a correlation analysis and find that LTV and DSCR are highly correlated, which suggests that LTV is good substitute for DSCR. In the robustness checks discussed below, we use the smaller sample to estimate the model using DSCR rather than LTV, so as to test the sensitivity of our results to this data limitation.

account for this, we also include the CMBS deal level information in our loan level analysis.

Table 8 reports our estimates. Again, model 1 demonstrates the raw spread differential. For the market conditions variables, the results are largely consistent with those reported in the deal level analysis. For example, we see that the corporate bond credit spread is significant and of the expected signs in all specifications. In contrast to findings reported in the deal-level analysis, however, the 1-quarter lagged commercial real Sharpe Ratio is significant and with expected sign in all specifications, suggesting that stronger lagged performance in the commercial property market is associated with lower commercial mortgage spreads. Regarding loan characteristics, as would be expected, findings indicate that property type matters to loan pricing. Compared to multifamily loans, the omitted category, retail, office and industrial loans all have higher spreads. This is consistent with findings reported in Titman, Tompaidis and Tsyplakov (2005). For the amortization term controls, the omitted group is loans with amortization terms between 20 and 30 years. Relative to the omitted category, loans with shorter amortization terms are apparently priced higher because amortization helps build equity so as to reduce default risk. This is also consistent with aforementioned evidence in Episcopos, Pericli and Hu (1998), Ciochetti et al (2002) and An (2007). The omitted category among loan maturity controls is loans with maturity of less than 10 years. Interestingly, the longer the maturity terms, the higher the loan is priced. This may be because only high quality property and high quality borrowers can have long maturity loans. We also see variations with respect to where the property is located. For example, loans in Southern/Atlantic, Midwest/Western and Western/Mountain areas are priced higher than those in the Western/Southern Pacific reference region. Prepayment constraints have significant positive impact on CMBS loan pricing, which is consistent with the common wisdom that investors may require less prepayment premium when there are prepayment protections. Contrary to expectations, LTV is shown to negatively affect loan spreads. However, this may be due to the endogeneity of LTV to commercial mortgage underwriting and pricing.[13] CMBS pool characteristics are shown to be important, as we see from model 4. In that regards, variables including deal weighted DSCR, property type composition and loan size diversification are significant and have the expected signs.

Finally, empirical results show a consistently negative and significant effect of our focus variable on commercial mortgage to Treasury spreads across different model specifications. In our most comprehensive specification (model 4), we find that conduit loans enjoyed a 34 bps price advantage over portfolio loans in the CMBS market after controlling for a wide array of loan quality, CMBS deal diversification, liquidity and prepayment characteristics.[14]

Next, we evaluate some of the comparative statics derived from our theoretical model. From theorem 1 and figure 1, we see that the "lemon's discount" increases with loan sellers' portfolio retention costs. In this regard, we first examine loans by property type. Recall that commercial mortgage default risk varies with collateral property type (Vandell et al 1993, Ciochetti et al 2002, Ambrose and Sanders 2003 and An 2007). If banks hold risk-based capital reserves in accordance with Basel II, then loans associated with high risk collateral property types should be more costly to hold. Table 9 shows that the conduit-portfolio spread differentials vary significantly across property types. Further, we control for the interactions between loan property type and the conduit dummy. Those results are reported in table 10. As expected, results indicate that the "lemon's discount" is the lowest for multifamily loans and is the highest for industrial loans. These findings are consistent with comparative statics results of our theoretical model.

Further, we expect that banks and non-banks (commercial mortgage companies) incur different retention costs given the more stringent bank regulatory requirements. To test this hypothesis, we classify the loan originators into

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[13] As discussed below, we estimate simultaneous equations models on loan spread and LTV. However, like above, results of that analysis show LTV entering the spread equation with a positive sign. Findings as regards the conduit dummy are robust to simultaneous equations specifications.

[14] It is noteworthy that in An, Deng and Gabriel (2009), results of hazard model estimation show that conduit loans do not imply higher default risk after controlling for similar risk factors considered here.

commercial bank lenders and non-commercial bank lenders, and interact the bank indicator with the conduit dummy. As evidenced in table 11, all things equal, the "Lemon's discount" is greater on bank loans. Again, this is consistent with our theoretical predictions.

4.4 Robustness

In this section we report on results of a number of robustness analyses. Firstly, as described above, we assess whether our results are sensitive to the use of DSCR instead of LTV in our regression. As shown in appendix table 2, regression results show that research findings are largely robustness to the substitution of DSCR for LTV in the regression analysis.

We also allow for the possibility that investors may pay a premium for loans originated by brand name originators or by originators who have a reputation for strict underwriting. Accordingly, we include categorical controls for the top 25 originators in our sample, and the results are reported in appendix table 3. Interestingly, investors pay a substantial premium for loans originated by lenders who had strong reputations in the commercial mortgage market, including GE Capital, JP Morgan Chase, Morgan Stanley, Wells Fargo, Principal Mortgage and Penn Mutual. That not withstanding, the coefficient of our focus variable remains unchanged.

We also stratify our loan-level sample by property type and re-run the analysis. Results, reported in appendix table 4, are consistent with those reported above in suggesting that the "Lemon's discount" is the lowest for multifamily loans and the highest for industrial loans

In addition, we run the regressions by year of loan origination to account for potential issuance timing effects not captured by the market conditions variables used in our models. The results are reported in appendix table 5. As shown, those results are consistent with our prior findings.

Finally, note that we tested the robustness of findings to the use of SWAP rates rather than constant maturity Treasury bond rates (CMT rate) as the benchmark to computation of CMBS/commercial mortgage spreads. They indicate the findings are largely robust to the use of SWAP spreads.[15]

Overall, results from both our deal level and loan level analyses strongly support our theoretical findings. We summarize our regression results in the following chart.

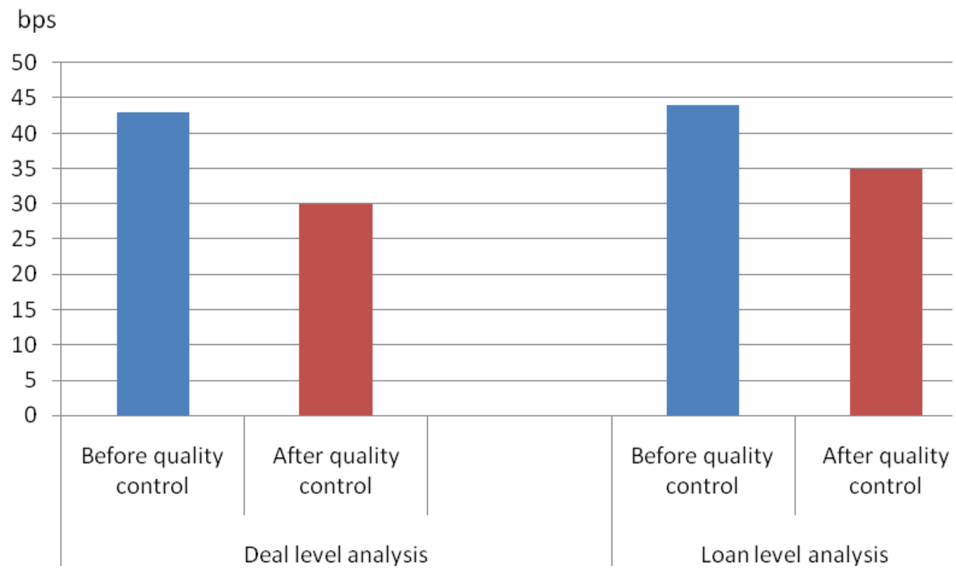

Figure 5: Pricing difference between conduit loans and portfolio loans

As shown above in the cases of both deal level and loan level analyses, portfolio loans sold into the CMBS market are priced lower than conduit loans. Further, the pricing differential derives from two sources: one being quality variations in the portfolio and conduit loans and the other being pricing differences that remain after controlling for loan quality. Findings are highly consistent with the theoretical results in our corollary 1 and suggestive that loan purchasers in the securitization market may have applied a "lemon's discount" to purchases of portfolio loans.

[15] Those results are available from the authors on request.

4.5 Are the results driven by the costs of retaining loans in portfolio?

A concern of the above results is whether the observed differential in pricing is attributable to the costs of loan retention on the part of portfolio originators. One may argue that even without information asymmetry, portfolio originators may choose to accept a lower bid price because of their retention costs.

In that regard, suppose there is no information asymmetry associated with portfolio loan sales (or no private information being exercised during the trade). Then for each loan, the loan buyer and loan seller will agree on a price between the true value $\tilde{\theta}_i$ and the portfolio originator's valuation $(1-\delta)\tilde{\theta}_i$, i.e. $(1-\delta)\tilde{\theta}_i < p^* < \tilde{\theta}_i$. As both the loan seller and the loan buyer gain from this trade, all portfolio loans will be traded. Now compare portfolio loans and conduit loans under this scenario. In this case, we will not observe a quality difference between traded portfolio and conduit loans, which apparently conflicts with our empirical observation that traded portfolio are characterized by lower quality.

Further, from the loan buyer's (investor's) perspective, it is assured that he always gets a favorable price from the portfolio loan seller relative to the conduit loan seller because he pays $p^* < \tilde{\theta}_i$ for $\tilde{\theta}_i$ in the portfolio loan trade and $p^* = \tilde{\theta}_i$ in the case of a conduit loan purchase. At the same time, this does not prevent the portfolio loan seller from selling his loan, in that he also gains from the trade. As a result, both investors and portfolio loan sellers will seek such sales and thus portfolio lending should continue to be a good source of CMBS loans. This is again in conflict with what we see in the CMBS market.

5. CONCLUSIONS

While portfolio lenders often faced a decision to hold for investment or sell newly–originated commercial mortgages, conduit lenders originated loans exclusively for sale into securitization markets. In so doing, conduit lenders may have alleviated a "lemon's problem" in selection of loans for sale in secondary markets, resulting in reduced mortgage risk premia and improved pricing of conduit commercial mortgage loans. In this paper, we investigate the adverse selection hypothesis, via modeling and empirical evaluation of pricing of conduit- versus portfolio-backed commercial mortgage backed securities (CMBS) and loans.

We provide an information economics model that explains the significance and prevalence of conduit lending. We show that this form of financial intermediation solves an information asymmetry problem between loan sellers (originators) and loan buyers (security investors) and in so doing mitigates loan under-pricing and facilitates loan sales. Mortgage buyers and sellers in the secondary market often have asymmetric information with respect to the quality of loans to be traded. Knowing that information-advantageous portfolio originators can choose to liquidate bad quality loans while retaining good quality loans, secondary market purchasers may apply a "lemon's discount" in their pricing of portfolio loans. Such a "lemon's discount" results in a trading price lower than the loans' fair value and causes reductions in trades of high quality loans. In contrast, conduit originators have no opportunity to exercise private information regarding loan quality given that they do not face the sell-retain choice. Knowing this, loan buyers will bid the fair price of these conduit loans and all loans originated will be traded.

Our model also helps explain a puzzle we observe regarding CMBS loan prices. Conduit CMBS deals were often characterized by substantially lower spreads than portfolio CMBS deals at CMBS issuance. This observation conflicts with the common assertion that portfolio loans were underwritten more carefully and hence those deals should generally be characterized by higher quality and stronger performance. According to our model, however, the portfolio loans we observe in the CMBS market represent the lower quality spectrum of all portfolio loans originated and CMBS investors apply a "lemon's discount" to these loans. As a result, we observe that portfolio loans in the CMBS market are priced lower than conduit loans.

Our empirical results are strongly consistent with those of the model. First, summary information on mortgage commercial interest rates and debt-service-coverage ratios (DSCR) suggest that portfolio deals in the CMBS market were characterized by lower credit quality than conduit deals. This is consistent with our theoretical result that lower quality portfolio loans were sold into the CMBS market. Second, we show that after controlling for credit quality, portfolio loans were priced lower than conduit loans. Our empirical analyses of 141 CMBS deals and 16,760 CMBS loans show that upon controlling for well-established determinants of loan pricing, conduit loans enjoyed a 30 bps pricing advantage over portfolio loans in the CMBS market. Our empirical results are robust to a number of model specifications. Results from this paper suggest that conduit lending served to mitigate problems of asymmetric information and adverse selection of commercial mortgages for securitization and in so doing facilitated efficiency of pricing and liquidity in the commercial mortgage marketplace. Those benefits should be reflected in structural review and re-design of mortgage securities markets.

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Table 1 Comparison of CMBS Conduit Deal and Portfolio Deal Spreads

Deal type	Mean	Std Dev	Minimum	Median	Maximum	Number of obs.
Conduit	2.2615	0.5835	0.6613	2.2153	4.4804	118
Portfolio	2.6951	0.8825	1.4987	2.5879	5.0899	23

Note: The spread is calculated as the deal net coupon (paid to investors) minus comparable maturity treasury rate at deal cutoff. Linear interpolation is applied to treasury rates to obtain the full term structure.

Table 2 Cut off Year Distribution of the Conduit and Portfolio Deals in our Sample

Cut off Year	All deals		Conduit deals		Portfolio deals	
	Number of deals	Percent of total	Number of deals	Percent of total	Number of deals	Percent of total
1994	5	3.55	3	2.54	2	8.7
1995	18	12.77	13	11.02	5	21.74
1996	26	18.44	20	16.95	6	26.09
1997	23	16.31	20	16.95	3	13.04
1999	36	25.53	32	27.12	4	17.39
2000	33	23.4	30	25.42	3	13.04
Total	141	100.00	118	100.00	23	100.00

Note: A total of 141 CMBS deals cutoff during 1994 and 2000, not including 1998 in which there is no portfolio deals recorded. Among these deals, 118 are conduit deals and 23 are portfolio deals.

Table 3 Descriptive Statistics of CMBS Deals in our Sample

Variable	Mean	Std Dev	Minimum	Maximum
Deal spread	2.3322	0.6578	0.6613	5.0899
Conduit deal	0.8369	0.3708	0.0000	1.0000
Debt service coverage ratio (DSCR) at deal cutoff	1.4338	0.1715	1.0400	2.3200
Weighted average maturity 10 ~ 20 years	0.6028	0.4911	0.0000	1.0000
Weighted average maturity > 20 years	0.0213	0.1448	0.0000	1.0000
Shares of multifamily loans	0.2858	0.2321	0.0000	1.0000
Shares of retail anchored property loans	0.1711	0.1760	0.0000	0.9338
Shares of office property loans	0.1528	0.1261	0.0000	0.5441
Shares of industrial property loans	0.0635	0.0820	0.0000	0.6239
Shares of retail unanchored property loans	0.1232	0.1561	0.0000	1.0000
Shares of healthcare property loans	0.0305	0.1128	0.0000	1.0000
Shares of full service hotel loans	0.0206	0.0414	0.0000	0.3414
Log of deal cutoff balance	20.1363	0.7076	18.1717	21.5883
Weights of the 5 largest loans in the deal	0.3664	0.2801	0.1066	1.0000
Prepayment coverage	0.9576	0.6465	0.0000	2.1301
Herfindahl index for loan size	0.0211	0.0304	0.0009	0.3441
Geographic diversification	0.8647	0.1069	0.0005	0.9735
Standard deviation of LTV at loan origination	9.7954	2.7022	5.6235	25.9052
Standard deviation of loan DSCR	0.5415	0.2225	0.1401	2.0162
Number of loans	149	87	22	558
Number of Observations	141			

Note: The deal spread is calculated as the deal net coupon (paid to investors) minus comparable maturity treasury rate at deal cutoff. Prepayment coverage is calculated as the proportion of months covered by any of the following types of prepayment constraint: yield maintenance, lock out, prepayment penalty or defeasance. The Herfindahl index for loan size, geographic diversification, standard deviations of LTV and DSCR are calculated using the loan level information of all loans in each deal.

Table 4 GLS Estimates of the CMBS Deal Spread Model

Dependent variable: The CMBS deal Weighted Average Coupon paid to investors (Net WAC), log deal balance used as the weight in the GLS estimation.

Variable	Model 1	Model 2	Model 3
Intercept	2.685***	3.514***	5.088***
	(0.133)	(0.334)	(0.501)
Focus variable			
Conduit deal	-0.427***	-0.257*	-0.329**
	(0.145)	(0.116)	(0.109)
Market conditions			
Corporate bond credit spread		0.952b	1.064*
		(0.516)	(0.439)
CMBS market cap		-0.007***	-0.008***
		(0.001)	(0.001)
Yield slope		-1.165***	-1.007***
		(0.133)	(0.12)
Interest rate volatility		2.342*	1.868b
		(1.181)	(1.09)
Previous quarter Sharpe ratio		0.011	0.019
of commercial real estate		(0.035)	(0.029)
CMBS pool characteristics			
Debt service coverage ratio (DSCR) at deal cutoff			-0.178
			(0.235)
WAM between 10 to 20 years			-0.097
			(0.089)
WAM over 20 years			0.126
			(0.283)
Prepayment constraint coverage			0.320*
			(0.125)
Shares of multifamily loans			-1.063***
			(0.263)
Shares of anchored retail property loans			-0.786*
			(0.341)
Shares of office property loans			-0.689b
			(0.389)
Share of industrial loans			-1.226*
			(0.486)
Shares of unanchored retail property loans			-0.237
			(0.358)
Share of healthcare property loans			0.139
			(0.414)
Share of full service hotel loans			2.753**
			(0.981)

Herfindahl index for loan size			2.274b
			(1.289)
Geographic diversification			-0.918*
			(0.419)
Number of observations	141	141	141
Adjusted R-square	0.0516	0.4253	0.6022

NOTE: Standard errors are in parenthesis, ***- p < .001, ** - p < .01, * - p < .05 and b – p < .1. There are 118 conduit deals and 23 portfolio deals in our sample.

Table 5 Comparison of Spreads of CMBS Loans in Conduit and Portfolio Deals

Loan Type	Mean	Std Dev	Minimum	Median	Maximum	Number of obs.
Conduit	2.0984	0.7203	0.0150	2.0692	5.6800	13655
Portfolio	2.5701	0.9409	0.0425	2.5645	7.1404	3105

Note: The spread is calculated as the loan net coupon (paid to investors) minus comparable maturity treasury rate at deal cutoff. Linear interpolation is applied to treasury rates to obtain the full term structure.

Table 6 Cut off Year Distribution of the Loans in Conduit and Portfolio Deals in our Sample

Cut off Year	All loans		Conduit loans		Portfolio loans	
	Number of loans	Percent of total	Number of loans	Percent of total	Number of loans	Percent of total
1994	332	1.98	180	1.32	152	4.9
1995	1,038	6.19	810	5.93	228	7.34
1996	2,118	12.64	1,713	12.54	405	13.04
1997	2,647	15.79	2,499	18.3	148	4.77
1999	6,739	40.21	4,950	36.25	1,789	57.62
2000	3,886	23.19	3,503	25.65	383	12.33
Total	16,760	100.00	13,055	100.00	3,105	100.00

Note: A total of 16,760 loans in 141 CMBS deals cutoff during 1994 and 2000, not including 1998 in which there is no portfolio deals recorded. Among these deals, 13,055 are in conduit deals and 3,105 are in portfolio deals.

Table 7 Descriptive Statistics of CMBS Loans in our Sample

	Mean	STD	Minimum	Maximum
Spread	2.1955	0.7810	0.0167	7.1404
Loans in conduit deals	0.8147	0.3885	0.0000	1.0000
Loan to value ratio (LTV)	68.5743	10.9955	10.6900	125.0000
Amortization term ≤ 20 years	0.1553	0.3622	0.0000	1.0000
Amortization term > 30 years	0.0169	0.1288	0.0000	1.0000
Maturity term 10 ~ 20 years	0.1677	0.3736	0.0000	1.0000
Maturity term > 20 years	0.0232	0.1506	0.0000	1.0000
MIDWEST / EASTERN	0.0922	0.2894	0.0000	1.0000
MIDWEST / WESTERN	0.0334	0.1797	0.0000	1.0000
NORTHEAST / MID-ATLANTIC	0.1107	0.3137	0.0000	1.0000
NORTHEAST / NEW-ENGLAND	0.0452	0.2078	0.0000	1.0000
SOUTHERN / ATLANTIC	0.1847	0.3881	0.0000	1.0000
SOUTHERN / EAST-COAST	0.0305	0.1719	0.0000	1.0000
SOUTHERN / WEST-COAST	0.1465	0.3537	0.0000	1.0000
WESTERN / MOUNTAIN	0.1001	0.3001	0.0000	1.0000
WESTERN / NORTHERN PACIFIC	0.1116	0.3149	0.0000	1.0000
WESTERN / SOUTHERN PACIFIC	0.1450	0.3522	0.0000	1.0000
Prepayment constraint coverage	0.7361	0.3535	0.0000	1.4667
Quarter 2	0.2841	0.4510	0.0000	1.0000
Quarter 3	0.2137	0.4099	0.0000	1.0000
Quarter 4	0.2973	0.4571	0.0000	1.0000
Column	0.0828	0.2756	0.0000	1.0000
Bank of America	0.1430	0.3500	0.0000	1.0000
Wachovia	0.0790	0.2697	0.0000	1.0000
GE Capital	0.0431	0.2030	0.0000	1.0000
JPMorgan Chase	0.0476	0.2128	0.0000	1.0000
Lehman Brothers	0.0338	0.1806	0.0000	1.0000
Wells Fargo	0.0486	0.2150	0.0000	1.0000
GMAC	0.0436	0.2042	0.0000	1.0000
Nomura	0.0221	0.1471	0.0000	1.0000
CITI Group	0.0348	0.1834	0.0000	1.0000
Number of observations	16,760			

Table 8 GLS Estimates of the CMBS Mortgage Spread Model

Dependent variable: The net coupon paid to investors, log loan balance at deal cutoff used as the weight in the GLS estimation.

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	2.534***	3.126***	3.875***	4.151***
	(0.014)	(0.04)	(0.054)	(0.111)
Focus variable				
Loan in conduit deal	-0.443***	-0.581***	-0.282***	-0.344***
	(0.015)	(0.014)	(0.016)	(0.017)
Market conditions				
Corporate bond credit spread		0.840***	0.633***	0.635***
		(0.058)	(0.055)	(0.056)
CMBS market cap		-0.005***	-0.005***	-0.006***
		(0)	(0)	(0)
Yield slope		-0.828***	-0.721***	-0.709***
		(0.017)	(0.016)	(0.016)
Interest rate volatility		3.771***	3.480***	3.943***
		(0.169)	(0.159)	(0.161)
Previous quarter Sharpe ratio		-0.093***	-0.084***	-0.057***
of commercial real estate		(0.009)	(0.008)	(0.008)
Loan characteristics				
Retail property loan			0.176***	0.159***
			(0.015)	(0.015)
Office property loan			0.170***	0.160***
			(0.012)	(0.012)
Industrial property loan			0.174***	0.170***
			(0.017)	(0.017)
Loan to value ratio (LTV)			-0.005***	-0.005***
			(0)	(0)
Amortization term ≤ 20 years			0.081***	0.095***
			(0.018)	(0.018)
Amortization term > 30 years			-0.227***	-0.216***
			(0.038)	(0.037)
Maturity term 10 ~ 20 years			-0.209***	-0.228***
			(0.015)	(0.015)
Maturity term > 20 years			-0.388***	-0.414***
			(0.034)	(0.034)
MIDWEST / EASTERN			-0.031	-0.045*
			(0.021)	(0.021)
MIDWEST / WESTERN			-0.066*	-0.071*

			(0.031)	(0.03)
NORTHEAST / MID-ATLANTIC			-0.014	-0.037
			(0.02)	(0.02)
NORTHEAST / NEW-ENGLAND			-0.039	-0.056*
			(0.027)	(0.027)
SOUTHERN / ATLANTIC			-0.059**	-0.078***
			(0.018)	(0.018)
SOUTHERN / EAST-COAST			-0.036	-0.052
			(0.032)	(0.031)
SOUTHERN / WEST-COAST			0.031	0.019
			(0.019)	(0.019)
WESTERN / MOUNTAIN			-0.042*	-0.035
			(0.021)	(0.02)
WESTERN / NORTHERN PACIFIC			-0.020	-0.024
			(0.02)	(0.02)
Prepayment constraint coverage			-0.665***	-0.613***
			(0.017)	(0.017)
CMBS pool characteristics				
Weighted DSCR at deal cutoff				-0.105*
				(0.044)
Share of multifamily loans				-0.501***
				(0.06)
Share of retail anchored property loans				-0.497***
				(0.066)
Share of office loans				-0.512***
				(0.077)
Share of industrial loans				-0.789***
				(0.09)
Share of retail unanchored property loans				-0.733***
				(0.073)
Share of healthcare property loans				-0.867***
				(0.157)
Share of full service hotel loans				1.370***
				(0.173)
Herfindahl index for loan size				4.276***
				(0.618)
Geographic diversification				0.311***
				(0.093)
Number of Observations	16,760	16,760	16,760	16,760
Adjusted R-Square	0.0470	0.2154	0.3166	0.3317

NOTE: Standard errors are in parenthesis, ***- p < .001, ** - p < .01, * - p < .05.
There are 13655 conduit loans and 3105 portfolio loans in our sample.

Table 9 Conduit and Portfolio Loan Spreads by Property Type

	Multifamily		Retail		Office		Industrial	
	Conduit	Portfolio	Conduit	Portfolio	Conduit	Portfolio	Conduit	Portfolio
Spread	2.0263	2.2851	2.1648	2.5614	2.1574	2.6752	2.1237	2.7222
	(0.7399)	(0.9411)	(0.6965)	(0.954)	(0.6757)	(0.9386)	(0.7434)	(0.8737)
Difference	26***		40***		52***		60***	
Number of obs.	6050	687	4231	844	2087	769	1287	805

NOTE: The spread is the difference between loan net coupon (paid to investors) and comparable maturity treasury rate at CMBS deal cutoff. *** indicates that the difference is significant at .1% significance level.

Table 10 GLS Estimates of the CMBS Mortgage Spread Model with Property Type Dummy Interactions

Dependent variable: The net coupon paid to investors, log loan balance at deal cutoff used as the weight in the GLS estimation.

Variable	Model 4
Intercept	4.066***
	(0.112)
Focus variable	
Multifamily loan * Conduit deal	-0.239***
	(0.027)
Retail loan * Conduit deal	-0.325***
	(0.027)
Office loan * Conduit deal	-0.365***
	(0.03)
Industrial loan * Conduit deal	-0.510***
	(0.031)
Market conditions	
Corporate bond credit spread	0.637***
	(0.056)
CMBS market cap	-0.006***
	(0)
Yield slope	-0.712***
	(0.016)
Interest rate volatility	3.954***
	(0.162)
Previous quarter Sharpe ratio	-0.057***
of commercial real estate	(0.008)
Loan characteristics	
Retail property loan	0.239***
	(0.035)
Office property loan	0.271***
	(0.035)
Industrial property loan	0.373***
	(0.035)
Loan to value ratio (LTV)	-0.005***
	(0)
Amortization term ≤ 20 years	0.087***
	(0.018)
Amortization term > 30 years	-0.218***
	(0.037)
Maturity term 10 ~ 20 years	-0.228***
	(0.015)
Maturity term > 20 years	-0.413***
	(0.034)
MIDWEST / EASTERN	-0.043*

	(0.021)
MIDWEST / WESTERN	-0.068*
	(0.03)
NORTHEAST / MID-ATLANTIC	-0.036
	(0.02)
NORTHEAST / NEW-ENGLAND	-0.054*
	(0.027)
SOUTHERN / ATLANTIC	-0.077***
	(0.018)
SOUTHERN / EAST-COAST	-0.052
	(0.031)
SOUTHERN / WEST-COAST	0.018
	(0.019)
WESTERN / MOUNTAIN	-0.032
	(0.02)
WESTERN / NORTHERN PACIFIC	-0.028
	(0.02)
Prepayment constraint coverage	-0.604***
	(0.017)
CMBS pool characteristics	
Weighted DSCR at deal cutoff	-0.105*
	(0.044)
Share of multifamily loans	-0.486***
	(0.06)
Share of retail anchored property loans	-0.482***
	(0.066)
Share of office loans	-0.491***
	(0.077)
Share of industrial loans	-0.768***
	(0.09)
Share of retail unanchored property loans	-0.718***
	(0.073)
Share of healthcare property loans	-0.860***
	(0.157)
Share of full service hotel loans	1.387***
	(0.173)
Herfindahl index for loan size	4.348***
	(0.618)
Geographic diversification	0.285**
	(0.093)
Number of Observations	16,760
Adjusted R-Square	0.3351

NOTE: Standard errors are in parenthesis, ***- p < .001, ** - p < .01, * - p < .05, and b – p< 0.10. There are 13655 conduit loans and 3105 portfolio loans in the sample.

Table 11 GLS Estimates of the CMBS Mortgage Spread Model with Bank Dummy Interaction

Dependent variable: The net coupon paid to investors, log loan balance at deal cutoff used as the weight in the GLS estimation.

Variable	Model 4
Intercept	4.074***
	(0.111)
Focus variable	
Conduit deal	-0.315***
	(0.017)
Originator as bank * Conduit deal	-0.118***
	(0.013)
Market conditions	
Corporate bond credit spread	0.673***
	(0.056)
CMBS market cap	-0.006***
	(0)
Yield slope	-0.723***
	(0.016)
Interest rate volatility	3.960***
	(0.161)
Previous quarter Sharpe ratio	-0.058***
of commercial real estate	(0.008)
Loan characteristics	
Retail property loan	0.158***
	(0.015)
Office property loan	0.161***
	(0.012)
Industrial property loan	0.174***
	(0.017)
Loan to value ratio (LTV)	-0.005***
	(0)
Amortization term ≤ 20 years	0.107***
	(0.018)
Amortization term > 30 years	-0.207***
	(0.037)
Maturity term 10 ~ 20 years	-0.235***
	(0.015)
Maturity term > 20 years	-0.395***
	(0.034)
MIDWEST / EASTERN	-0.054*
	(0.021)
MIDWEST / WESTERN	-0.077*
	(0.03)
NORTHEAST / MID-ATLANTIC	-0.048*

	(0.02)
NORTHEAST / NEW-ENGLAND	-0.062*
	(0.027)
SOUTHERN / ATLANTIC	-0.078***
	(0.018)
SOUTHERN / EAST-COAST	-0.048
	(0.031)
SOUTHERN / WEST-COAST	0.010
	(0.019)
WESTERN / MOUNTAIN	-0.040
	(0.02)
WESTERN / NORTHERN PACIFIC	-0.023
	(0.02)
Prepayment constraint coverage	-0.598***
	(0.017)
CMBS pool characteristics	
Weighted DSCR at deal cutoff	-0.041
	(0.045)
Share of multifamily loans	-0.398***
	(0.061)
Share of retail anchored property loans	-0.446***
	(0.066)
Share of office loans	-0.526***
	(0.076)
Share of industrial loans	-0.731***
	(0.09)
Share of retail unanchored property loans	-0.643***
	(0.074)
Share of healthcare property loans	-0.801***
	(0.157)
Share of full service hotel loans	1.392***
	(0.173)
Herfindahl index for loan size	3.456***
	(0.624)
Geographic diversification	0.221*
	(0.093)
Number of Observations	16,760
Adjusted R-Square	0.3349

NOTE: Standard errors are in parenthesis, ***- $p < .001$, ** - $p < .01$, * - $p < .05$, and b – $p < 0.10$. There are 13655 conduit loans and 3105 portfolio loans in the sample.

Appendix Table 1 Names of CMBS Deals in our Sample

AETNA 1995-C5	FUNB 1999-C4	MLMI 1996-C2
AMRESCO 1997-C1	FUNB 2000-C1	MLMI 1997-C1
ASC 1995-D1	FUNB-CMB 1999-C2	MLMI 1997-C2
ASC 1996-D2	GECCMC 2000-1	MLMI 1999-C1
ASC 1996-D3	GMAC 1996-C1	MSCI 1995-GAL-1
BACM 2000-1	GMAC 1997-C1	MSCI 1996-BKU1
BACM 2000-2	GMAC 1999-C3	MSCI 1996-C1
BSCMS 2000-WF1	GMAC 2000-C1	MSCI 1996-WF1
BSCMS 2000-WF2	GMAC 2000-C2	MSCI 1997-ALIC
BSCMSI 1999-C1	GMAC 2000-C3	MSCI 1997-C1
BSCMSI 1999-WF2	GSMSCII 1996-PL	MSCI 1997-HF1
CAISSE 1999	GSMSCII 1999-C1	MSCI 1997-LB1
CCA1-2	HMAC 1999-PH1	MSCI 1997-WF1
CCMS 1996-1	HMAC 2000-PH1	MSCI 1999-CAM1
CCMS 1996-2	JPM 1995-C1	MSCI 1999-FNV1
CCMS 1997-1	JPM 1996-C2	MSCI 1999-RM1
CCMS 1997-2	JPM 1996-C3	MSCI 1999-WF1
CCMSC 1999-2	JPM 1997-C4	MSCI 2000-LIFE1
CCMSC 2000-1	JPM 1997-C5	MSDWC 2000-PRIN
CCMSC 2000-2	JPM 1999-C7	NASC 1994-C3
CCMSC 2000-3	JPM 1999-C8	NFC 1996-1
CMAC 1996-C1	JPMC 1999-PLS1	NFC 1999-1
CMAC 1999-C1	JPMC 2000-C10	NFC 1999-2
CMAT 1999-C1	JPMC 2000-C9	OCMI 1995-1
CMAT 1999-C2	KEY 2000-C1	PMAC 1996-M1
CMB-FUNB 1999-1	KPAC 1994-M1	PMAC 1999-C1
COMM 1999-1	LBCC 1995-C2	PMLI 1996-PML
COMM 2000-C1	LBCC 1996-C2	PNCMA 2000-C1
CSFB 1995-M1	LBUBS 2000-C3	PNCMAC 1999-CM1
CSFB 1995-MBL1	LBUBS 2000-C4	PNCMAC 2000-C2
CSFB 1995-WF1	LBUBS 2000-C5	PSSFC 1995-C1
CSFB 1999-C1	MCFI 1995-MC1	PSSFC 1995-MCF2
CSFB 2000-C1	MCFI 1996-MC1	PSSFC 1999-C2
DLJ 1994-MF11	MCFI 1996-MC2	PSSFC 1999-NRF1
DLJ 1995-CF2	MCFI 1997-MC1	RMF 1995-1
DLJ 1996-CF1	MCFI 1997-MC2	RMF 1997-1
DLJ 1996-CF2	MIDL 1996-C1	SASC 1995-C4
DLJ 1997-CF1	MIDL 1996-C2	SASC 1996-CFL
DLJ 1997-CF2	MLFA 1999-CAN2	SBMS 1996-C1
DLJ 1999-CG1	MLFA 2000-CAN3	SBMS 1999-C1
DLJ 1999-CG2	MLFA 2000-CAN4	SBMS 2000-C1
DLJ 1999-CG3	MLIC 1996-1	SBMS 2000-C2

DLJ 2000-CF1	MLMI 1994-C1	SBMS 2000-C3
DLJCMC 2000-CKP1	MLMI 1995-C1	SBMS-VII 2000-NL1
FUCMT 1999-C1	MLMI 1995-C2	SLCMT 1997-C1
FULB 1997-C1	MLMI 1995-C3	SMSC 1994-M1
FULB 1997-C2	MLMI 1996-C1	TIAA-RCMT 1999-1

Note: A total of 141 CMBS deals cutoff during 1994 and 2000, not including 1998 in which there is no portfolio deals recorded. Among these deals, 118 are conduit deals and 23 are portfolio deals.

Appendix Table 2 GLS Estimates of the CMBS Mortgage Spread Model Using DSCR rather than LTV

Dependent variable: The net coupon paid to investors, log loan balance at deal cutoff used as the weight in the GLS estimation.

Variable	Model 4
Intercept	3.224***
	(0.745)
Focus variable	
Loan in conduit deal	-0.224***
	(0.065)
Market conditions	
Corporate bond credit spread	2.078***
	(0.325)
CMBS market cap	-0.007***
	(0.001)
Yield slope	-1.197***
	(0.09)
Interest rate volatility	3.777***
	(0.792)
Previous quarter Sharpe ratio	0.001
of commercial real estate	(0.028)
Loan characteristics	
Debt service coverage ratio (DSCR)	-0.092***
	(0.024)
Amortization term ≤ 20 years	0.125
	(0.074)
Amortization term > 30 years	0.223
	(0.141)
Maturity term 10 ~ 20 years	-0.190**
	(0.064)
Maturity term > 20 years	-0.381***
	(0.084)
MIDWEST / EASTERN	-0.069
	(0.089)
MIDWEST / WESTERN	-0.067
	(0.114)
NORTHEAST / MID-ATLANTIC	-0.128
	(0.084)
NORTHEAST / NEW-ENGLAND	0.026
	(0.104)
SOUTHERN / ATLANTIC	-0.143
	(0.074)
SOUTHERN / EAST-COAST	-0.111
	(0.117)
SOUTHERN / WEST-COAST	-0.016

	(0.074)
WESTERN / MOUNTAIN	-0.031
	(0.081)
WESTERN / NORTHERN PACIFIC	-0.023
	(0.095)
Prepayment constraint coverage	-0.323***
	(0.079)
CMBS pool characteristics	
Share of multifamily loans	-1.539***
	(0.369)
Share of retail anchored property loans	-0.536
	(0.353)
Share of office loans	-0.825
	(0.451)
Share of industrial loans	-0.946
	(0.701)
Share of retail unanchored property loans	-0.929*
	(0.468)
Share of healthcare property loans	-0.450
	(0.522)
Share of full service hotel loans	2.333*
	(1.155)
Herfindahl index for loan size	2.191
	(2.339)
Geographic diversification	0.784
	(0.647)
Number of Observations	1,064
Adjusted R-Square	0.4334

NOTE: This is a robustness check on whether using DSCR rather than LTV affects model results. The model specification is the same as that in Table 9 model 4, except that the pool level weighted average DSCR is dropped from the regression because it is highly correlated with the loan DSCR. Standard errors are in parenthesis, ***- p < .001, ** - p < .01 and * - p < .05. There are 861 conduit loans and 203 portfolio loans in the sample.

Appendix Table 3 GLS Estimates of the CMBS Mortgage Spread Model with 25 Originator Dummies

Dependent variable: The net coupon paid to investors, log loan balance at deal cutoff used as the weight in the GLS estimation.

Variable	Model 4
Intercept	4.216***
	(0.117)
Focus variable	
Loan in conduit deal	-0.261***
	(0.024)
Market conditions	
Corporate bond credit spread	-0.497***
	(0.054)
CMBS market cap	-0.006***
	(0)
Yield slope	-0.447***
	(0.015)
Interest rate volatility	4.471***
	(0.19)
Previous quarter Sharpe ratio	-0.055***
of commercial real estate	(0.009)
Loan characteristics	
Loan to value ratio (LTV)	-0.006***
	(0.001)
Amortization term ≤ 20 years	0.084***
	(0.018)
Amortization term > 30 years	-0.188***
	(0.039)
Maturity term 10 ~ 20 years	-0.190***
	(0.016)
Maturity term > 20 years	-0.297***
	(0.035)
MIDWEST / EASTERN	-0.047*
	(0.022)
MIDWEST / WESTERN	-0.058
	(0.031)
NORTHEAST / MID-ATLANTIC	-0.044*
	(0.021)
NORTHEAST / NEW-ENGLAND	-0.060*
	(0.028)
SOUTHERN / ATLANTIC	-0.071***
	(0.019)
SOUTHERN / EAST-COAST	-0.024
	(0.032)
SOUTHERN / WEST-COAST	0.040*

	(0.02)
WESTERN / MOUNTAIN	-0.037
	(0.021)
WESTERN / NORTHERN PACIFIC	-0.055**
	(0.02)
Prepayment constraint coverage	-0.595***
	(0.018)
Loan Originator	
Column Financial	0.266***
	(0.022)
Bank of America	-0.005
	(0.024)
Wachovia	0.042
	(0.024)
GE Capital	-0.189***
	(0.028)
JPMorgan Chase	-0.096***
	(0.027)
Lehman Brothers	-0.050
	(0.034)
Wells Fargo	-0.469***
	(0.031)
GMAC	-0.049
	(0.028)
Nomura	0.113**
	(0.039)
CITI Group	-0.035
	(0.031)
Midland	-0.137***
	(0.03)
Merrill Lynch	0.090**
	(0.033)
UBS	-0.041
	(0.033)
Morgan Stanley	-0.151***
	(0.038)
Conti	0.038
	(0.052)
Bear Sterns	-0.218***
	(0.039)
Key Bank	0.265***
	(0.04)
GACC	-0.183***
	(0.039)
Greenwich	-0.055
	(0.042)

Protective	0.069
	(0.071)
Provident	0.341***
	(0.062)
General American	0.078
	(0.06)
Confederation Life	0.342***
	(0.076)
Principal	-0.680***
	(0.054)
Penn Mutual	-0.445***
	(0.078)
CMBS pool characteristics	
Weighted DSCR at deal cutoff	0.264***
	(0.052)
Share of multifamily loans	-0.449***
	(0.067)
Share of retail anchored property loans	-0.284***
	(0.078)
Share of office loans	-1.411***
	(0.087)
Share of industrial loans	-0.581***
	(0.1)
Share of retail unanchored property loans	-0.126
	(0.082)
Share of healthcare property loans	-0.980***
	(0.171)
Share of full service hotel loans	1.620***
	(0.187)
Herfindahl index for loan size	2.488***
	(0.72)
Geographic diversification	-0.349***
	(0.103)
Number of Observations	16,760
Adjusted R-Square	0.3001

NOTE: Standard errors are in parenthesis, ***- p < .001, ** - p < .01, * - p < .05, and b – p< 0.10. There are 13,655 conduit loans and 3,105 portfolio loans in the sample.

Appendix Table 4 GLS Estimates of the CMBS Mortgage Spread Model by Property Type

Dependent variable: The net coupon paid to investors, log loan balance at deal cutoff used as the weight in the GLS estimation.

Variable	Multifamily	Retail	Office	Industrial
Intercept	3.466***	5.372***	3.474***	5.076***
	(0.196)	(0.196)	(0.266)	(0.303)
Focus variable				
Loan in conduit deal	-0.320***	-0.391***	-0.341***	-0.541***
	(0.029)	(0.03)	(0.041)	(0.047)
Market conditions				
Corporate bond credit spread	1.149***	0.245*	0.204	0.393*
	(0.084)	(0.096)	(0.142)	(0.181)
CMBS market cap	-0.006***	-0.006***	-0.005***	-0.006***
	(0)	(0)	(0)	(0)
Yield slope	-0.846***	-0.651***	-0.514***	-0.555***
	(0.024)	(0.03)	(0.04)	(0.053)
Interest rate volatility	4.669***	3.920***	3.408***	3.269***
	(0.265)	(0.269)	(0.415)	(0.53)
Previous quarter Sharpe ratio	-0.079*	-0.201***	-0.190***	-0.084***
of commercial real estate	(0.037)	(0.038)	(0.027)	(0.014)
Loan characteristics				
Loan to value ratio (LTV)	-0.005***	-0.007***	-0.002	-0.004**
	(0.001)	(0.001)	(0.001)	(0.001)
Amortization term ≤ 20 years	0.069	-0.036	0.193***	0.169***
	(0.037)	(0.029)	(0.039)	(0.041)
Amortization term > 30 years	-0.192***	-0.158*	-0.304***	-0.167
	(0.053)	(0.074)	(0.075)	(0.206)
Maturity term 10 ~ 20 years	-0.190***	-0.199***	-0.169***	-0.329***
	(0.026)	(0.026)	(0.037)	(0.042)
Maturity term > 20 years	-0.271***	-0.428***	-1.151***	-0.381*
	(0.044)	(0.055)	(0.198)	(0.194)
MIDWEST / EASTERN	0.009	-0.062	-0.017	-0.008
	(0.034)	(0.036)	(0.053)	(0.066)
MIDWEST / WESTERN	0.011	-0.089	-0.180*	-0.107
	(0.045)	(0.053)	(0.075)	(0.108)
NORTHEAST / MID-ATLANTIC	0.099**	-0.116***	-0.145**	0.106
	(0.034)	(0.035)	(0.045)	(0.06)
NORTHEAST / NEW-ENGLAND	0.153***	-0.171***	-0.204***	0.049
	(0.046)	(0.044)	(0.059)	(0.082)
SOUTHERN / ATLANTIC	0.058	-0.143***	-0.142***	-0.025
	(0.031)	(0.03)	(0.043)	(0.053)
SOUTHERN / EAST-COAST	-0.022	-0.029	-0.100	0.117
	(0.046)	(0.051)	(0.09)	(0.18)
SOUTHERN / WEST-COAST	0.119***	0.011	-0.025	-0.030

	(0.03)	(0.035)	(0.054)	(0.061)
WESTERN / MOUNTAIN	0.024	-0.042	-0.102*	-0.013
	(0.035)	(0.035)	(0.047)	(0.053)
WESTERN / NORTHERN PACIFIC	0.035	-0.003	-0.108**	-0.047
	(0.038)	(0.038)	(0.041)	(0.042)
Prepayment constraint coverage	-0.556***	-0.587***	-0.636***	-0.674***
	(0.029)	(0.031)	(0.039)	(0.045)
CMBS pool characteristics				
Weighted DSCR at deal cutoff	-0.167*	-0.001	0.231*	-0.659***
	(0.068)	(0.08)	(0.11)	(0.153)
Share of multifamily loans	-0.573***	-0.452***	0.531**	-0.042
	(0.087)	(0.121)	(0.195)	(0.226)
Share of retail anchored property loans	-0.366**	-0.708***	-0.203	-0.888***
	(0.118)	(0.108)	(0.175)	(0.22)
Share of office loans	-0.397**	-0.243	-0.253	-0.701**
	(0.123)	(0.136)	(0.201)	(0.239)
Share of industrial loans	-0.941***	-1.044***	-1.281***	-0.897***
	(0.164)	(0.156)	(0.255)	(0.217)
Share of retail unanchored property loans	-0.604***	-1.092***	-0.523**	-0.701**
	(0.122)	(0.126)	(0.193)	(0.216)
Share of healthcare property loans	-1.012***	-1.422***	0.137	-0.305
	(0.209)	(0.323)	(0.539)	(0.567)
Share of full service hotel loans	1.048***	1.031***	1.688***	1.926**
	(0.265)	(0.291)	(0.462)	(0.618)
Herfindahl index for loan size	2.077*	6.038***	9.468***	22.225***
	(0.939)	(1.042)	(1.911)	(2.41)
Geographic diversification	0.679***	-0.394*	0.333	0.402
	(0.168)	(0.165)	(0.238)	(0.234)
Number of Observations	6,737	5,075	2,856	2,092
Adjusted R-Square	0.3313	0.3588	0.3414	0.3786

NOTE: This is a robustness check on whether running the regression by property type affects model results. The model specification is the same as that in Table 9 model 4. Standard errors are in parenthesis, ***- $p < .001$, ** - $p < .01$ and * - $p < .05$.

Appendix Table 5 GLS Estimates of the CMBS Mortgage Spread Model with Stratified Sample

Variable	1994	1995	1996	1997	1999	2000
Intercept	-2.880	4.138***	4.657***	5.948***	2.298***	1.543***
	(1.856)	(1.032)	(1.054)	(0.515)	(0.339)	(0.323)
Focus variable						
Loan in conduit deal	-0.388**	-0.414***	-0.412***	-0.389***	-0.385***	-0.344***
	(0.134)	(0.093)	(0.072)	(0.072)	(0.035)	(0.05)
Market conditions						
Corporate bond credit spread	9.080**	0.717	7.269***	3.140***	2.018***	3.171***
	(2.755)	(1.487)	(1.404)	(0.417)	(0.116)	(0.146)
Interest rate volatility	1.328	7.044***	5.048***	1.273**	1.817***	4.469***
	(2.141)	(0.711)	(0.841)	(0.414)	(0.5)	(0.345)
Previous quarter Sharpe ratio	-0.314***	-0.239**	-0.043	-0.033***	-0.079***	-0.052**
of commercial real estate	(0.091)	(0.077)	(0.029)	(0.01)	(0.015)	(0.016)
Loan characteristics						
Loan to value ratio (LTV)	-0.013***	-0.010***	-0.007***	-0.008***	-0.006***	-0.001
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Amortization term ≤ 20 years	-0.007	-0.032	0.061	0.024	0.100***	0.038
	(0.198)	(0.066)	(0.056)	(0.033)	(0.026)	(0.04)
Amortization term > 30 years	-1.760***	-0.252	0.118	-0.296***	-0.315***	-0.150**
	(0.414)	(0.241)	(0.334)	(0.082)	(0.058)	(0.052)
Maturity term 10 ~ 20 years	-0.169	-0.199***	-0.248***	-0.187***	-0.266***	-0.195***
	(0.132)	(0.059)	(0.053)	(0.028)	(0.023)	(0.036)
Maturity term > 20 years	-0.328*	-0.455***	-0.026	-0.288***	-0.452***	-0.446***
	(0.164)	(0.098)	(0.084)	(0.057)	(0.065)	(0.128)
MIDWEST / EASTERN	0.282	-0.186*	0.051	-0.029	-0.080*	0.049
	(0.194)	(0.09)	(0.064)	(0.042)	(0.034)	(0.037)
MIDWEST / WESTERN	-0.309	-0.008	-0.027	-0.014	-0.108*	-0.053
	(0.242)	(0.123)	(0.102)	(0.051)	(0.047)	(0.055)
NORTHEAST / MID-ATLANTIC	0.146	0.125	0.049	-0.001	-0.055	0.004
	(0.172)	(0.103)	(0.066)	(0.039)	(0.032)	(0.035)
NORTHEAST / NEW-ENGLAND	0.031	-0.041	0.150	0.019	-0.117**	0.021
	(0.305)	(0.118)	(0.084)	(0.049)	(0.044)	(0.044)
SOUTHERN / ATLANTIC	-0.276	-0.050	0.076	-0.095**	-0.150***	0.045
	(0.182)	(0.078)	(0.057)	(0.035)	(0.028)	(0.033)
SOUTHERN / EAST-COAST	0.222	0.002	0.275***	-0.033	-0.253***	-0.044
	(0.217)	(0.112)	(0.081)	(0.055)	(0.055)	(0.064)
SOUTHERN / WEST-COAST	0.042	-0.030	0.072	-0.025	-0.099**	0.145***
	(0.161)	(0.08)	(0.058)	(0.036)	(0.03)	(0.035)
WESTERN / MOUNTAIN	-0.346*	0.060	0.131	-0.001	-0.072*	0.004
	(0.171)	(0.089)	(0.069)	(0.04)	(0.03)	(0.039)

WESTERN / NORTHERN PACIFIC	0.070	-0.043	0.011	-0.047	-0.084**	-0.006
	(0.173)	(0.112)	(0.086)	(0.046)	(0.026)	(0.039)
Prepayment constraint coverage	-0.607***	0.016	0.283*	0.105	-0.797***	-0.496***
	(0.127)	(0.083)	(0.111)	(0.088)	(0.03)	(0.032)
CMBS pool characteristics						
Weighted DSCR at deal cutoff	-0.023	-0.653	-0.256*	-0.488**	-0.889***	1.068***
	(0.217)	(0.5)	(0.118)	(0.182)	(0.162)	(0.105)
Share of multifamily loans	—	-0.512**	-2.151***	-0.866***	1.082***	2.289***
	—	(0.193)	(0.177)	(0.178)	(0.222)	(0.177)
Share of retail anchored property loans	—	0.067	-1.922***	-0.623***	0.612***	-1.511***
	—	(0.305)	(0.168)	(0.169)	(0.165)	(0.178)
Share of office loans	—	-0.489	-2.696***	0.373	1.055***	-0.997***
	—	(0.558)	(0.346)	(0.238)	(0.241)	(0.187)
Share of industrial loans	—	-0.294	-2.780***	-0.420	-2.160***	-3.376***
	—	(0.228)	(0.411)	(0.23)	(0.335)	(0.331)
Share of retail unanchored property loans	—	-0.720***	-3.797***	-0.157	0.866***	-2.821***
	—	(0.189)	(0.198)	(0.185)	(0.252)	(0.37)
Share of healthcare property loans	—	-3.931	-6.349***	-0.819***	-2.586***	-15.435***
	—	(2.36)	(0.595)	(0.223)	(0.558)	(1.343)
Share of full service hotel loans	—	0.878	-6.715***	-0.662	0.802*	-0.038
	—	(0.703)	(0.664)	(0.486)	(0.377)	(0.41)
Herfindahl index for loan size	—	9.275	0.468	10.555***	6.072**	-0.204
	—	(10.362)	(1.649)	(2.282)	(2.29)	(1.92)
Geographic diversification	—	—	-0.030	-0.143	-0.058	-2.122***
	—	—	(0.38)	(0.575)	(0.262)	(0.307)
Number of Obs.	332	1038	2118	2647	6739	3386
Adjusted R-square	0.2998	0.2451	0.3742	0.2207	0.4028	0.3299

Note: These are weighted-least square regression results. Log balance is used as the weight. Standard errors are in parenthesis, ***- p < .001, ** - p < .01, * - p < .05, and b – p< 0.10. Some variables are omitted from the explanatory variable list due to singularity problem – there's not enough variation in those variables.