Risk Retention and Qualified Commercial Mortgages

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We study the effectiveness of the risk retention rule - requiring 5% of underlying credit risk for commercial mortgage backed securities, that was differentially implemented with differential impact on commercial loan markets. Since the primary objective of this rule is for the deal sponsors to have skin in the game, we expect that underwriting standards should tighten following the implementation of the rule. We find that, treated loans, have a higher time-to-securitization, lower price premium, less rating shopping, and lower default probability. Overall our results show that the Dodd-Frank risk retention rule curtailed credit growth in the commercial real estate market.

Keywords: CMBS, Risk Retention

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I. Introduction

The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank Act) was one of the signature legislative and regulatory actions arising from the Great Recession and financial crisis.[1] The purpose of the Dodd-Frank Act was to attack perceived structural deficiencies in the financial markets that led to the Great Recession. Given the central role that mortgage securitization played in the period prior to the financial crisis, new regulations covering mortgage origination, securitization, and investment are central features of the Dodd-Frank legislation. In particular, the Dodd-Frank Act codified a new "Risk Retention Rule" for issuers of mortgage-backed securities.[2] Under the theory that the creators of securitization deals should have interests aligned with investors (Demiroglu and James, 2014), this rule requires that sponsors retain 5% of the credit risk in a deal.[3]

While the majority of the Dodd-Frank Act regulations center on the residential mortgage market, many of the Act's provisions are much broader and target other areas of the capital markets. For example, the credit risk retention rule also applies to commercial mortgage backed securities (CMBS) and specifies that

[1] The Dodd-Frank Act is available online at `http://www.cftc.gov/idc/groups/public/@swaps/documents/file/hr4173_enrolledbill.pdf`.

[2] The risk retention rule became effective on December 24, 2016 as a joint regulation of the Office of the Comptroller of the Currency, the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, and the Securities and Exchange Commission as specified in Section 941 (Regulation of credit risk retention), Subtitle D (Improvements to the Asset-Backed Securitization Process), of Title IX (Investor Protections and Improvements to the Regulation of Securities), which amended the Securities Exchange Act of 1934 (15 U.S.C. 78a et seq.).

[3] See Sweet (2018) and Sargent and Jewesson (2016) for comprehensive overviews of the credit risk retention rule. Furthermore, Floros and White (2016) note that risk retention is designed to attenuate moral hazard between loan originators and investors.

the CMBS sponsor can meet the 5% risk retention through holding a vertical or horizontal interest in the deal or by selling the credit risk interest to the so-called "B-Piece Buyer." A vertical interest refers to the sponsor having an ownership position of at least 5% in each of the deal classes (or tranches) while a horizontal interest refers to the first-loss position for the deal. However, regardless of type of interest, the risk-retention rule effectively requires the issuer to retain exposure to the underlying mortgage pool.

Interestingly, the risk retention rule created a number of exemptions for securitization deals backed by "Qualified Mortgages" (QM). While most of the attention surrounding these exemptions focuses on residential mortgages, certain commercial mortgages also satisfy the regulations for QM status.[4] For example, the exemption applies to mortgages on multifamily or health care facilities that are insured or guaranteed by the U.S. government or the government sponsored enterprises (Fannie Mae and Freddie Mac) while they remain in conservatorship (see Harris et al., 2015). However, the exemptions are narrowly defined such that the majority of commercial real estate loans that comprise CMBS deals do not meet these requirements.[5]

[4] Section 15G (Credit Risk Retention) of the Securities Exchange Act of 1934 (as amended by Section 941 of the Dodd-Frank Act) outlines the exemptions and exceptions to the credit risk retention rule for Qualified Residential Mortgages (see Section 15G.–Credit Risk Retention, paragraph (e)–Exemptions, Exceptions, and Adjustments, subparagraph (B)–Qualified Residential Mortgage.) Furthermore, Sections 1234.15 "Qualifying commercial loans, commercial real estate loans, and automobile loans" and 1234.17 "Underwriting standards for qualifying CRE loans" of Subpart D–Exceptions and Exemptions of Part 1234–Credit Risk Retention (Eff. 2-23-15) of Chapter XII–Federal Housing Finance Agency of Title 12–Banks and Banking of the Code of Federal Regulations outline the exemptions for qualifying commercial real estate loans.

[5] McBride (2014) notes that only between 3.6% to 15.6% (by loan balance) of Trepp's public conduit universe of CMBS deals issued between 1997 and 2013 would meet the qualified CRE exemption. Thus, the vast majority of CMBS transaction are subject to the risk retention rules set forth by the Dodd-Frank Act.

The carve-out for CMBS deals comprising multifamily loans guaranteed by the GSEs creates a natural experiment for testing the impact of the Dodd-Frank Act risk retention rules. Since the primary objective of this rule is to require the deal sponsors to participate in the risks associated with the loans backing CMBS, we expect that underwriting standards should tighten following the implementation of the rule. As a result, the Dodd-Frank Act regulations may have a profound impact on capital costs in the commercial real estate market.

In order to test the impact of the Dodd-Frank risk retention rule on the commercial real estate market, we examine various individual loan risk metrics as well as changes in issuer actions. For example, one aspect reflecting a change in risk is the observable *ex post* default performance for commercial loans. If the Dodd-Frank regulation altered underwriting and created incentives for less risk taking, then we should see this change reflected in lower *ex post* default rates following enactment of the regulations. We also examine changes in loan origination spreads to see the whether loan pricing reflects the change in risk associated with the implementation of the risk retention regulation. We then look to the response of CMBS issuers to changes in the risk retention rule by focusing on loan warehouse time (time-to-securitization), deal level pricing as reflected in average deal coupons, and issuer rating shopping. Finally, we focus on the macro-economic impact by examining whether the risk retention rule reduced the supply of credit.

Our empirical analysis reveals that the Dodd-Frank risk retention rule had a significant impact on commercial real estate mortgage originations. Following the

rule's implementation, we find that (1) conduit loans saw a significant increase in the time-to-securitization relative to agency loans, (2) the relative pricing premium between agency and conduit deals declined, (3) issuers were less likely to engage in ratings shopping on conduit deals, (4) conduit loans had a decline in their risk premium relative to agency loans, and (5) the probability of default on conduit loans declined. Thus, these results are consistent with lenders imposing tighter underwriting standards on conduit loans following the risk retention rule implementation. Furthermore, we find that loan growth significantly declined for lenders who engaged in high conduit volume loan activity prior to the rule implementation. As a result, we confirm that the Dodd-Frank risk retention rule did curtail credit growth in the commercial real estate market. Finally, we show that relatively weaker underwriters (as measured by their capital ratio) reduced their exposure to CMBS deals subject to risk retention.

Our paper is part of a growing strand of literature examining the incentives associated with the originate-to-distribute model in the mortgage market and how government regulations can alter tendencies to take excessive risk.[6] Much of this literature focuses on how asymmetric information between lenders and investors about the quality of the underlying mortgages can impact incentives in the securitization model. For example, empirical studies show that higher proportions of riskier mortgages in MBS deals are often associated with higher retention of the junior tranche (Begley and Purnanandam, 2017) or that lenders tend to retain

[6]Frame (2018) provides an exhaustive survey of the existing literature, focusing on securitizaiton of residential mortgages.

riskier mortgages in portfolio (Ambrose et al., 2005; Agarwal et al., 2012; Jiang et al., 2014). The empirical findings tend to mirror theoretical models showing that equity risk retention is not always the optimal mechanism for offsetting the incentives of lenders to take advantage of asymmetric information in order to securitize risky assets (Hattori and Ohashi, 2011; Fender and Mitchell, 2009; Kiff and Kisser, 2010).[7] In addition, Guo and Wu (2014) develop a formal model that shows how risk retention can enhance adverse selection on the part of lenders. As noted by Frame (2018), the take-away from this literature is that participants in the residential market were aware of the incentives embedded in the securitization model and thus the need for additional regulation may have been overstated.[8] While much work examines risk retention and securitization in the residential market, the literature examining effects in the commercial mortgage space is sparse. However, recent work does focus on the role of risk retention in the commercial mortgage back security space. For example, Ashcraft et al. (2018) examines how the sale of junior CMBS tranches into collateralized debt obligations (CDOs) is correlated with the quality of the overall CMBS deal. As a result, their study suggests that requiring issuers to retain risk could have positive affects on security performance. Perhaps closest to our paper is the work of Furfine (2018), however his focus is on the impact of the policy change on observable loan characteristics such as DSCR and LTV. Our work, on the other hand, focuses on

[7] See also Bougheas (2014) for a model of the incentives for MBS sponsors to retain risk in securitization deals during the pre-crisis period.

[8] Willen (2014) is also highly critical of risk retention regulations and points out a number of problems with justifications for government intervention.

the effect of the policy change on the measure of risks such as pricing, default, rating shopping, and the growth of credit in commercial real estate market.

II. Empirical Method and Data

We obtained data from Trepp for 27,024 commercial mortgages originated between January 2014 and February 2018.[9] These loans were securitized in 490 CMBS deals.

Table 1 reports the deal-level (Panel A) and loan-level (Panel B) descriptive statistics for the full sample, conduit deals, and non-conduit deals. Consistent with the Dodd-Frank Act regulations having a significant impact on capital costs in the commercial real estate loan market, we see substantial differences across observables with respect to conduit or non-conduit classifications. For example, conduit deals have higher risk premiums (2.3% versus 1.9%), higher probabilities of rating shopping (50% versus 15%), and shorter terms to maturity. Furthermore, we note that the number of non-agency (or conduit) CMBS deals declined 60 percent in the first quarter of 2017 from the previous quarter (following the implementation of the risk-retention rule in December 2016). In contrast, issuance of agency CMBS in the first quarter of 2017 declined 27 percent from the fourth quarter of 2016. We also note a similar decline in the number of non-agency loans. The on-line appendix provides greater detail about the sample (including the geographic distribution of the loans).

[9] Trepp is cited as one of the real estate industry's largest providers of information on securitized commercial mortgages. Trepp tracks over 1,500 CMBS deals comprising over 100,000 mortgages. More information about Trepp is available at `http://www.trepp.com/about-us`.

We estimate the following difference-in-difference regression to examine the affect of the risk retention rule on commercial mortgages:

$$\begin{aligned} y_i &= \alpha + \beta_1 * Conduit_i + \beta_2 * Post_i + \beta_3 * (Post_i * Conduit_i) \\ &\quad + \beta_4 * Announce_i + \beta_5 * (Announce_i * Conduit_i) + \theta * Z_i + \varepsilon_i, \end{aligned} \tag{1}$$

where $Conduit_i$ represents a dummy variable denoting loans originated by a conduit lender (i.e. loans that are not guarantee by a government agency or part of an agency CMBS deal); $Announce_i$ is a dummy variable indicating loans originated after the announcement of the risk retention rule, $Post_i$ is a dummy variable indicating loans originated originated after the risk retention rule (December 2016); and Z_i is a set of control variables (loan-to-value ratio, loan maturity, and cap rate) as well as property, originator, time, and location (state) fixed effects. The coefficient on the interaction terms ($Announce_i * Conduit_i$ and $Post_i * Conduit_i$) are the diff-in-diff parameters that represent the differential effect of the risk retention regulation on non-agency (conduit) loans. If the risk retention regulation effectively reduced asymmetric information or altered the underwriting standards of commercial mortgages, then we expect β_3 and β_5 to be significant.

To examine the affect of the new risk retention rule on the commercial real estate loan market, we examine changes in loan pricing and performance as well as issuer reactions to the new regulation. Thus, the dependent variable, y_i, represents a set of variables that proxy for either the riskiness of mortgages or the response

of the CMBS issuer. For example, we examine the log time-to-sale, defined as the time lag between mortgage origination and CMBS issuance (Titman and Tsyplakov, 2010), as a measure of the costs associated with securitization. To the extent that the risk retention regulation altered the liquidity of the CMBS market, then this should be reflected in a change in the time-to-securitization. We also examine mortgage performance (probability of default) since the intention of the risk retention rule is to cause originators to internalize the costs of bad underwriting (since CMBS originators are now required to hold part of the deal). To explore issuer responses to changes in the regulation, we examine differences in mortgage warehouse risk (time-to-securitization), deal level pricing, and the probability of issuer rating shopping.

Tables 2 and 3 report the estimation results. In table 2, we focus on the response of the mortgage-backed security issuer to the new regulation stemming from changes in loan originator underwriting. Our analysis examines changes in loan time-to-sale, deal level pricing (via the coupon spread), and issuer rating shopping. In table 3, we focus on changes in risk at the individual loan level (via mortgage origination spread and ex post probability of default).

III. Results

A. Risk Retention and Issuer Response

Warehouse Risk

We first focus on the time between loan origination and securitization (otherwise

known as time-to-sale or warehouse risk) as an observable proxy for the level of due diligence the CMBS issuer conducts on the mortgage pool prior to securitization. Since the purpose of the risk retention rule is to require the security issuer to hold a risk position in the security (i.e. have 'skin-in-the-game'), we expect a positive shift in the time-to-sale for affected loans following the rule announcement as issuers subject individual loans to greater due diligence scrutiny, necessitating a longer warehouse period. As a result, the risk retention rule should mitigate the natural tendency for issuers to quickly securitize higher-risk loans.

Column (1) in Table 2 presents the estimation results where the dependent variable is the time between loan origination and securitization (time-to-sale). The negative coefficient for *Conduit* indicates that loans in non-agency CMBS deals have a significantly shorter period between origination and securitization than multi-family GSE loans, on average. Again, this is consistent with the view that time-to-securitization is a proxy for risk appetite on the part of the issuer since GSE-backed loans are less risky than non-GSE backed loans due to the credit enhancement provided by the GSEs. As a result, originators are willing to take on greater warehouse risk for GSE-backed loans as the default risk exposure on these loans is minimal.

Turning to the impact of the new risk retention rule, we see that the negative (and statistically significant) coefficients for *Announcement* and *Post-Reform* indicate that loans originated in the announcement period and after the regulation enactment have significantly shorter time-to-securitization than loans originated

prior to the discussion of the regulation. In order to assess the differential effect of the regulation on mortgages subject to the new regulation, we note that the positive and significant coefficient for *Conduit*Announcement* implies that the time-to-securitization for non-agency loans significantly lengthened relative to agency-backed mortgages following the announcement of the risk-retention rules. This is consistent with issuers requiring longer periods for due diligence when creating securities comprising loans subject to the new regulation. Furthermore, the significant positive coefficient for *Conduit*Post-Reform* confirms a permanent increase in securitization time for non-agency loans relative to agency-backed mortgages. The estimates also display an economically significant effect. For example, in response to the implementation of risk retention rule, the estimated coefficients indicate that the securitization time of non-agency loans created following risk retention requirements is 96-days longer than the corresponding shift for agency-backed mortgages. Furthermore, when evaluated relative to the sample mean, the estimates are equivalent to a 73% (96/132) increase in the time-to-securitization.

Finally, with respect to the control variables, we note that LTV and capitalization (or cap) rate (*NOI/Property Vale*) have the expected signs. Consistent with incentives to quickly securitize higher risk loans, we note that the negative and statistically significant coefficient for LTV implies that mortgages with higher loan-to-value ratios (or less equity on the part of the borrower) are securitized faster than loans with lower LTV ratios. Furthermore, the positive and significant coefficient for the capitalization rate suggests that, all else equal, loans collater-

alized by properties that have higher cap rates are viewed as less risky and thus have longer times-to-securitization. The intuition is that as borrowers pay higher values per dollar of cash flow (resulting in lower cap rates), the loans underlying those properties have greater risk. In contrast, when borrowers pay less per dollar of cash flow (i.e. a higher cap rate), then the loan underlying the property has less risk.

Deal Level Pricing

Column (2) in table 2 reports regression coefficients examining the differences in deal level pricing following the introduction of the risk retention rule. The negative and statistically significant coefficient for *Conduit*Post-Reform* suggests that following the enactment of the risk-retention rule, relative pricing premium demanded for non-agency CMBS deals declined. Again, this is consistent with the impact of the regulation reducing the overall risk profile of mortgage-backed securities. The estimates are, once again, economically meaningful. For example, the deal spread for non-agency CMBS deals created after the reform is 0.42% lower in absolute terms compared to the change for agency deals. This reduction is equivalent to a 20% (0.42/2.11) decline relative to the sample mean.

Issurer Rating Shopping

Finally, column (3) in table 2 turns to the actions of the issuer in securing ratings for the CMBS deal. In this regression, we exploit a unique feature of the structured finance product. We note that rating a CMBS tranche that lies below others in the security waterfall requires an analysis of the interest that the

waterfall promises to the tranches above it (Flynn and Ghent, 2018). Thus, the dependent variable takes a value of one if the deal has a tranche with a missing rating but the tranche below it in the capital stack is rated. As expected, the positive and significant coefficient for *Conduit* indicates that non-agency CMBS deals are more likely to be associated with issuer rating shopping. However, consistent with the risk retention regulation altering the incentives to originate risky deals, we see that the coefficient on the interaction term (*Conduit*Post-Reform*) is negative and significant. This indicates that following enactment of the risk retention rule, issuers were less likely to engage in rating shopping. Economically speaking, the estimated coefficients imply a 65% (53.7/82.7) reduction in issuer rating shopping propensity for non-agency CMBS deals relative to the agency deals following the regulation announcement.

B. Risk Retention and Individual Loan Risk

We anticipate that mortgage originators responded to the greater CMBS issuer due diligence requirements by imposing tighter underwriting standards. Thus, we expect the outcome of these changes to be reflected in changes in ex post mortgage default and the individual mortgage risk premium (loan spread).

Loan Pricing

Table 3, column (1) reports the regression results for loan pricing. The dependent variable is the mortgage spread, which is defined as the difference between the mortgage interest rate at origination and the comparable maturity Treasury

rate observed at the mortgage origination date. The spread is thus a proxy for the loan's risk premium.

As expected, the difference-in-difference parameter (*Conduit*Post-Reform*) is negative and statistically significant, revealing the expected decline in relative risk premiums on affected mortgages following the introduction of the risk retention rule. This is consistent with the credit enhancement provided by the GSE's. The significant decline in the risk premiums, relative to the non-treated agency mortgages, is consistent with lenders imposing tighter underwriting standards on commercial mortgages. The significant decline in the risk premiums, relative to the non-treated agency mortgages, corresponds to a decline of 16% (0.336/2.12), which is consistent with lenders imposing tighter underwriting standards on commercial mortgages.

Mortgage Default

In column (2) of table 3, we report the estimated coefficients for the model of the probability of loan default (90+ days delinquency) over the 24-months following securitization. The results confirm the view that lenders tightened underwriting standards following the announcement and enactment of the risk-retention rule. For example, the difference-in-difference parameters (*Conduit*Announcement* and *Conduit*Post-Reform*) are negative and statistically significant indicating that the relative probability of default on non-agency mortgages declined following the risk retention rule announcement and enactment. For instance, the difference-in-difference estimate shows that the treated mortgages experienced a significant

reduction in the default probability by about 0.4% on average during the 2-year period after the risk retention rule relative to the control group.

C. Macro-Economic Impact

We now turn to the broader outcome of bank operations in order to explore whether the risk retention rule affected the credit supply. The empirical challenge is how to identify the extent that different banks are exposed to the regulation. To do so, we exploit bank-level heterogeneity in the Conduit CMBS business engagement for each time-point and construct time-varying measures. Specifically, for bank i at quarter t, we trace all its non-agency CMBS underwriting activities in the past year and obtain the total number as well as total balance of Conduit CMBS it underwrites.Besides the absolute level, we also create dummy variables that equal to one if its total number/ total balance of Conduit CMBS business is above the cross-sectional median.In other words, our approach explores the cross-sectional variation in bank exposure to the risk retention rule.

Next, we adopt a specification similar to Cornett et al. (2011) to analyze how the bank's quarterly credit supply varies with its exposure to the risk retention rule. Table 4 reports the estimated coefficients for this credit supply model. Columns (1) and (2) report the OLS estimation results using number of conduit deals as the proxy for exposure to the regulation.[10] The interaction of number of conduit deals and post is negative and statistically significant, indicating that

[10]Column (1) includes the variable *Post* while column (2) includes quarter fixed effects.

the relative loan growth declined following the risk retention rule implementation for lenders that engaged in greater conduit deal origination activity. We find the same effect in columns (3) through (8) using a dummy variable for high conduit lenders, the dollar value of conduit deals, and a dummy variable for high dollar value lenders. Thus, we find evidence that enactment of the risk retention rule had a significant negative impact on growth in CMBS origination activity.

Finally, in Table 5 we explore the how lender market shares shifted following implementation of the risk retention rule. Our focus is on the CMBS lead underwriters and we restrict the analysis to bank holding companies that file US regulatory reports. To ensure the consistency of bank holding company (BHC) level information, we follow the process outlined in Acharya et al. (2017) to obtain all BHC information from US regulatory reports (FR Y-9C). Foreign bank offices (FBOs) and other subsidiaries are supervised by the Federal Reserve but do not file US regulatory reports.[11] Thus, based on this restriction, we examine the commercial loan origination market shares for the ten US banks identified as lead underwriters for CMBS transactions.[12] These ten banks account for 474 of the 490 deals (97%) in our sample.

Table 5 panel A reports the shift in market shares following implementation of the risk retention rule for "large" and "small" banks. We define the underwriters as large (small) if the bank's average total assets prior to the risk retention rule

[11] For example, Acharya et al. (2017) note that Nomura Holdings Inc. is among the foreign banks that do not file regulatory reports.

[12] The ten US banks are Bank of America, Barclays Capital, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, JP Morgan, Morgan Stanley, UBS, and Wells Fargo.

(2014-2016) is above (below) the sample median.[13] The results indicate almost no change in market shares across underwriters for Conduit CMBS deals (the average deal volume market share for large underwriters is 57.9% prior to the reform versus 60.3% following the reform.) However, we see a substantial and statistically significant increase in Agency CMBS origination market share for large underwriters (49.2% prior to the reform to 66.4% after the reform.) Thus, comparing origination market shares before and after the risk retention implementation shows that the larger underwriters gained greater market power in deals not subject to the risk retention rule.

Next, in Table 5 panel B we compare the change in origination market shares after classifying underwriters based on their Tier 1 capital ratios. The capital ratio is defined as total equity divided by total assets and is used as a measure of a bank's financial health. By segmenting banks into high (low) capital ratios based on whether their average pre-reform capital ratio is above (below) the sample average, we measure a bank's financial strength relative to its peers.[14] In contrast to the comparison across bank size, in Panel B we see that underwriters with relative high capital ratios increase their Conduit CMBS origination market shares following the risk retention rule (going from 40.9% to 57.8%) while Agency CMBS origination market shares remain essentially constant (going from 49.1% to

[13]Based on this classification, small underwriters are Barclays Capital, Credit Suisse, Deutsche Bank, Morgan Stanley, and UBS, while large underwriters are Bank of America, Citigroup, Goldman Sachs, JP Morgan, and Wells Fargo. The classification stays the same if we use post-reform average total assets.

[14]Note, our analysis does not imply that banks with capital ratios below the sample median are at greater risk than the other banks, but rather that they are relatively weaker than banks with capital ratios above the median. The banks below the median capital ratio are Barclays Capital, Deutsche Bank, Goldman Sachs, JP Morgan, and Morgan Stanley, while those above the median are Bank of America, Citigroup, Credit Suisse, UBS, and Wells Fargo.

48.1%) and not statistically different. Thus the comparison of CMBS origination market shares shows that relatively weaker underwriters reduced their exposure to the CMBS market when required to take a risk position in the securitization deals. In contrast, for the market segment where underwriters are not required to hold a risk position (Agency CMBS deals), we see no change in underwriting market shares.

IV. Conclusion

This paper presents an empirical test of the Dodd-Frank Act's risk retention rule that is aimed at issuers of mortgage-backed securities. The regulation requires that MBS issuers retain a minimum of 5% of any deal they underwrite. The rational for this rule is to align the incentives of issuers who create the securities with those of investors by requiring that issuers retain a portion of the risk associated with the securities.

We take advantage of an exemption in the risk retention rule for mortgages insured or guaranteed by the US government or GSEs that created a natural experiment – certain CMBS portfolios that contain mortgages insured by the GSEs are not subject to the risk retention rule while the remaining commercial mortgage market is subject to the rule. Thus, we use the CMBS market to test whether the Dodd-Frank regulation altered underwriter risk taking. Using a difference-in-difference regression framework, we confirm that underwriting standards on commercial mortgages subject to the risk retention regulation did increase following

the regulation's enactment. Specifically, our analysis shows that risk premiums on affected mortgages declined following the regulation, which is consistent with the decline in ex post default probabilities for affected mortgages. Furthermore, we show that the underwriters with lower relative capital positions reduced their exposure to the risk retention requirement. Thus, the results are consistent with lenders responding as expected by tightening underwriting standards following the regulation's enactment. Finally, we find evidence that lenders' reduced the overall supply of credit following the risk retention rule implementation.

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Table 1—Descriptive Statistics

	Full Sample		Conduit		Non-Conduit	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A Deal-Level Characteristics						
Number of Deals	490		217		273	
Conduit (Treated Deal)	0.443	0.497	1.000	0.000	0.000	0.000
Deal Coupon (%)	4.232	0.653	4.511	0.263	4.009	0.774
Deal Spread (%)	2.110	0.735	2.333	0.384	1.933	0.885
D(Rating Shopping) (%)	0.306	0.461	0.498	0.501	0.154	0.361
Weighted Average Loan-to-Value (%)	65.024	6.188	61.402	4.725	67.904	5.685
Weighted Average Maturity (Months)	113.957	35.538	112.807	4.600	114.872	47.453
Share of Top 10 Loans	46.565	17.125	51.351	7.784	42.760	21.125
Share of Multifamily Loans	59.438	43.237	11.809	7.458	97.297	8.268
Share of Retail Property Loan	11.538	14.084	26.054	8.314	0.000	0.000
Share of Office Property Loan	11.670	15.156	26.351	11.461	0.000	0.000
Share of Industry Loans	2.295	4.059	5.182	4.720	0.000	0.000
Share of Hotel Loans	6.820	8.503	15.399	5.565	0.000	0.000
Share of Self-Storage Loans	1.772	3.195	4.002	3.762	0.000	0.000
Share of Other Type Loan	6.467	8.738	11.203	6.806	2.703	8.268
Panel B Loan-Level Characteristics						
Number of Loans	27024		12479		14545	
Mortgage Rate(%)	4.281	0.708	4.629	0.456	3.983	0.749
Mortgage Spread(%)	2.117	0.748	2.451	0.505	1.831	0.802
Time-to-Sale(days)	132.562	130.638	73.786	56.260	182.988	153.254
Delinquency(late payment, %)	6.731	25.056	11.587	32.009	2.564	15.808
Delinquency(30 days +, %)	0.437	6.594	0.841	9.135	0.089	2.988
Delinquency(60 days +, %)	0.200	4.466	0.353	5.928	0.069	2.621
Delinquency(90 days +, %)	0.126	3.545	0.232	4.815	0.034	1.854
Loan-to-Value(%)	65.744	5.269	62.239	4.303	68.750	4.015
Loan Maturity(months)	125.951	49.552	115.791	16.070	134.667	64.622
NOI/(Property value)	0.139	0.226	0.164	0.288	0.117	0.151
D(Multifamily Loans)	0.585	0.493	0.147	0.354	0.961	0.193
D(Retail Property Loan)	0.138	0.345	0.298	0.458	0.000	0.000
D(Office Property Loan)	0.069	0.254	0.150	0.358	0.000	0.000
D(Industry Loans)	0.023	0.150	0.050	0.217	0.000	0.000
D(Hotel Loan)	0.064	0.245	0.139	0.346	0.000	0.000
D(Self-Storage Loan)	0.037	0.188	0.079	0.271	0.000	0.000
D(Other Type Loan)	0.084	0.277	0.136	0.343	0.039	0.193

Table 2—Risk-Retention Rule and Unobservable Loan Quality

	(1) Time-to-sale	(2) Deal Spread	(3) Rating Shopping
Conduit (Treated)	-205.585***	-0.483	0.827**
	(-16.94)	(-1.12)	(2.63)
Announcement	-91.304***	-0.573***	-0.005
	(-9.32)	(-3.02)	(-0.02)
Conduit*Announcement	60.853***	0.004	-0.126
	(5.40)	(0.02)	(-0.86)
Post-Reform	-131.119***	-0.555***	0.113
	(-13.07)	(-3.52)	(0.32)
Conduit*Post-Reform	95.743***	-0.415**	-0.537***
	(9.12)	(-2.35)	(-4.31)
LTV or WLTV	-3.331***	-0.046***	0.002
	(-9.15)	(-5.86)	(1.42)
Maturity or WAM	-0.015	-0.005**	-0.001
	(-0.43)	(-2.44)	(-1.04)
NOI/(Property Value)	118.500***		
	(5.43)		
Share of Top 10 Loans		-0.011***	-0.003***
		(-5.10)	(-3.99)
Property Type Shares (vs other use type)			
Shares of Multifamily Loans		-0.009	0.002
		(-1.42)	(0.95)
Share of Retail Property Loan		-0.004	-0.005
		(-0.79)	(-1.60)
Share of Office Property Loan		-0.002	0.000
		(-0.44)	(0.11)
Share of Industry Loans		-0.003	0.001
		(-0.36)	(0.11)
Share of Hotel Loans		0.008	0.001
		(1.09)	(0.18)
Share of Self-Storage Loans		0.007	0.002
		(0.70)	(0.34)
Constant	449.850***	7.050***	-0.119
	(15.07)	(6.21)	(-0.35)
Property type Fixed effects	Yes		
Originator (or Underwriter) Fixed effects	Yes	Yes	Yes
Origination (or Securitization) Month Fixed Effects	Yes	Yes	Yes
Origination State Fixed Effects	Yes		
Observations	27,024	490	490
R-squared	0.55	0.41	0.38

This table presents the regression estimates of the impact of the issuer response to the Risk-Retention-Rule. The dependent variable in column (1) is the loan-level time-to-sale (or shelf risk) for all loans originated from January 2014 to September 2017. Time-to-sale is defined as the time lag between mortgage origination and CMBS issuance (Titman and Tsyplakov, 2010). The column (2) dependent variable is the deal weighted average coupon minus the comparable maturity Treasury rate observed at the secrutization date, where linear interpolation is applied to the Treasury rates to obtain the full term structure. The dependent variable in column (3) takes a value of 1 for a CMBS deal for which a tranche in the deal is missing a rating from a credit rating agency but a tranche below it in the waterfall has a rating from the same credit rating agency. Announcement is a dummy indicating the period of Dec 2014 - Dec 2016. Post-Reform is a dummy variable for CMBS originated after the reform, Dec 2016. Conduit is an indicator variable that equals to one for Conduit CMBS and zero for Agency CMBS. Controls include loan-to-value, mortgage maturity (in months) and NOI/(Property value), the ratio of net operating income divided by property value at origination, and property type, originator (or underwriter), origination (or securitization) date, and location fixed effects. Robust t-statistics are reported in parenthesis and are based on standard errors clustered by originators and state. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Table 3—Risk Retention Rule and Loan Level Risk

	(1) Mortgage Spread	(2) Default
Conduit (Treated)	0.087	0.003**
	(0.47)	(2.04))
Announcement	-0.107	0.003**
	(-1.49)	(2.38)
Conduit*Announcement	-0.029	-0.002*
	(-0.61)	(-1.78)
Post-Reform	-0.010	0.002
	(-0.13)	(1.22))
Conduit*Post-Reform	-0.336***	-0.004***
	(-5.48)	(-3.10)
LTV	-0.043***	0.000
	(-11.20)	(0.17)
Maturity	-0.004***	0.000
	(-13.02)	(0.97)
NOI/(Property Value)	0.261**	0.000
	(2.57)	(0.27)
Constant	5.588***	-0.006
	(16.32)	(-1.34)
Property type Fixed effects	Yes	Yes
Originator Fixed effects	Yes	Yes
Origination Month Fixed Effects	Yes	Yes
Origination State Fixed Effects	Yes	Yes
Observations	27,024	27,024
R-squared	0.49	0.03

This table presents the regression estimates of the impact of the Risk-Retention-Rule on loan-level mortgage rate spread at origination and the ex post default performance (90-day+ delinquency). The sample includes loans from all CMBS originated from January 2014 to September 2017. The dependent variable in column (1) is the difference between the mortgage rate and the comparable maturity Treasury rate observed at the loan origination date. Linear interpolation is applied to Treasury rates to obtain the full term structure. The dependent variable in column (2) equals one if the mortgage is classified either as delinquent (90-day+), foreclosed or ROE, and zero otherwise. Announcement is a dummy indicating the period of December 2014 - November 2016. Post-Reform is a dummy variable for CMBS originated after the reform, December 2016. Conduit is an indicator variable that equals to one for conduit CMBS and zero for Agency CMBS. Controls include loan-to-value, mortgage maturity (in months) and NOI/(Property value), the ratio of net operating income divided by property value at origination, and property type, originator, origination time, and location fixed-effects. Robust t-statistics are reported in parenthesis and are based on standard errors clustered by originators and state. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Table 4—Macro Impact: Bank Ex Post Credit Supply and Ex Ante Engagement in Conduit CMBS Business

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Var = (Loans growth from t-1 to t)/assets[t-1] (%)							
VARIABLES								
No. of Conduit Deals*Post	-0.821**	-0.760**						
	(-2.99)	(-2.78)						
No. of Conduit Deals	0.479**	0.492**						
	(2.73)	(2.90)						
No. of Conduit Deals_High*Post			-0.676*	-0.587*				
			(-2.20)	(-2.02)				
No. of Conduit Deals_High			0.471***	0.368**				
			(3.48)	(3.22)				
Value of Conduit Deals*Post					-0.815**	-0.732**		
					(-2.81)	(-2.70)		
Value of Conduit Deals					0.472**	0.468**		
					(2.32)	(2.67)		
Value of Conduit Deals_High*Post							-0.779**	-0.758**
							(-2.71)	(-2.93)
Value of Conduit Deals_High							0.447***	0.453***
							(4.86)	(5.25)
Post	1.611**		0.480*		18.482**		0.584**	
	(3.07)		(2.22)		(2.84)		(2.78)	
Deposit/Assets[t-1]	-0.614	-0.614	-0.624	-0.523	-0.613	-0.610	-0.559	-0.558
	(-1.55)	(-1.67)	(-1.13)	(-0.92)	(-1.67)	(-1.70)	(-1.04)	(-1.03)
Capital/Assets[t-1]	1.749	2.278	2.224	1.590	1.920	2.206	1.127	1.234
	(1.03)	(1.35)	(0.82)	(0.63)	(1.25)	(1.37)	(0.46)	(0.55)
LogAssets[t-1]	0.297**	0.250**	0.221	0.186	0.304**	0.257**	0.222	0.192
	(2.90)	(2.93)	(1.69)	(1.50)	(3.14)	(2.91)	(1.77)	(1.67)
Constant	-8.821**	-7.205**	-6.079	-4.859	-18.817**	-17.112**	-6.043	-5.020
	(-2.97)	(-3.07)	(-1.65)	(-1.48)	(-3.05)	(-3.21)	(-1.73)	(-1.66)
Quarter Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	111	111	111	111	111	111	111	111
R-squared	0.17	0.36	0.11	0.30	0.18	0.37	0.13	0.34

In order to identify the impact of the risk retention rule on a lender's operation, we exploit bank-level heterogeneity in the Conduit CMBS business engagement just prior to the program and classify all banks into two groups: high or low based on their underwriting activities ex ante. We adopt a specification similar to Cornett et al. (2011) to analyze how the bank's quarterly credit supply varies with its exposure to the risk retention rule.

Table 5—Underwriter Market Shares by Loan Volume and Number of Deals Based on Underwriter Size and Capital Ratio

		Dollar Amount			Deal Number		
		Pre-Reform	Post=Reform	t-statistic	By Volume	By Number	t-statistic
Panel A: Underwriter Size							
Full Sample	Large Underwriters	0.529	0.644	2.32	0.577	0.685	2.67
	Small Underwriters	0.471	0.356	-2.32	0.423	0.315	-2.67
Loans of Conduit CMBS	Large Underwriters	0.579	0.603	0.36	0.593	0.591	-0.04
	Small Underwriters	0.421	0.397	-0.36	0.407	0.409	0.04
Loans of Agency CMBS	Large Underwriters	0.492	0.664	3.30	0.567	0.714	3.33
	Small Underwriters	0.508	0.336	-3.30	0.433	0.286	-3.33
Panel B: Underwriter Capital Ratio							
Full Sample	High Capital Ratio	0.469	0.530	1.29	0.472	0.535	1.28
	Low Capital Ratio	0.531	0.470	-1.29	0.528	0.465	-1.28
Loans of Conduit CMBS	High Capital Ratio	0.390	0.571	2.21	0.409	0.578	2.00
	Low Capital Ratio	0.610	0.429	-2.21	0.591	0.422	-2.00
Loans of Agency CMBS	High Capital Ratio	0.528	0.513	-0.33	0.509	0.519	0.26
	Low Capital Ratio	0.472	0.487	0.33	0.491	0.481	-0.26

Internet Appendix

Table A1—Top 10 States Ranked by Market Share Based on Original Balance

Full Sample	Before the Reform (2014Q1-2016Q4)		After the Reform (2017Q1-2018Q1)	
	State	Market Share	State	Market Share
	CA	13.746	CA	16.809
	TX	11.501	NY	10.860
	NY	8.370	TX	10.716
	FL	7.073	FL	6.669
	VR	4.747	VR	6.417
	GA	4.168	GA	3.910
	CO	3.654	CO	3.173
	MD	3.522	AZ	2.956
	IL	3.073	MD	2.803
	VA	3.065	NJ	2.649
Loans of Conduit CMBS				
	CA	14.552	CA	18.857
	NY	11.622	NY	15.931
	TX	9.291	VR	11.085
	VR	8.137	TX	7.526
	FL	6.339	FL	4.048
	IL	3.500	PA	3.235
	PA	3.143	NJ	3.118
	MI	3.135	OH	3.064
	NJ	2.846	MI	2.721
	GA	2.707	IL	2.525
Loans of Agency CMBS				
	TX	14.165	CA	15.252
	CA	12.774	TX	13.141
	FL	7.958	FL	8.662
	GA	5.930	NY	7.003
	CO	5.835	GA	5.062
	MD	5.210	CO	4.697
	NY	4.449	AZ	4.138
	WA	4.103	MD	4.058
	VA	3.603	VA	3.273
	AZ	3.302	WA	3.160

Table A2—Top 10 States Ranked by Market Share Based on Number of Loans

Full Sample	Before the Reform (2014Q1-2016Q4)		After the Reform (2017Q1-2018Q1)	
	State	Market Share	State	Market Share
	CA	14.923	CA	13.447
	TX	12.290	NY	12.842
	NY	7.560	TX	10.742
	FL	7.093	FL	6.429
	GA	4.576	GA	4.122
	MI	3.235	IL	3.581
	OH	3.216	CO	3.183
	WA	3.023	NJ	3.167
	IL	3.018	AZ	2.976
	AZ	2.965	OH	2.849
Loans of Conduit CMBS				
	CA	13.335	CA	16.190
	TX	11.476	NY	12.834
	NY	7.748	TX	9.297
	FL	7.271	VR	6.213
	MI	4.653	FL	5.986
	VR	4.370	OH	3.537
	GA	3.884	GA	3.447
	OH	3.815	MI	3.401
	IL	3.319	IL	3.311
	NC	3.047	PA	3.175
Loans of Agency CMBS				
	CA	16.482	NY	12.846
	TX	13.090	CA	11.964
	NY	7.376	TX	11.522
	FL	6.918	FL	6.668
	GA	5.255	GA	4.486
	WA	4.443	CO	3.898
	CO	3.765	IL	3.726
	AZ	3.411	NJ	3.604
	NC	2.809	AZ	3.408
	IL	2.723	WA	2.991