Whose Skin Is It? Examining the Role of Risk Retention in CMBS Markets[1]

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ABSTRACT

This paper examines the risk retention issue of security design in the context of commercial mortgage backed security (CMBS) markets. Focusing on the role of the B-piece investor, we examine the link between risk retention, incentives to screen, and the loss severity of CMBS collateral pools. Using data from 539 CMBS deals issued over the period 2000-2015, we find only modest evidence that observable measures of both ex-ante screening effectiveness and screening incentives help to predict ex-post loss severities. Consistent with these results, we accordingly find little evidence that investment grade investors take such relationships into account when pricing CMBS bonds. This research helps us better understand how evolutions in CMBS market structure and regulation impact CMBS deal pricing and performance—important information for issuers, investors, and policymakers, alike.

Keywords: Securitization, Risk retention, Commercial mortgage-backed securities, B-piece investing, Financial regulation
JEL Codes: G23, G28, D82

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1. Introduction

The market for commercial mortgage-backed securities (CMBS) represents a significant source of public debt funding for commercial real estate investment. Investors held over $800 billion in CMBS debt at the market's peak in 2007 (Figure 1, A). More impressive than the size of the market, however, is the rapid growth that it experienced leading up to the Global Financial Crisis of 2007-2008. Following the crisis, CMBS issuance volume recovered slowly while other markets for securitized assets (e.g., private-label residential mortgage-backed securities and collateralized debt obligations) all but disappeared. The CMBS market developed in the 1990s and has proven to be an important source of capital for commercial real estate borrowers alongside more traditional intermediaries such as life insurance companies and banks.

Like any type of securitization, CMBS markets effectively unbundle banks (Titman and Tsyplakov, 2010). In a traditional banking model, the roles of loan screening, risk bearing, and monitoring are all played by a single institution. In CMBS markets, it takes dozens of institutions – loan originators, deal sponsors, master servicers, special servicers, trustees, and rating agencies – to make the market operate. Each participant is not only highly specialized in focus, but also operates independently from the others. The coordination of these actors in intermediating hundreds of billions of dollars of capital provides a unique setting in which to empirically test classical theories of principal-agent relationships. In this paper, we specifically focus on studying the impact that ex-ante screening by a third-party investor – the B-piece buyer – has on ex-post collateral pool loss severities and ex-ante bond pricing.

CMBS market participants commonly refer to a deal's equity tranche or first-loss piece as its B-piece investment. The B-piece investment typically consists of multiple bonds, or tranches, with below-investment-grade ratings (i.e., below triple-B minus). Investors in the B-piece are the first to incur losses realized on the underlying collateral pool. They are high risk, information sensitive investors whose decision to purchase the B-piece - and thus retain the underlying credit risk - is highly contingent on the quality of the underlying collateral pool. B-piece buyers tend to specialize in screening CMBS collateral pools, usually re-underwriting a significant portion of the mortgage loans before submitting a purchase bid to the deal sponsor. In addition to proposing a price, bidders can also request that, as a condition of purchase, potentially problematic loans be removed from the final collateral pool at the expense of the deal sponsor. This is called the kick-out option. B-piece investors can thus have a direct impact on expected collateral pool loss-severities through effort spent on screening and shaping the collateral pool.

In this paper we examine whether heterogeneity in B-piece buyer characteristics, investment objectives, and institutional affiliations can result in varying incentives to screen and shape the collateral pool. We outline three broad types of screening incentives: (1) the internal screening effectiveness of the B-piece buyer, (2) external deal-level incentives to screen, and (3) external market-level incentives to screen. We then empirically test the relationship between proxies for these drivers and ex-post realized losses while controlling for observable loan-, deal-, and market-level risk factors. After testing the link between these screening measures and ex-post loss severities, we then test whether investors account for those relationships when pricing CMBS bonds.

This research takes advantage of a rich monthly panel CMBS data provided by Trepp and CRE Direct at the deal-, bond-, and loan-level. The final sample encompasses 539 CMBS deals issued over the years 2000-2015 and backed by approximately 70,000 commercial real estate mortgage loans. For each deal, we observe at-issue collateral pool characteristics as well as a monthly panel of contemporaneous risk and performance measures. These data provide a number of proxies for B-piece buyer screening effectiveness and incentives. We use the B-piece buyer's past number of deals as a proxy for market experience and screening effectiveness. For deal-level screening incentives, we primarily consider the B-piece buyer's affiliation with the transaction's special servicer. Finally, we use CDO collateral pool data to proxy for market-level forces that can shape the B-piece buyer's incentives to screen. There is significant cross-sectional and time-series heterogeneity in all of the measures for screening effectiveness and incentives, thus allowing for a cleaner identification of differences in screening effectiveness and incentives.

Our empirical results suggest the links between realized losses and measures of screening effectiveness and incentives are generally modest in nature. While the signs of the coefficients of interest are generally as anticipated, we do not find them to be as significant as our hypothesized expectations. First, we fail to find a statistically significant relationship between realized losses and the level of B-piece buyer screening effectiveness (as measured by market experience) after controlling for other observable deal and market risks. Our results also suggest that the link between market experience and deal pricing is economically small, albeit statistically significant. Second, our results do not provide conclusive evidence for the existence of an economically significant relationship between realized losses and the amount of the B-piece investment that is quickly (i.e., within a year after CMBS issue) traded into CDOs rather than being held through maturity. We are likewise unable to establish a statistically significant relationship between CDO sales and ex-ante deal pricing. Finally, we find mixed evidence of the extent to which relationships may exist between CMBS losses, pricing, and alternative measures of deal-level incentives to screen.

This study is most closely related to work done in Ashcraft et al. (2014), which documents a causal link between risk retention and performance that is not priced into investment grade tranches at origination. In addition to studying risk retention, our paper also includes an analysis of other drivers of screening activity such as investor screening effectiveness, as well as measures of deal- and market- level screening incentives. Another difference is that rather than using the default status of the deal's most junior triple-B rated bond as the main measure of performance, our study focuses on monthly, total cumulative loss rates to all bond classes.[2]

Other related research in CMBS markets analyzes how deal pricing and performance is impacted by loan originator characteristics (Black et al., 2012), deal complexity (Furfine, 2014), master and special servicers (Ambrose and Sanders, 2003, Ambrose et al., 2009), and special servicing incentives (Gan and Mayer, 2006). This study contributes to the literature by exploring the role of the B-piece buyer in CMBS market transactions, while more broadly helping us to better understand how evolutions in market structure and regulation impact the pricing and performance of securitized assets—important information for issuers, investors, and policymakers, alike.

The loss severity of CMBS bonds is ultimately driven by the performance of the underlying collateral: commercial real estate mortgage loans. As a result, this paper rests on the foundations of the literature on determinants of commercial real estate mortgage loan

[2] The triple-B minus rated bond is an investment grade bond ranking directly above the first-loss B-piece bond.

performance. Mortgage loan loss severities are the product of default rates and loss given default rates. There are a handful of papers that measure these items for commercial real estate mortgages, primarily focusing on life insurance and commercial bank portfolio loans. Many of these papers also look at how the realized performance (i.e. default rates and losses) of commercial mortgages impact the pricing of said loans in equilibrium. There are a number of articles that focus on uncovering determinants of commercial loan defaults (e.g., LTV and DSC ratios) including Snyderman (1991), Vandell et al. (1993), Esaki et al. (1999), Ciochetti et al. (2003) and others. There is also a body of research that examines the issues of risk retention, moral hazard, and adverse selection problems in residential mortgage-backed security (RMBS) markets.[3] Significant differences between RMBS and CMBS markets, however, make it difficult to apply inferences gleaned from this research to the setting of CMBS markets.

Besides contributing to our academic understanding of screening incentives, our study also has important policy implications. It has been estimated that approximately $350 billion of pre-crisis CMBS debt was set to mature in 2015, 2016, and 2017 alone (Hambly, 2015). As CMBS markets prepare to refinance these debts, industry participants have also grappled with changes to risk-retention rules that went into effect on December 24, 2016 (Office of the Comptroller of the Currency, 2014). These rules, originally stemming from Dodd-Frank legislation passed in 2010, apply to all types of securitizations (i.e., RMBS, CMBS, ABS, CDO, CLO, etc.), and require deal sponsors to retain—for at least five years—no less than a 5% first-loss slice of each deal. The goal of the policy is to help mitigate the moral hazard issues associated with an "originate-to-distribute" model, where loan originators are compensated for supplying loans to be securitized without retaining exposure to future loan losses. The new risk-retention rules force issuers to keep "skin-in-the-game"—a guarantee that any losses on the underlying collateral will first be borne by the issuer, and then by outside investors. In the context of CMBS markets, the new rules contain an exemption that allow CMBS (and only CMBS) sponsors to comply by designating a third-party investor, the B- piece buyer, to hold the 5% first-loss slice.

[3] See Demiroglu and James (2012), Elul (2011), Jiang et al. (2013, 2014), Krainer and Laderman (2014), Keys, Mukherjee, Seru, Vig (2008), Bubb and Kaufman (2014), An, Deng, and Gabriel (2011), Titman and Tsyplakov (2010), and Adelino, Frame, and Gerardi (2014).

The rest of the paper is structured as follows. Section 2 introduces our main hypotheses and empirical predictions. Section 3 discusses data sources and measures. Sections 4 and 5 report our main results. Section 6 presents a discussion of the results, and Section 7 concludes.

2. Hypotheses and empirical predictions

While lower loss severities benefit investors across the CMBS capital stack, it is the B-piece buyer specifically who internalizes many of the costs required to screen collateral pools. What incentives does the B-piece buyer have to exert costly screening effort to detect and kick out potentially problematic loans? We approach this question by outlining a theoretical cost-benefit framework for screening. We then use the framework to motivate our main hypotheses and empirical predictions.

Costs of screening

The due diligence and screening process requires an in-depth analysis of underlying property-level fundamentals (e.g., analysis of rent rolls, local real estate markets, etc.), mortgage-level terms and conditions (e.g., interest-only, amortization periods, defeasance clauses, etc.), and deal-level structures (e.g., waterfall payment schemes, control rights, etc.). While the costs of this screening process can be significant, they likely also vary across investors. B-piece buyers that are familiar with evaluating commercial real estate investments could have lower screening costs than investors with no prior commercial real estate investment experience. It is therefore possible that firms with more B-piece market experience face lower screening costs than new entrants to the marketplace. For example, firms that have participated in B-piece markets for a longer time should be better able to lean on proprietary data from past deals when evaluating default risk in future transactions.

Lower costs of screening due to market experience should ultimately lead to more effective screening processes. We would therefore expect firms with greater market experience (i.e., firms with high internal screening effectiveness) to be better able to identify and kick out high risk loans. It should be noted that both CMBS deal sponsors and loan originators can bear significant costs when loans are kicked out. Deal sponsors bear the opportunity- and capital-related-costs of warehousing kicked out loans, in addition to facing the adverse selection problem of Akerlof (1970) in finding other B-piece buyers to accept what may be perceived as "damaged goods" in subsequent deals.[4] These costs should in turn cause the deal sponsor to better screen loans purchased from loan originators, who also face the risk of having loans being put back on them through representations and warranties.[5] Effective B-piece buyer screening and kick outs can thus create a chain of effects impacting the credit decisions of CMBS deal sponsors and loan originators. Using ex-post realized losses as an observable, ex-post measure of credit risk, our first hypothesis is thus:

> **H1: Collateral pools that have been screened by more experienced B-piece buyers will have lower ex-post realized losses on average.**

If H1 holds, then other, investment-grade CMBS investors in an efficient market should also be willing to accept lower ex-ante risk premiums (i.e., yield spreads) to hold deals with lower expected losses:

> **H1': Investment grade bonds from deals with more experienced B-piece buyers will attain higher at-issue prices (lower spreads) on average.**

H1 and H1' are tied together by the relation that ex-ante prices should be driven by expected ex-post losses. If investors are aware that deals with more experienced B-piece buyers tend to suffer lower loss severities, then it follows that they should also be willing to accept lower risk-adjusted returns when pricing investment grade bonds at issue.

Benefits of screening

B-piece investments are highly leveraged positions with significant variability in ex-post performance. Time-to-default models drive investment decisions, and a single default can wipe

[4] Private discussions with a prominent B-piece buyer suggest it is common for B-piece buyers to request that deal sponsors identify whether any of the underlying mortgage loans have previously been kicked out of earlier CMBS deals. These loans then have a higher conditional probability of being kicked out again. Interestingly, this led one large CMBS sponsor to issue an entire deal backed primarily by previously kicked out loans.

[5] It is even common practice for loan originators to seek the help and opinions of B-piece buyers when vetting potential borrowers.

out the entire B-piece.[6] Deal sponsors, however, are willing to sell B-piece bonds at steep discounts to provide investors with acceptable risk-adjusted returns. Although B-piece primary market pricing data has not historically been made publically available, private sources have reported deals pricing at annual yields upwards of twenty percent through maturity.[7] The potential rewards of successfully screening and holding a high-performing B-piece investment through maturity are therefore great.

But buying and holding until maturity is only one possible investment strategy. Another is to buy-and-trade, selling a portion of the B-piece in a collateralized debt obligation (CDO) transaction. Such a transaction could be motivated by a number of reasons: to take advantage of pricing differences through arbitrage across CMBS and CDO primary markets; as a source of matched term funding for B-piece investments; or to exit previously made B-piece investments by selling into a CDO.

While this type of secondary market liquidity is generally beneficial to market participants, it can also have a "dark side", as demonstrated in Myers and Rajan (1995), where greater asset liquidity reduces the ability of firms to commit to a certain investment project. In the case of CMBS markets, a liquid secondary market for B-piece bonds could similarly undermine the incentive of the initial buyer to screen the collateral pool for especially adverse risks.

Whereas buy-and-hold investors are concerned with minimizing losses over the entire lifespan of the CMBS deal, buy-and-trade investors could be more likely to focus only on problems that could arise within a shorter time horizon.[8] While the ability to generate consistent trading profits in efficient markets depends on possessing superior information over one's counterparty, CDO deal structures presented B-piece investors with the opportunity to trade with information insensitive CDO sponsors. The diversification effect of pooling helps transform information sensitive claims – such as CMBS B-pieces – into investment grade, information

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[6] To give an example, a *Financial Times* article states one particular B-piece buyer's strategy is to underwrite every loan in the CMBS pool before submitting a bid for the B-piece. The CEO sums up the importance of intensive screening by saying, "Averages kill you. All you need is one loan to go bad." http://www.ft.com/intl/cms/s/2/42b79cc8-caa7-11e1-8872-00144feabdc0.html#axzz48T5LTVhx

[7] In comparison, the lowest available investment-grade rated tranches (triple-B minus) typically have yields that range between four to nine percent annually.

[8] An investor that sells the senior portion of the B-piece bond realizes instant proceeds from the sale and then continues to receive coupon payments on the retained junior claim until maturity or when it is wiped out by losses on the underlying collateral pool. Three to four years of coupon payments on the junior piece, in conjunction with proceeds from selling the senior piece, can potentially be enough to break even on the initial outlay.

insensitive claims on a large, diversified pool of collateral thus overcoming (in theory) the adverse selection problem presented in Akerlof (1970). Although one would expect there to be an informed, information sensitive investor holding the equity tranche of the CDO deal, the arrival of CDO^2 transactions and the resulting layers of complexity would make it difficult for the end investor to accurately assess the underlying risks involved.

To the extent that CDO sponsors may not price B-piece risk as accurately as more informationally sensitive counterparties, we therefore argue that the benefits of B-piece screening are lower in the presence of active secondary market trading opportunities. We argue that these trading opportunities mitigate the external market-level incentives to screen. Our second and third hypotheses follow as:

H2: Deals will have higher average realized losses when the B-piece is traded into a CDO within a short period (i.e., one year) after closing.

A short time period between CMBS closing and pledging a large proportion of the B-piece bonds to a CDO is more likely to identify B-piece buyers with a short-term trading strategy. These B-piece buyers should have relatively lower incentives to screen on average than those who sell into CDOs later on (e.g., for liquidity reasons).

If H2 holds then it follows that they should adjust their pricing of the deal's bonds accordingly. But it may be a stretch to believe that investment grade investors know with perfect foresight how much of each deal's B-piece will eventually be sold into CDOs. This leaves them only with the ability to deduce the probability of future CDO sales by observing the historical behavior of the deal's B-piece buyer. If investors expect higher losses on deals with higher probabilities of CDO sales, then it could follow that:

H2': Investment grade bonds from deals with B-piece buyers that consistently trade into CDOs within a short period (i.e., one year) will attain lower at-issue prices (higher spreads) on average.

In addition to external market conditions, the benefits of screening may also depend on whether the B-piece buyer retains special servicing rights on the collateral pool.[9] Assuming there are benefits to the special servicer of conducting ex-ante due diligence (e.g., to more quickly identify and take action on problematic loans), we conjecture that the benefits of screening may be greater when the B-piece buyer is also the special servicer due to economies of scale and scope that can be realized by combining the two roles within a single company. Alternatively, B-piece buyers may have less secondary market liquidity when they are also the special servicer because of adverse selection issues stemming from the sharper informational asymmetries created by combining the two roles. If secondary market liquidity is lower, the benefits of screening in order to pursue a buy-and-hold strategy should then be relatively greater.

Another deal-level driver of screening benefits worth considering is whether there is more than one B-piece buyer at issuance. On the one hand, the expected benefits of screening may be lower if the B-piece investment is split across multiple parties. Counteracting this possibility, the costs of screening may be also relatively lower if they are shared by multiple B-piece buyers. We therefore conjecture that the effects on ex-post losses of having two B-piece buyers are ambiguous.

Finally, we conjecture that the complexity of the underlying collateral pool should have a negative impact on the ability of the B-piece buyer to effectively screen and kick out high default risk loans. It is more difficult to screen 200 loans than 20; likewise, the more concentrated the loan pool is, the easier it may be to screen a large proportion of the collateral pool's balance by focusing on only a small handful of large loans.[10]

Our main hypotheses related to the external deal-level screening incentives described above are:

H3: Deals in which the B-piece buyer is also the special servicer will have lower realized losses on average.

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[9] Most CMBS pooling and servicing agreements grant the owner of the B-piece control rights to appoint a special servicer that is in charge of working out distressed mortgage loans. If the B-piece buyer also happens to be a special servicing company, it may choose to appoint itself to this role.

[10] See Furfine (2014) for a rigorous examination of the overall impact of complexity on CMBS pricing and performance.

H4. The number of B-piece buyers in a single deal will have an ambiguous effect on realized losses.

H5: Deals with more complex collateral pools will exhibit higher realized losses on average.

The associated pricing related hypotheses are:

H3': Investment grade bonds from deals where the B-piece buyer is also the special servicer will attain higher at-issue prices (lower spreads) on average.

H4'. The number of B-piece buyers in a single deal will have an ambiguous effect on ex-ante deal pricing.

H5': Deals with more complex collateral pools will attain lower at-issue prices (higher spreads) on average.

The relationship of H3 and H4 with H3' and H4' is again defined by the notion that competitive investors in an efficient market will set ex-ante prices to reflect expected ex-post losses. If the factors described in H3 and H4 have a material impact on ex-post losses, then we would expect investors to adjust the prices they are willing to pay accordingly. If one of the factors impacts ex-post losses but not ex-ante pricing, there could be evidence of a mispricing of risk in the primary market.

3. Data and Screening Measures

We conduct our analysis using Trepp loan-level, bond-level and deal-level CMBS data over the period 2000-2015.[11] We augment the Trepp data with B-piece buyer names from

[11] Trepp is cited as the commercial real estate industry's largest and most transparent database of securitized commercial mortgage loans. Trepp also provides clients with a host of risk assessment tools, data, and analysis for non-CMBS commercial real estate lending, banking, and finance.

Commercial Real Estate Direct (CRE Direct). The Trepp and CRE Direct data sets do not share a common deal ID variable, so we construct a merge key that matches 94% of the CRE Direct deals to Trepp data. The Trepp deal file contains data for 2,055 CMBS deals during the sample period for a wide range of CMBS deal types. For our analysis, we focus only on conduit CMBS deals, the most prevalent sector of CMBS markets. [12] This leaves 622 deals during the sample period, out of which we extract our final sample of 539 deals.[13]

At the loan-level, the data include initial pricing of the individual mortgage loans; important terms and provisions of the loan (e.g., interest rates, fees, amortization type, payment frequencies, etc.); the loan originator and servicing companies; monthly loan status (e.g., outstanding balance, delinquency status (e.g., 30, 60, or 90 days), modifications, REO status, etc.); and underwriting measures (e.g., DSCR, LTV, geographic location, property type, etc.) at the loan origination date, securitization date, and contemporaneously.

Deal-level data includes aggregate at-issue characteristics and ex-post, contemporaneous performance variables for an entire collateral pool backing a CMBS single deal. At the deal-level, the data provided by Trepp include aggregate default and cumulative loss rates; the identity of underwriting syndicate members, master servicer, and special servicer; and aggregate underwriting statistics (e.g., DSCR, LTV, geographic location, property type, etc.). Trepp collects these data from a variety of sources including prospectuses, servicers, special servicers, and trustees. The data record these variables for all deals at the securitization date as well as on a monthly basis.[14]

The bond-level data file includes information on the CMBS bonds that are backed by the collateral pool of loans and issued to investors. It includes data on bond subordination levels, credit ratings, payment schedules and histories, among other fields. The bond-level data also include CUSIP information for each bond, which we use to link CMBS bonds with CDO collateral also provided by Trepp.

[12] Conduit deals are characterized by collateral pools consisting largely of loans originated with the intent to be securitized. Other deal types tracked by Trepp include agency, CDO, Canadian, conduit, credit tenant leases, franchise loans, large loans, non performing, private, seasoned, short term, single family, small loan, and single asset/borrower.

[13] We drop any deals for which there is no corresponding CRE Direct data (42 deals), any deals that do not have a b-piece buyer listed in CRE Direct (20 deals) as well as deals missing a series of ex-post performance data (21 deals), leaving a final sample of 539 deals. The 20 deals missing b-piece buyers tend to be smaller deals, averaging about $810 million in initial balance, or approximately half of the $1.6 billion average size for deals with b-piece buyers listed.

[14] Monthly tracking begins in 2008 for most deals, thus producing an unbalanced panel of data.

Loan-level summary statistics

Table 1, Panel B presents loan-level summary statistics for 75,016 loans used as collateral in CMBS deals during the years 2000-2016.[15] The average loan was about $13 million, had a coupon rate at the securitization date of about 6%, and had an average remaining term at securitization of 113 months. This reflects the common practice of structuring conduit loans as partially amortizing loans with a term of ten-years and balloon payment due in the tenth year.[16] The average debt-service-coverage ratio (DSCR) using net operating income (NOI) is 1.9, and the average loan-to-value ratio is 67% at securitization. About 15% of the loans enter distress (e.g., 60+ days delinquent, foreclosure, or real-estate owned) at some point over the course of the sample period (2000-2015). 56% of loans are located in states that allow deeds of trust, which can help to expedite foreclosure and lower loss severities conditional on loan default.

Panel C presents means for the same variables, sorted by the vintage year of the deal for which the loan serves as collateral. It is apparent that there is significant time-variation in the underwriting and distress statistics in relation to overall business cycles before, during, and after the financial crisis of 2007-'08. For example, average DSCR (NOI) dropped to 1.63 in 2007 immediately preceding the financial crisis, while the proportion of interest-only loans peaked at 30% in the same year. As expected, distress rates are higher for vintage years with lower average underwriting standards, peaking at 24% in 2007. We observe significantly lower distress rates in more recent years mainly because there has not yet been as much time for significant problems to develop and burn off equity in the underlying properties. It is also apparent, however, that underwriting standards tightened in the years directly following the crisis (i.e., 2010 and onwards) as evidenced by more conservative DSCR and LTV ratios, as well as shorter average remaining terms at securitization (indicating longer seasoning). Underwriting statistics loosened slightly over the final 2-3 years of the sample period, but still remain more conservative than what was observed in 2006-2007.

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[15] Our final deal sample is backed by a subset of approximately 70,000 of these loans that were included in deals issued over the period 2000-2015.

[16] Because loans are originated with 120 month terms, the 113 month average is likely attributable to loan aggregation time in the sponsor's pipeline.

Deal-level summary statistics

Panel A of Table 1 presents summary statistics of the at-issue deal characteristics of our final matched sample of 539 deals. The statistics are taken as of the cutoff date of the transaction, which is the date when the collateral pool is finalized before CMBS bonds are marketed to investors. It indicates that potential B-piece buyers are tasked with completing due-diligence on 129 mortgage loans, on average, assuming they examine each one individually. If they were to choose to only analyze the top ten largest loans in the pool, the B-piece buyer would have completed due-diligence on about 45% of the outstanding collateral pool balance, on average. This speaks to the ability of proficient B-piece buyers to realistically underwrite a large proportion of the collateral pool.

In terms of deal characteristics, the average deal balance at cutoff (the date when the collateral pool is finalized) is $1.66 billion USD. 19% of deals are rated by three or more credit rating agencies. About 5% of deals had two or more B-piece buyers at-issue. Rating agencies assigned average triple-A and triple-B minus subordination levels of 14% and 5%, on average. The triple-B minus subordination level is important to our analysis because the B-piece typically consists of the portion of the deal's capital stack that is rated below triple-B minus. This means the face value of the average B-piece investment amounted to about 5% of the total collateral pool value over the period 2000-2015.

In terms of risk measures, cutoff loan-to-value and debt-service-coverage-ratio, both measures of leverage, average 66% and 1.6x, respectively. Note that there is considerable cross-sectional and time-series variation in these measures, as partly evidenced by the reported standard deviations. Nearly all loans underlying the final sample deals pay fixed rate coupons, and only 7% of the deals are classified as 144a offerings. We control for cross-sectional and time-series variation in all of the above measures in our multivariate tests, thus allowing for cleaner estimates of relationships between our main proxies for screening incentives and ex-post loss severities.

Who are the B-piece buyers?

We observe 42 distinct B-piece buyers in our sample during the years 2000-2015. Figure 2 shows that there are usually no more than about ten or eleven active B-piece buyers in any given year. Most B-piece bonds are bought by a small group of extremely active firms, many of whom are special servicing firms with experience in the management of distressed commercial real estate assets. The top ten most active B-piece buyers purchased nearly two thirds of the bonds in our final sample. The rest of the B-piece buyers participate on a much more sporadic basis, many only participating in one deal each. A number of new firms entered the market after 2010 as it began to recover following the crash in issuance volume caused by the Global Financial Crisis. These entrants included real estate investors, banks, and hedge funds. Anecdotal evidence suggests that many of these entrants were motivated by a trend of "reaching for yield". For the purposes of our study, the heterogeneous mix of B-piece buyers allows for better identification of our main screening measures that we describe below.

Investor-level screening effectiveness measure

Recall that our hypotheses focus on how internal, firm-specific characteristics, as well as deal- and market-specific structural incentives impact the costs and benefits of B-piece screening. Our first set of testable hypotheses (H1 and H1') posit that transactions with more experienced B-piece buyers will have lower realized losses and fetch higher prices at issue. The reasoning is that the success of a B-piece investment is driven by the ability of the investor to screen for potentially problematic loans, and B-piece buyers with more experience in CMBS markets should have a comparative advantage in screening collateral pools.[17] We use a measure of the number of deals completed prior to the current deal (*past deal count)* to capture one aspect of the screening effectiveness of the B-piece buyer. If past deal count is an accurate proxy of market experience, we would then expect it to be negatively related to both ex-post loss severities and at-issue yield spreads. A limitation of this measure is that it does not account for instances where seasoned B-piece investors leave an established firm to join a new entrant. This would most likely bias our results toward finding an insignificant relationship between past deal count and ex-post losses.

Measuring B-piece size and resecuritization activity

Our second set of hypotheses (H2 and H2') focus on the impact of secondary market trading opportunities on the B-piece buyer's incentives to screen. To measure secondary market

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[17] For anecdotal evidence on the competitive advantage of having a large database of historical loan data see: The Institutional Real Estate Letter, 2005, http://www.irei.com/documents/sponsors/ARCapInter3_05.pdf .

trading by the B-piece buyer, we first identify the B-piece bonds in our sample deals as those with ratings below triple-B minus. We then carefully check the accuracy of the identification using a combination of filters and manual cross-references.[18]

After identifying the B-piece bonds for each deal, we then use CDO data provided by Trepp to calculate our main measures of risk retention. The CDO data from Trepp maps the CUSIP of each CMBS B-piece bond to the CDO collateral pools that it shows up in (if any). For bonds that were pledged to CDOs, the data provide the amount pledged, as well as the CDO name, CDO lead underwriter, and CDO closing date.

The CDO dataset has 63 deals issued over the period 2000-2012 that include B-piece bonds from the final deal sample of 539 deals. We drop 3 deals that are classified as Synthetic Re-REMICs (SRRs). SRRs are backed by CDS contracts rather than cash sales of CMBS bonds. To the extent that the B-piece buyer is not typically involved in the CDS contract, we would not expect the existence of these synthetic references have any impact on its screening incentives.

Using the remaining 60 CDO deals, the data show that 1,947 out of 2,638 below triple-B minus rated bonds were pledged to CDOs in the period before 2008.[19] We assume that the full amount of the bond is pledged to the CDO in cases where the bond appears in a CDO but has a missing figure for the amount pledged (133 cases). After this change, 1,170 out of the 1, 947 bonds were fully (i.e., 100%) pledged to the CDO, an additional 84 were close to fully pledged (i.e., 95% or greater), and 664 were only partially pledged (i.e., under 95% of the original balance). There are 29 cases where the amount pledged to the CDO exceeds the original balance of the bond. We drop these from the CDO data as they are likely synthetic references backed by CDS contracts rather than cash sales of the B-piece bonds. Figure 3 charts the aggregate amount of our final sample B-piece bonds (by face value) that were traded into CDOs on a quarterly basis. The chart indicates demand for collateral to be used in CDO transactions was highest during the years 2004-2007, before the CDO market's collapse in 2008.

[18] We additionally filter out all interest-only tranches and any tranches that have a rating below triple-B minus but are not part of the residual bond class (e.g., tranches tied to the performance of a specific mortgage loan in the collateral pool). We manually cross check the B-piece identification using original issuing prospectuses until the aggregate balance of the B-piece bonds divided by the deal's cutoff balance matches the triple-B minus bond's subordination level.

[19] There are only 2 cases of below triple-B minus rated bonds pledged to CDOs after 2008, when CDO market issuance essentially collapsed.

Observing the amount pledged allows us to measure the B-piece buyer's risk retention as the percentage of the B-piece bond pledged to a CRE CDO. We can then differentiate between B-piece buyers who may have sold a small portion of the bond into a CDO for funding or liquidity purposes versus B-piece buyers who sold the entirety of the bond. Our cost-benefit framework suggests that as the amount of risk transferred into a CDO increases, ex-ante screening incentives should decrease and ex-post loss severities should increase, on average.

Panel D of Table 1 indicates that there is a considerable heterogeneity in how frequently B-piece buyers participate in the CDO market. It shows that 39% of the average B-piece investment is pledged to CDOs over the lifetime of the deal with a standard deviation of 39%. The average level of 39% is lower than the 65% reported in a similar working paper by Ashcraft et al. (2014). This is primarily because of our longer sample period that extends beyond 2008 when CDO issuance collapsed. Comparing over the same time period of 2000-2008, we observe an average amount sold of 57% (n=371 deals) versus 65% (n=398 deals) as reported in Ashcraft et al. (2014). This could be due to differences in final sample selections, variations in CMBS and CDO data sources, or differences in methods used to identify the B-piece bonds.

In addition to examining how the amount sold impacts ex-post losses, our hypotheses H2 and H2' also consider how long it takes for B-piece buyers to pledge bonds to CDOs. We use the initial CDO closing date as our closest available proxy for the date that the B-piece bond is pledged to a CDO.[20] As done in Ashcraft et al. (2014), we primarily focus on resecuritization activity that takes place within one year of the original CMBS deal closing date. A short time period between CMBS closing and pledging a large proportion of the B-piece bond to a CRE CDO is more likely to identify B-piece buyers with a short-term trading strategy and relatively lower incentives to screen.

Figure 4 shows distributions by vintage year for the time elapsed between CMBS and CDO closing dates for all resecuritized B-piece bonds. The figure indicates that it takes B-piece buyers in earlier vintage years a longer time to sell into CDOs than those in later vintage years. This is likely a function of the at-first limited demand for CDO collateral, which then increased

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[20] In practice, CRE CDOs can be structured with a dynamically managed collateral pool. Unlike CMBS pools, which are static and do not change after the initial cutoff date, CDO managers can buy and sell collateral throughout the life of the CDO deal if allowed by the CDO deal prospectus. A possible limitation of using the CDO closing date as our main measure of timing is that it may result in shorter-than-actual estimates of how long it takes the initial B-piece investor to sell to a CDO.

in each subsequent year until the market collapse in 2008. Although there is heterogeneity in the time-to-sale across all years, most of the under 12 month sales are completed in later years during the height of CDO market activity in 2004-2007. By focusing our analysis on sales completed within 12 months, we expect our risk-retention related results (H2 and H2') to be primarily driven by deals completed during these years. Negative observations in the chart are an artifact of using the CDO closing date as a proxy for the date when the B-piece bond was actually pledged to the CDO, and can be explained by cases when a CDO manager added a B-piece bond to the CDO collateral pool between one to twelve months after the initial CMBS closing date.

Alternative measures of risk retention

While the percentage of the B-piece sold into CDOs is a good starting point for measuring risk retention and incentives to screen, it also has a limitation in that it does not provide any information about the initial size of the B-piece. This is especially important because there is significant time-series variation in the size of the B-piece relative to total collateral pool value. Figure 5 graphs by closing year the average B-piece investment size as a percentage of total deal balance (measured using triple-B minus subordination levels). It shows that average B-piece sizes started at 8.6% in 2000, then quickly declined to a low of 3.1% in 2007, followed by a steady increase back to 7.9% in the most recent data from 2015. An et al. (2014) examine the drivers of these changes, and find them to be mainly attributable to a handful of non-credit risk factors. For the purposes of our study, we calculate two additional measures of risk retention to better control for time-variation in B-piece investment size.

First, we measure the amount retained as a percentage of the total collateral pool balance. Panel D of Table 1 shows that at the one-year mark, the average B-piece buyer retains a residual bond with par value worth about 4.5% of the total collateral pool balance at cutoff. Again, there is relatively large variation in this variable with a standard deviation of 2.7%. All else equal, this heterogeneity should aid in our ability to empirically detect any relationships that may exist between risk retention and ex-post losses. The total amount retained decreases to 3.5% on average when measured over the entire lifetime of the deal.

As an additional measure of screening incentives, we also measure the total dollar exposure retained. This measures how much money the B-piece buyer has at stake in a given transaction. At the one-year mark, the average B-piece buyer retained about $60 million in outstanding residual bond balance. There is again significant heterogeneity in this measure as shown by the standard deviation of $33 million.

In addition to the deal-level measures of risk retention, we also calculate B-piece buyer specific rolling average measures of risk retention using the method proposed in Ashcraft et al. (2014). B-piece buyer specific rolling averages do not suffer from the endogeneity issues that arise from regressing loss severities on deal-specific risk retention. B-piece buyers may endogenously retain greater risk exposure on deals with lower expected losses, while reducing exposure to deals with higher expected losses. Using the average measure of risk retained over the sample period circumvents this problem by providing a buyer-specific measure of the incentives for a B-piece buyer to screen and shape the collateral pool.

Measures of external, deal-level incentives to screen

Our final set of hypotheses (H3-H5 and H3'-H5') examine how external, deal-specific characteristics can influence the incentives of the B-piece buyer to exert costly ex-ante screening effort.

H3 and H3' address this issue by in the context of how the B-piece buyer's choice to retain special servicing rights on the transaction impacts its incentives to screen. As discussed in Section 2, there may be larger benefits to screening for special servicing firms acting as B-piece buyers due to economies of scale and scope gained from holding the first-loss piece in addition to the servicing rights of the transaction. To capture this effect, we use our sample data to flag B-piece buyers that also show up as special servicers during the sample period. We denote these firms as B-piece buyers who are also special servicing firms. These firms will commonly buy the B-piece and then retain special servicing rights rather than selling to another special servicing firm.

Hypotheses H4 and H4' test the impact on deal performance and pricing of having multiple investors split the B-piece investment at issue. Only a small percentage of deals (about 5%) in our sample list more than one B-piece buyer in the primary market sale at closing. We create a dummy variable to flag such deals. Again, the effect is ambiguous from a theoretical standpoint, but is of interest from a policy standpoint given new regulatory limitations on how many B-piece buyers can participate in a single transaction.

Finally, we test H5 and H5' by using two proxies for the complexity of the underlying collateral pool: the total asset count, and the percentage of the total collateral pool comprised by the top ten largest loans. A lower asset count means fewer loans to monitor, which could potentially translate into lower cost of screening the pool. On the other hand, it also lowers pool diversification while introducing risk that the default of any given loan will on average have a larger impact on overall losses. The same reasoning applies to the top ten percentage measure. Having a few large loans in the pool makes it easier to screen, but the high loan concentration could also negatively impact the benefits of diversification.

Performance measures

Realized losses. Trepp tracks a comprehensive history of monthly performance data at the loan-, bond-, and deal-levels that allow us to measure default rates and cumulative loss rates through time. We measure losses at the deal level using the total cumulative realized loss to all bond classes as a percentage of the original deal balance. This reflects the total amount of losses realized on the CMBS collateral pool. Realized losses are the product of default rates and loss given default, and are the ultimate driver of returns to CMBS investors. While many studies on CMBS markets have access to only default rates alone, the inclusion of realized losses in the Trepp deal file allows us to make stronger inferences about the economic impact of our right-hand-side variables.

The realized loss measure is expressed as a percentage of the total amount of CMBS bonds at issuance and is tracked on a monthly basis for each deal in our sample. Panel A of Figure 6 shows pool losses by vintage year for a subset of deals issued over the years 2000-2008. We omit deals issued in later years because they had not yet realized significant losses as of the end of our sample period in June 2015. The charts indicate that average losses are highly time-varying. Early CMBS deals issued in 2000 and 2001 realized losses of no more than 2.6% on average after ten years of seasoning. Average losses after ten years of seasoning then declined in 2002 (2.3%) and 2003 (1.8%). As expected, the worst average loss severities occur in deals issued in the years leading up to the Global Financial Crisis, spiking at an average of approximately 4% in 2006. The charts also demonstrate how variation in losses changed through time. For example, the spread on realized losses 8 years after issue ranges from slightly above 0% to 7% for 2005 vintage deals. In contrast, realized losses 8 years after issue range from about

1% up to 14% for 2007 vintage deals. This suggests that both the average quality as well as the dispersion of collateral pool qualities vary significantly through time.

Panel B more clearly shows how aggregate loss severity curves were similar for deals issued in 2000-2002, but then began to steepen for the average deal issued each consecutive year during the period 2003-2007. Not only deals issued in each successive year experience higher losses overall as of the latest observation date in our dataset (June 2015), but they also experienced those losses sooner due to the onset of the financial crisis in 2007-'08 and subsequent recession. Again, deals issued after 2008 have not yet realized significant losses as of the end of our sample period in June 2015.

Table 2 presents the time-varying nature of deal-level performance in more detail. It shows that performance varies by both vintage year and seasoning (i.e., years past closing). Both deal-level distress rates (Panel A) and realized losses (Panel B) increase through time for all vintage years when deal seasoning is held constant. For example, the losses on 2005 vintage deals after three years of seasoning average about 0.9%. That number increases to 3.4% for 2006 vintage deals, 9.4% for 2007 vintage deals, and 10.0% for 2008 vintage deals. These differences across vintage years can likely be attributed to a mix of a deterioration in underwriting quality, as well as the arrival of adverse market conditions resulting from the financial crisis.

There is also a discrete jump in both distress rates and losses as seasoning increases and underlying loans come up for refinancing. Most commercial real estate loans are written as partially amortizing loans with a ten-year balloon payment. One benefit of this that it leads to a close maturity match between the CMBS collateral pool loans and the CMBS bonds that are issued to investors with similar short- to medium-term maturities. As loans face refinancing risk about ten years after issue, however, distress rates can spike. Table 2 shows a large year 10 jump in distress rates, defined as the percentage of 60+, 90+, Foreclosed, and REO loans. The jump in loss rates is not as drastic, partly because of the lag between default and booking of losses, and partly because losses are a function of default rates multiplied by loss given default rates. Even if default rates suddenly spike, low loss given default rates (i.e., due to high collateral value during strong markets) can keep overall loss severities low. In contrast, loss severities are considerably worse when property values are low during weak markets. This is readily apparent in Panel B where loss severities steadily increase for all seasoning years as the vintage year approaches the Global Financial Crisis of 2007-2008.

Loss severity of the B-piece bond. We estimate the ex-post loss severity of the B-piece as the cumulative losses to the CMBS trust divided by the triple-B minus subordination level for the bond. If losses exceed the triple-B minus subordination level, we set the B-piece loss severity equal to 100%.

Figure 7 provides a histogram of the ratio of losses to triple-B minus subordination on a subsample of deals issued over the period 2000-2005. Because our dataset ends in 2015, focusing on this sub-period allows us to examine the "cradle-to-grave" performance of deals through a full 10 year cycle. In this figure, we do not truncate at 100%; ratios greater than or equal to 100% reflect deals where the B-piece investment was fully wiped out. The figure indicates that B-piece bonds routinely suffer large realized losses, averaging 62% for the 243 deals issued over 2000-2005. The standard deviation of this measure is 31% over the same period, indicating that there is also considerable variation in outcomes. The wide range in losses to the B-piece can be attributed to the small size of the B-piece bond. Being equivalent to a highly levered equity position, even relatively small losses to the collateral pool can have a large impact on losses to the B-piece bond.

Note that the measure shown in Figure 7 ignores the price paid for the B-piece bond, which has historically not been publically disclosed. It also ignores the offsetting effects of interest income that accrues to the owner of the B-piece bond. Figure 7 therefore does not reflect the actual investment performance of B-piece bonds. It is rather a measure of the percentage of the B-piece principal that is wiped out by losses in the underlying collateral pool. This is a significant distinction to make because B-piece buyers often buy bonds at a steep discount to par, and can recoup their initial investment by accruing interest alone. Ignoring the time value of money, a firm that bought a 5% coupon B-piece at 25 cents on the dollar would recoup its initial investment after 5 years, even if the entire principal balance of the bond was eventually wiped out in year 6. Furthermore, the B-piece buyer could potentially sell either a part of the whole amount of the B-piece to a CDO manager before maturity.

4. Does B-piece buyer screening impact loss severity?

Univariate evidence of the relationship between screening measures and losses

Our second set of hypotheses (H2 and H2') examine the relationship between risk retention and cumulative losses to the CMBS collateral pool. Before exploring this question in a multivariate setting, we first examine a series of scatter plots in Figure 8 that show the univariate relationship between pool losses and the percentage of the B-piece bonds sold into CDOs. Pool losses are measured as of June, 2015 – the latest date in our sample period. To control for differences in vintage years and seasoning lengths, we plot separate charts for each vintage year. We do not create charts for vintage years after the collapse of the CDO market at the end of 2007.

Panel A of Figure 9 examines the relationship between losses and the percentage of the B-piece sold into CDOs over the entire lifetime of the deal. Deals issued in 2001, 2003, and 2007 exhibit somewhat positive relationships between the amount sold over the lifetime of the deal and cumulative losses to the pool with correlations of 0.3, 0.2, and 0.1, respectively. All other vintage years, however, exhibit essentially flat or negative relationships. Taken together, these scatter plots do not support the existence of a strong relationship between the amount of the B-piece sold into CDOs over the lifetime of the deal and cumulative losses to the CMBS pool.

A potential issue with these charts is that they focus on the amount of the B-piece sold into CDOs over the lifetime of the deal. The charts could potentially conflate opportunistic, arbitrage based CDO transactions that were planned before the deal's closing date (where incentives to screen and kick-out problematic loans are likely lower) with CDO transactions made simply to meet liquidity shocks months or years after the closing date (which would have no impact on ex-ante screening incentives). To better isolate the types of CDO transactions that are most likely to impact screening incentives, the next series of scatter plots in Panel B of Figure 8 are constructed using the amount of the B-piece sold into CDOs within the first year after the CMBS deal's closing date. We observe positive correlations between the percentage of the B-piece sold and cumulative pool losses for deals issued in 2001 (0.1), 2004 (0.3), 2006 (0.2), and 2007 (0.1). Confidence intervals of the best-fit-line, however, are wide, and deals issued in other vintage years exhibit flat or even slightly negative relationships. Again, these preliminary univariate results do not provide strong evidence in support of the null hypothesis of

H2 that deals will have higher losses when the B-piece is traded into a CDO within a short time after closing.

Figure 9 presents a preliminary test of H1 by exploring the univariate relationship between pool losses (as of June, 2015) and the number of deals previously completed by the B-piece buyer, a measure of market experience. To control for differences in vintage years and seasoning lengths, we plot separate charts for each vintage year during the period 2000-2008. Overall, the univariate results do not support the existence of a strong relationship between B-piece buyer experience (as measured by the number of past deals completed) and cumulative losses to the CMBS pool. Correlations switch signs across vintage years, and are generally close to zero. The charts do, however, indicate a sharp break in past deal count between experienced and relatively new B-piece buyers in certain years. The break is especially evident in the years 2003-2007, when new investors began to enter the market. The break between experienced and inexperienced investors continues after the financial crisis in 2010-2015. The market for B-piece bonds, however, appears to be dominated by relatively newer entrants to the marketplace in these years.

Multivariate tests: do observable deal characteristics predict CDO sales?

Before testing our main hypotheses on the effect of screening on deal losses and pricing, we first test whether it is possible to predict sales of B-piece bonds into CDOs based on observable measures. Table 3 reports OLS regressions of the percentage of the B-piece bonds that are sold into CDOs on a set of deal-level and B-piece buyer specific variables as of the deal's cutoff date. Models (1) and (2) use the percentage of the B-piece bonds that are sold within one year of the deal's closing date ("Before Anniversary") as the dependent variable. Models (3) and (4) use the total percentage that was sold over the lifetime of the deal (as of the end of our sample period in June 2015). We restrict the sample to include only deals issued before the collapse of the CDO market in 2008.

The results do not indicate a significant difference in resecuritization activity between B-piece buyers with and without special servicing experience. Few of the coefficients on the screening and deal control measures are statistically significant ($p<0.1$), with the exception of the coefficients for the cutoff triple-B minus subordination level. These are statistically significant at the 1% level in (3) and (4) and at the 5% level in (1). The negative sign of the coefficients suggests that deals with larger B-pieces are less likely to be sold into CDOs. One possible explanation of this relationship is that triple-B minus subordination levels were at all-time lows in the years when CDO market activity was most prominent (and vice-versa: subordination levels started increasing back to historical highs after 2009 when CDO market activity dropped to zero).

Overall, the results in Table 3 do not provide evidence of a strong link between observable deal-level risk factors and CDO sale activity. Instead, it is likely that CDO sales were largely driven by time trends in the demand for CDO collateral. This is further bolstered by the statistically significant loadings on a number of the vintage year dummies, reflecting the rise in demand for CDO collateral over the years 2000-2007.

Multivariate tests: does B-piece buyer screening impact loss severity?

We now turn to our main tests of H1-H5. We use a panel of monthly data aggregated to the deal-level to test these main hypotheses. The regression models are specified to control for cross-sectional variation in ex-ante risk factors (structural, credit related factors), as well as time-series variation in ex-post risk factors (market conditions, deterioration of deal risk measures through time, etc.). We employ a host of ex-ante and ex-post controls found in the CMBS literature (Furfine (2014), Yildirim (2008), An et al. (2013), and others). We also control for unobservable cross-sectional and time-series variation by using deal sponsor and year time effects. We use monthly, pooled panel regressions with the following main specification:

$$y_{it} = \alpha + \beta_1 RiskRetention_i + \beta_2 SPS_i + \beta_3 Experience_i$$
$$+\beta_{4-6} DealIncentives_i + \boldsymbol{\gamma X_i} + f(Seasoning_{it}) + \epsilon_{it} \qquad (1)$$

Where

- $\boldsymbol{y_{it}}$ is our measure ex-post deal-level performance. We use both cumulative losses to the pool (%), as well as our estimate of the percentage of the B-piece that was wiped out by realized losses.

- ***Risk Retention$_i$*** is a measure of the B-piece buyer's risk retention using the three main measures described in Section 3: the percentage of the B-piece bonds sold, the percentage of total collateral pool value retained, and the dollar exposure retained.
- ***SPS$_i$*** is an indicator variable that takes on a value of 1 if the B-piece buyer is a special servicing firm. Special servicing firms typically appoint themselves as special servicers when purchasing the B-piece (i.e., controlling class) of a CMBS deal.
- ***Experience$_i$*** is a continuous variable measuring the number of past deals completed by the B-piece buyer. Because the number of past deals increases mechanically through time, we also interact it with vintage year dummies.
- ***Deal-Level-Incentives$_i$*** includes measure of B-piece buyer count in addition to our two main measures of the complexity of the collateral pool: cutoff asset count, and Top 10 Loans %.
- ***X$_i$*** is a vector of time-invariant deal-level controls recorded on the deal's cutoff date. It includes:
    - *Deal vintage year dummies* to control for time-variation in the quality of deals issued each year. The estimated coefficients are therefore driven by cross-sectional variation in the cutoff date deal characteristics, *within* each calendar year. We could alternatively implement a proportional hazards model (e.g., Ciochetti, et al. (2003)) to control for any ex-post, time-varying factors that may impact realized default rates. We choose to focus on the model in equation (2), however, because we are more concerned with measuring the impact on losses of cross-sectional variation in screening incentives at origination than in modeling the dynamics of CMBS loan defaults through time.
    - Indicator if the deal received *3 or more ratings*, which controls for rating agency involvement in the screening process as in Furfine (2013).
    - *Cutoff LTV* that measures the cutoff loan-to-value ratio for the deal.[21]
    - *Property type controls* that measure the percentage of the collateral pool composed by each of 15 distinct property types reported in Table 1. We include

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[21] We also include the cutoff DSCR as well as one-month lags of contemporary LTV and DSCR in a series of robustness checks. Iincluding these measures decreases the overall sample size, but results remain consistent with those presented in Table 4 and are available upon request.

these variables to control for property-specific risk factors that may drive ex-post loss severities.

- ***f(Seasoning$_{it}$)*** captures the impact of deal seasoning on realized losses by interacting the time passed since the initial deal closing date with the closing year of the deal. The two time variables are interacted to reflect the changing relationship between losses and seasoning across vintage years, as previously illustrated in Figure 6.

Table 4 reports the output of twelve regressions using the full sample of deals issued during the years 2000-2015. The dependent variable is the cumulative realized loss on the CMBS collateral pool in Panel A, and our estimate of the loss severity on the B-piece in Panel B. Because of the large amount of control variables included in the regression, the tables present coefficients for our main measures of screening incentives with most control variable coefficients suppressed. Even numbered columns include B-piece buyer fixed effects. All regressions include vintage year fixed effects, and standard errors are clustered by deal.

We first examine our test of H1 on the relation between B-piece buyer experience and realized losses. None of the coefficients on the measure of the B-piece buyer's past deal count are statistically significant at the 10% level in any of the twelve model specifications; nor are the suppressed coefficients on the *Vintage x PDC* interaction variables. The results in Panel B are similar. In all, these results are in line with the univariate scatter plots presented in Figure 9 that failed to establish a consistent relationship between a B-piece buyer's past deal count and ex-post losses. This evidence runs contrary to H1, suggesting that B-piece buyers with more experience (as measured by past deal count) do not necessarily achieve lower ex-post losses. This measure of experience, however, does not capture the fact that new entrants to the B-piece market are often founded by seasoned B-piece investors. Lacking a better measure of investor experience, it is therefore difficult to draw conclusions about the extent to which experience may impact marginal screening costs and subsequent deal performance.

In testing our second hypothesis on risk retention, the coefficients in all twelve specifications take on the expected signs, but the economic and statistical significance of the coefficients vary. The coefficient of 0.0057 in column (1) is statistically significant ($p<0.01$); to estimate the economic significance, a one standard deviation shift in the percentage of the B-piece sold over the sample period (32.2) would translate into an 18 bps increase in realized losses, on average. When B-piece buyer fixed effects are added, the coefficient ticks downward to 0.0035 ($p<0.1$) but is still statistically significant. This suggests the results are not driven by a small handful of investors. We do not observe statistically significant relationships between other measures of risk retention - % retained, and dollar amount retained – and ex-post losses in Panel A. The negative signs of the coefficients, however, are as predicted in H2 (higher levels of risk retention should lead to lower ex-post losses.) Overall, the risk-retention related results in Panel A provide tentative evidence of a relationship between risk retention and ex-post realized losses. These results are consistent with the univariate scatter plots presented in Figure 8 that also failed to depict a significant relationship between risk retention and ex-post losses.

The results in Panel B tell a similar story, although the coefficients on the three main measures of risk retention increase slightly in magnitude and statistical significance. The coefficient of 0.0755 ($p<0.01$) in column (1) implies a one standard deviation shift in the percentage of the B-piece sold over the sample period (32.2) should translate into a 243 bps increase in realized losses to the B-piece, on average. While this is a larger effect, note that B-piece losses averaged over 50% with a large standard deviation of around 30% over the sample period. The coefficient on the % retained in (3) and the dollar exposure retained in (4) are similar in economic and statistical significance, but the effects of both are subsumed by the addition of B-piece buyer fixed effects in columns (4) and (6).

In the only other work to our knowledge on the topic, Ashcraft et al. (2014) establish a causal link between risk retention and CMBS performance. The weaker coefficient estimates in our results can likely be attributed to differences in how performance is measured. While Ashcraft et al. (2014) focus on triple-B minus default rates, our study uses the total cumulative realized loss to all bond classes. Our results can thus be reconciled by the fact that bond default rates are a function of cumulative losses and subordination levels. Because subordination levels change through time (An et al. (2014)), it is not surprising that our results would vary slightly.

Turning to the Special Servicing Firm coefficients, the results in Panel A and Panel B do not suggest the existence of a statistically significant relationship between the B-piece buyer being a special servicer and ex-post losses. These results fail to provide evidence in support of H4 that there are greater benefits to screening for special servicing companies, either due to potential economies of scale and scope that can be realized by combining the due-diligence efforts of the B-piece buyer and special servicer into a single firm, or because combining roles may also reduce the opportunity cost of trading by making it more difficult to sell because of adverse selection problems related to sharper informational asymmetries.

An alternative interpretation to the insignificant Special Servicing coefficients is that B-piece buyers that are also special servicers have stronger incentives for the ex-post monitoring of loan pools in order to make more efficient, value-maximizing special servicing decisions on distressed loans. After the closing date, the B-piece buyers that are also special servicers continue to play an active role as special servicer in monitoring and managing the CMBS collateral pool. The special servicer is responsible for working out distressed mortgage loans in order to maximize the overall value of the collateral pool on a net present value basis. If the special servicer is also the B-piece buyer, then it should be highly incentivized to make efficient decisions to minimize losses on the collateral pool in order to avoid having its claim wiped out. While this would suggest deals with special servicers should realize lower losses through better ex-post monitoring, there are also potential conflicts of interests that can arise. If the B-piece buyer is also the special servicer, then there may be an incentive to focus on generating excess servicing fees from distressed loans even when doing so conflicts with the goal of maximizing net recoveries to the CMBS trust. The classical asset substitution problem also exists between B-piece buyers (who are de facto equity holders given their residual claim on the collateral pool) and investment-grade investors (more senior debt holders). These conflicts are discussed in further detail by Gan and Mayer (2006), who show that special servicers delay the liquidation decision for loans in deals for which they also own the B-piece. For the purposes of our study, it is unclear to what extent our ability to accurately measure the relationship between having special servicing experience and losses could be confounded by various ex-ante screening incentives versus differences in ex-post monitoring incentives.

Turning to the Table 4 results for our test of H4, the B-piece buyer count coefficient estimates are negative in all twelve specifications, but statistically significant only in Panel A. These results suggest that having more than one B-piece buyer has been historically correlated with lower ex-post losses, on average. As a caveat, however, note that only 5% of the sample had more than one B-piece buyer. The small size of this sub-sample makes it difficult to draw conclusions on the impact of having multiple B-piece buyers participate in the same deal.

In our tests of H5, the top ten percentage coefficient estimates are positive in sign and statistically significant in all twelve specifications. The cutoff asset count coefficients are also positive in sign, but are only statistically significant in Panel B. We conjecture that these variables could have strong effects at the limits, but might not necessarily have an impact on screening incentives for the deals in our sample. It would clearly be easier to screen a pool of 10 loans than a pool of 10,000; however, the asset count and top ten percentage measures do not vary quite as significantly in our sample deals.[22] This would imply that small ex-ante variations in these measures will not necessarily lead to significantly different ex-post loss outcomes. In other words, deals with marginally more concentrated collateral pools may not necessarily be easier to screen. Alternatively, increasing the concentration of the collateral pool could increase overall risk by reducing the benefits of diversification gained by pooling together larger numbers of smaller loans.

Overall, the results in Table 4 provide tentative evidence of links between ex-post losses and measures of B-piece buyer screening effectiveness, deal-level incentives to screen, and market-level incentives to screen. A possible limitation of our risk-retention related results (H2), however, is that they may be subject to an adverse selection related endogeneity issue. Rather than abstaining from screening, B-piece buyers could engage in adverse selection by diligently screening collateral pools and then, based on their assessment of the collateral pool, either (1) buy-and-hold the B-piece if it is backed by a lower risk pool, or (2) buy-and-trade if it is backed by a riskier pool. To disentangle this issue, we run a separate set of regressions in Table 5 using a variation of the instrumental variable approach proposed in Ashcraft et al. (2014).

Instrumental variable approach: does B-piece buyer screening impact loss severity?

Table 5 is structured the same way as Table 4, except that the risk retention variables are measured as averages by B-piece buyer across all deals for that B-piece buyer, rather than being calculated on a deal-by-deal basis. The averages exclude the current deal and are calculated for each B-piece buyer over a 2 year rolling window that is centered on the closing date of the current deal. To adapt the technique to our longer sample period that includes years after the collapse of the CDO market, we restrict the rolling window to the period 2000-2008. Any deals issued outside of this window are subsequently assigned an average resecuritization rate of zero to reflect the fact that B-piece buyers no longer had the option to sell into a CDO. This

[22] There are 129 loans per deal on average with a standard deviation of 68, while the percentage of top ten loans averages 45% with a standard deviation of 11%.

adaptation allows us to test our full sample, which extends beyond the collapse of the CDO market in 2008. The average resecuritization rate can thus be interpreted as a measure of the probability that the deal's B-piece buyer will sell a portion of the B-piece into a CDO. It varies both cross-sectionally (across B-piece buyers) and through time (as market conditions change), and reflects the fact that certain B-piece buyers were more active in CDO markets than others. Importantly, the measure is also unrelated to risk retention in the current deal, and thus does not introduce bias due to endogeneity in our regressions. Formally, the measure is calculated across all deals, *j*, purchased by B-piece buyer, *BPB*, within a +/- 1-year window of the time of deal closing, *t*, using the formula:

$$Ave. Risk\ Retention_{BPB,t} = \left(\frac{\sum_{j \neq i, BPB, t \in [t-1, t+1]} (Risk\ Retained_{j,BPB,t})}{\sum_{j \neq i, BPB, t \in [2000, 2008]} 1}\right) \quad (2)$$

where the current deal, *i*, is not included in the +/- 1-year rolling window. Again, the rolling averages are calculated using data only for deals issued before the collapse of the CDO market in 2008. We then set the average risk retention measure equal to zero for any deals issued after 2008.

The first-stage model presented in columns (1) and (2) of Table 5 regresses the potentially endogenous % sold variable on our instrument, the rolling average % sold by the B-piece buyer within one year. The coefficient on the instrumental variable is statistically significant both with and without B-piece buyer fixed effects included. In columns (3) and (4), we then regress the realized pool loss variable on the instrumented risk retention variable in addition to all of the control variables previously included in Table 4. The coefficients on the instrumented measure of % sold are similar in economic magnitude to those in Table 4, but are statistically insignificant.

5. Do B-piece buyer characteristics impact deal pricing?

If screening impacts ex-post deal loss severity, then investors in an efficient market should be willing to pay higher prices for bonds in deals with a vigilant B-piece buyer. We test this relationship within the regression framework presented in Section 4 using CMBS bond pricing data provided by Trepp. Specifically, our measure of deal pricing is an estimate of the initial yield spread on each deal's triple-B minus rated bond. We focus on the triple-B minus rated bond because it is the lowest rated, most credit sensitive bond outside of the B-piece. If investors take into account the characteristics of B-piece buyers when investing in CMBS, then the pricing effects should be strongest in the triple-B minus rated bond.

We estimate initial yield spreads using secondary market trading prices supplied by Trepp. The prices represent the first time the bond was traded in the secondary market. To avoid capturing post-issuance price movements due to factors outside of our regression framework, we drop any bonds that are not priced within two months of the deal's closing date. This results in a sample of 396 deals with available triple-B minus prices. We then calculate the expected yield-to-maturity for each bond. In practice, calculating the expected yield on structured products such as CMBS bonds involves projecting cash flows based on a set of assumptions about default rates, prepayments, deal structure, etc. To simplify our yield calculations, we treat the triple-B minus bonds as plain vanilla, fixed rate, 10 year maturity bonds with monthly coupon payments. We then calculate the initial yield spread as the incremental amount that must be added to a comparable maturity Treasury bond.[23] Outliers are winsorized at the 5th and 95th percentiles. For deals that have more than one triple-B minus rated bond priced within two months of closing, we take an average of initial spreads. There are 21 such deals in the sample.

We adjust the regression model in Section 4 to reflect information that is available to investors in the primary market. The main explanatory variables of interest are B-piece buyer experience (past deal count), the number of B-piece buyers participating in the deal, and whether the B-piece buyer is a special servicing firm. We also include the rolling-average measure of risk retention to proxy for perceptions that investors may have about the B-piece buyer's likelihood to sell a portion of the B-piece into a CDO. Additional deal-level controls are the same as in Section 4, with the addition of a cutoff BBB- subordination measure, as well as dummy variables to control for potential effects of the bond's coupon type (i.e., "Fixed rate", "WAC/Pass-through", and "Other, non-fixed") on our yield calculations.

As expected, the results also indicate that investors demand higher yield spreads on privately placed bonds as well as bonds that pay WAC / Pass-through rather than more

[23] Treasury bond yields are downloaded from the constant maturity series provided by FRED, and are linearly interpolated to match the exact maturity of the underlying CMBS bond.

predictable fixed rate coupons. Other coefficients are not statistically significant, possibly due to the sample selection. Although measures such as LTV and Asset Count may be important determinants of a bond's yield spread, they may not matter as much within a homogenous pool of triple-B minus rated bonds.

The results in Table 6 provide evidence of a relationship between initial triple-B minus bond spreads and triple-B minus subordination. Interestingly, the results suggest that investors demanded higher spreads on deals with higher subordination levels. While investors should typically be willing to accept lower spreads as credit enhancement increases, a potential explanation for the positive coefficient is that subordination levels reached historic lows during 2004-2007, precisely when the demand for CDO collateral in 2004-2007 may have helped to push spreads down. The same argument could potentially also apply to the negative and statistically significant coefficients on the rolling average % sold measure. The negative sign on these coefficients runs contrary to the prediction stemming from H2' that greater levels of risk retention will lead to higher at-issue prices (lower spreads). Likewise, the statistically insignificant coefficients on the special servicing indicator variable suggest that investors do not necessarily pay attention to the B-piece buyer's experience as measured by past deal count (H1').

Furthermore, the results in Table 6 do not provide convincing evidence that investors price the relationships established in H3', H4', or H5'. Because we found only weak relationships in Tables 4 and 5 between realized losses and our main measures of screening effectiveness and incentives, we would likewise not expect to find a relationship between those measures and the spread demanded by investors.

6. Discussion

Why does third party B-piece exist in CMBS but not other types of securitizations?

While every securitization transaction – whether ABS, CLOs, CDOs, credit card receivables, student loans, etc. – has a first-loss piece, it is only in CMBS markets that a market for third-party ownership of the first-loss piece has developed. Why is this? Consider a model where the deal sponsor has informational advantages regarding the quality of the underlying collateral pool. Through the use of tranching, the sponsor can create a triple-A rated, informationally insensitive claim that pays in full in all states of the world and can be sold at full-information price to uniformed investors (Riddiough and Zhu, 2015). But the informationally sensitive subordinate piece of the deal can only be sold at a severe discount to outsider, uninformed investors. As a result, the sponsor typically holds on to the B-piece.

This raises the question of whether there are means by which uninformed outside investors can become informed. The answer for CMBS markets is evidently yes. In our sample of 539 deals, there are only about 127 loans comprising the average collateral pool. With so few loans and access to underlying property reports (rent rolls, market analysis), loan reports (mortgage structure, etc.), and deal prospectuses (waterfall structure, etc.), it is within reach for an experienced commercial real estate investor to overcome the information wedge and confidently buy the most subordinate piece of a CMBS deal.

This may be less feasible, however, for securitizations of other asset types. For example, the average RMBS pool contains thousands of loans. Residential and commercial mortgage loans are also fundamentally different along a number of dimensions including government involvement, mortgage insurance policies, and deal-level credit enhancement techniques, among many others. Most importantly, the small average loan size of residential versus commercial mortgage loans would make it difficult for a prospective third party investor to impact loan pool quality via a kick-out clause. The number of loans in a typical RMBS pool is orders of magnitude larger than that in an average CMBS pool.[24] The information destruction effect (DeMarzo, 2005) of pooling large numbers of small residential mortgage loans makes it nearly impossible to profit off of private information on a manageably small subset of the pool. CMBS pools, on the other hand, average far fewer loans per deal, and a single commercial mortgage loan can represent up to 10% of the total loan balance.[25] Thus, it is arguably less costly for third party investors to analyze a significant proportion of the pool on a loan-by-loan basis. The same line of reasoning should also apply to student loan securitizations (small average size, large N) and securitziations of credit card receivables (small average size, large N, and constantly changing pool).

Are there any markets in which it would be possible for a third-party investor to overcome the information wedge and confidently assess the quality of the deal's B-piece? Such

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[24] CMBS transaction sizes depend on the type of loans being securitized. Conduit CMBS transactions typically have between 150-300 loans per pool, large loan CMBS transactions can consists of only 5-20 mortgage loans per pool, and fusion transactions are a hybrid between conduit and large loans with the distinguishing feature that the 10 largest loans make up about half of the pool balance (Federal Reserve Board (2010)).

[25] This is consistent with findings by Ghent and Valkanov (2013) and Black, Krainer, Nichols (2015) that larger commercial real estate mortgage loans more likely to be securitized than smaller ones, ceteris paribus.

a market would likely need to be characterized by deals with a low average asset count. To this extent, the market for collateralized loan obligations (CLO) could potentially qualify. However, the assets would need to be of verifiable quality – to that extent, the reliance on soft information in unsecured commercial lending might make CLOs more difficult to screen than CMBS that are backed by real estate.

Securitizations can be thought of as financial intermediaries like banks (though they are not actively managed) where the first-loss bond is the residual equity claim. Because commercial banks have outside shareholders, it is possible the lack of third-party risk retention in other securitization markets is simply a matter of differences in governance structures. Giving deal sponsors the flexibility to manage collateral pools after issuance (just as banks actively manage their loan portfolio) could make B-piece investments more feasible in other markets. This may not be possible, however, as securitization laws generally limit the ex-post management of securitized assets for legal ownership reasons as well as to qualify for more efficient tax treatment.

Potential costs of risk retention

The results presented herein make it clear that there are benefits to incentivizing costly, ex-ante collateral pool screening. This can be achieved through both incentives-based market design and regulation. But what are the costs of risk retention regulations? In this section, we provide an overview of forthcoming risk retention rules and then use our main empirical results to shed light on the cost-benefit tradeoff of the new rules.

The Dodd-Frank Wall Street Reform and Consumer Protection Act went into effect in July 2010 with broad reaching reforms. One such reform was the credit risk retention requirement outlined in Section 15G, requiring "the securitizer of asset-backed securities to retain not less than 5 percent of the credit risk of the assets collateralizing the asset-backed securities."[26] Slightly over four years later, the final rules outlining the implementation and enforcement of the Dodd-Frank credit risk retention requirement were signed into effect by a consortium of six regulatory agencies.[27] The rules cover risk retention in all securitization

[26] Credit Risk Retention, Federal Register Vol. 79, No. 247.
[27] The agencies are the Office of the Comptroller of the Currency, the Treasury (OCC), the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the U.S. Securities and Exchange Commission, Federal Housing Finance Agency, and the Department of Housing and Urban Development.

transactions including residential mortgage backed securities (RMBS), asset backed securities (ABS), and commercial mortgage backed securities (CMBS). The following is a brief summary of the main changes that took place when the new risk retention rules went into effect in December of 2016:

- *Risk retention amounts.* Total risk retention on CMBS deals must amount to at least a 5% exposure to the credit risk of the deal. It can be held as a single, first-loss horizontal interest, as a vertical slice amounting to 5% of each bond class, or in a combination "L" shape. The 5% minimum is based on deal proceeds (market value), not principal balances (par). To give an example of how these are different, consider a transaction where the par value of the B-piece is 5% of the total collateral pool value, but it is sold at a steep discount of 40 cents on the dollar. Using market values would result in a total risk retention amount of only 2% (40% *x* 5%), versus 5% using book values. Certain higher quality, qualifying mortgage loans are not included in the calculation of the 5% interest. Nonetheless, post-risk retention era investors are now required to hold significantly more risk than what had previously been the industry norm.
- *Third-party purchaser.* Unique to CMBS markets, the 5% credit risk retention can be held by a qualified third party purchaser. Up to two third-party B-piece purchasers can share the 5% interest. Each purchaser must take a horizontal pari-passu interest in the deal's first-loss piece. Previously, there had not been a limit to the number of investors and it was common practice to take vertical senior/subordinate positions.
- *Compliance.* The deal sponsor is responsible for assuring the third-party purchaser remains in compliance with all risk retention rules post-issuance. This provision may improve underwriting standards by imposing a requirement for deal sponsors to monitor the B-piece buyer (who plays an important screening and monitoring role), although some market participants have raised concerns about the logistics of verifying and enforcing B-piece buyer compliance.
- *Sunset horizon.* There is a 5-year sunset horizon during which the third-party purchaser(s) cannot sell or hedge their exposure to the first-loss piece. After the 5-year period expires, the B-piece can be sold to another qualified B-piece investor. This

requirement is meant to strengthen screening incentives by requiring the B-piece buyer to hold the residual piece for a longer horizon, rather than selling it to another investor, resecuritizing it in a collateralized debt obligation (CDO) deal, or hedging the risk otherwise (Minton et al., 2009). Relatedly, Myers and Rajan (1995) demonstrate how greater asset liquidity reduces the ability of firms to commit to a certain investment project. In that vein, one benefit of the sunset horizon is to possibly incentivize better screening on the part of the B-piece investor by limiting liquidity and thus imposing greater commitment. A potential cost is that any liquidity premiums demanded by B-piece investors could be implicitly passed through deal sponsors (who receive lower overall proceeds) and on to borrowers in the form of higher borrowing costs.

- *Price disclosures*. The identity of the B-piece buyer and the price paid for the B-piece interest must be publically disclosed. Pricing information currently remains confidential in most cases. As argued in Riddiough (2011), price disclosures can aid in increasing transparency and incentivizing the production of information. Because of the large amount of due-diligence that goes into purchasing a B-piece, the price paid by the B-piece buyer can in certain conditions serve as a signal of collateral pool quality to outside investors. Assuming higher prices paid are correlated with lower expected future losses, deal sponsors could be incentivized to favor B-piece bids that pay a higher price with more kick-outs over bids offering a discounted price with fewer kick-outs. Deal sponsors could potentially maximize proceeds from investment grade investors by choosing the former option, as long as the price paid by the B-piece buyer is a reliable signal of collateral pool quality.

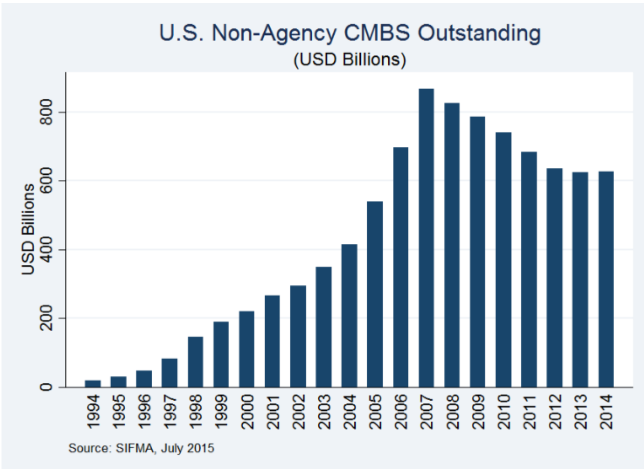
7. Conclusions

The financial crisis of 2007-’08 led to an increased awareness of the role of risk retention in securitized debt markets. This paper examines risk retention by proposing and then empirically testing a cost-benefit framework that links CMBS deal performance and pricing to the internal screening effectiveness of the B-piece buyer, external deal-level incentives to screen, and external market-level incentives to screen. Using a sample of 539 conduit deals issued over the period 2000-2015, our empirical results are mixed. While the signs of the coefficients of interest are generally as anticipated, we do not find them to be as significant as our hypothesized expectations. We find only weak relationships between realized losses and our main measures of screening effectiveness and incentives (H1-H5). Consistent with these results, we accordingly do not find conclusive evidence that investment grade investors take these measures into account when pricing the triple-B minus rated tranches of CMBS deals (H1'-H5'). These results do not necessarily rule out the possibility that more restrictive third-party risk retention rules can help to incentivize prudent underwriting practices in CMBS markets. They do, however, suggest that further research is needed to better understand the overall costs and benefits of such regulations. Because our results are specific to CMBS markets, future work should also examine the extent to which our results can be generalized to other markets. While third-party risk retention arrangements are common in CMBS markets, it remains an open question whether they could be effectively replicated in other types of asset-backed security markets.

Figures

Figure 1. CMBS Debt Outstanding and Volume.

Panel A: U.S. Non-Agency CMBS Debt Outstanding



Panel B: U.S. Non-Agency CMBS Debt Volume

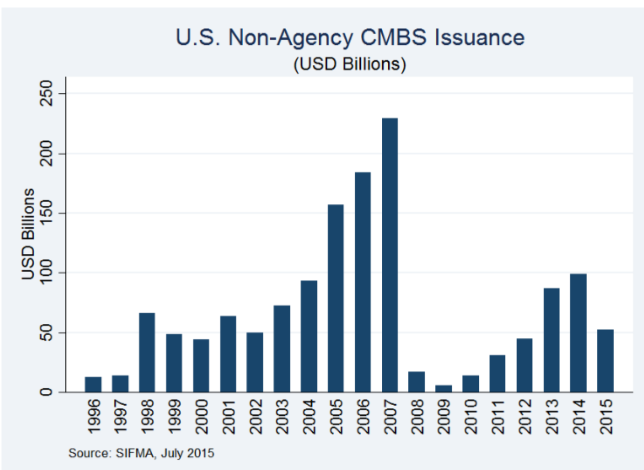


Figure 2. Distinct B-piece Buyers by Year.

This figure shows the total number of active B-piece buyers for each vintage year.

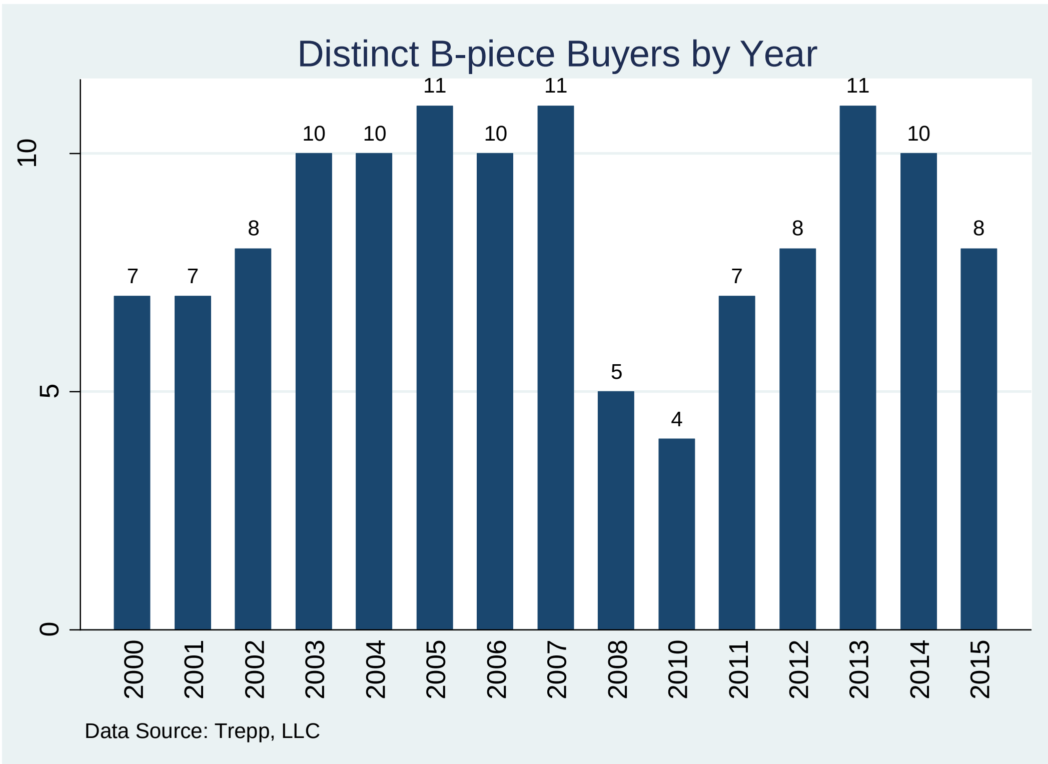


Figure 3. Aggregate volume of B-piece bonds pledged to CDOs

This chart shows the aggregate volume of B-piece bonds sold to CDOs, according to the quarter in which the CDO sale occurred. The chart is constructed using our final sample of 557 CMBS transactions, described in Section 3.

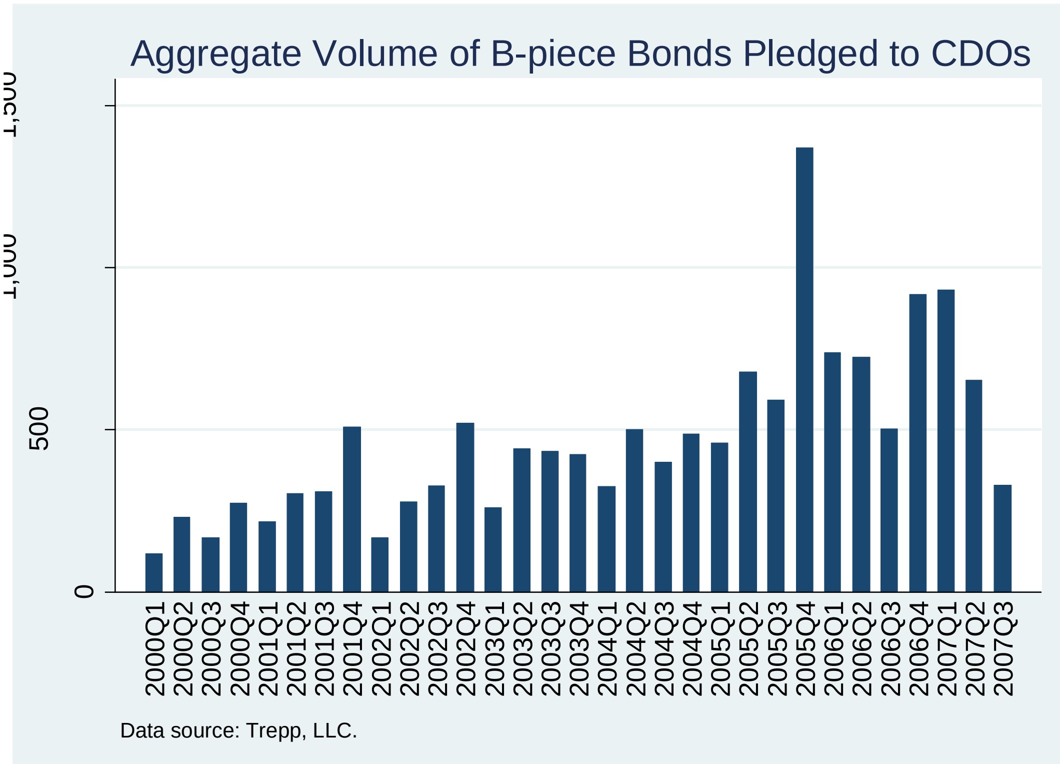


Figure 4. Time to CDO pledge

This figure reports distributions by vintage year of the time it takes for B-piece bonds to be pledged to CDOs. We use the closing date of the CDO as a proxy for the date that the bond is pledged to the CDO. The chart omits 2 sales that occurred in 2011.

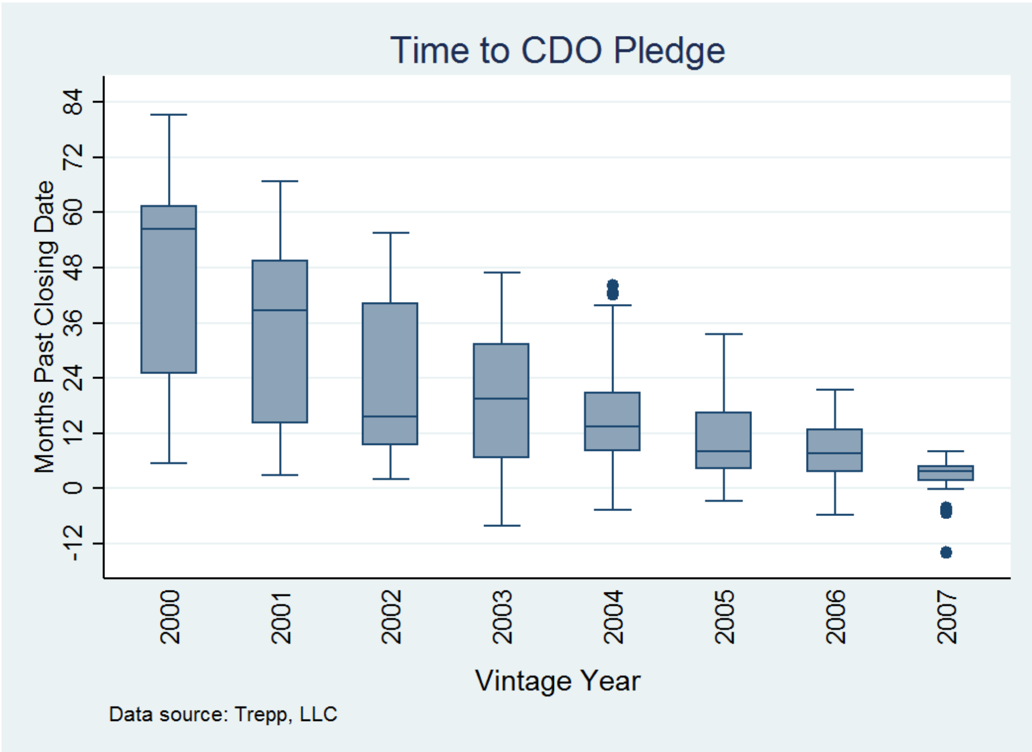


Figure 5. BBB- Subordination by Closing Year.

This figure presents yearly averages for triple-B minus subordination levels as calculated by Trepp. Our final deal sample does not include any deals issued in 2009.

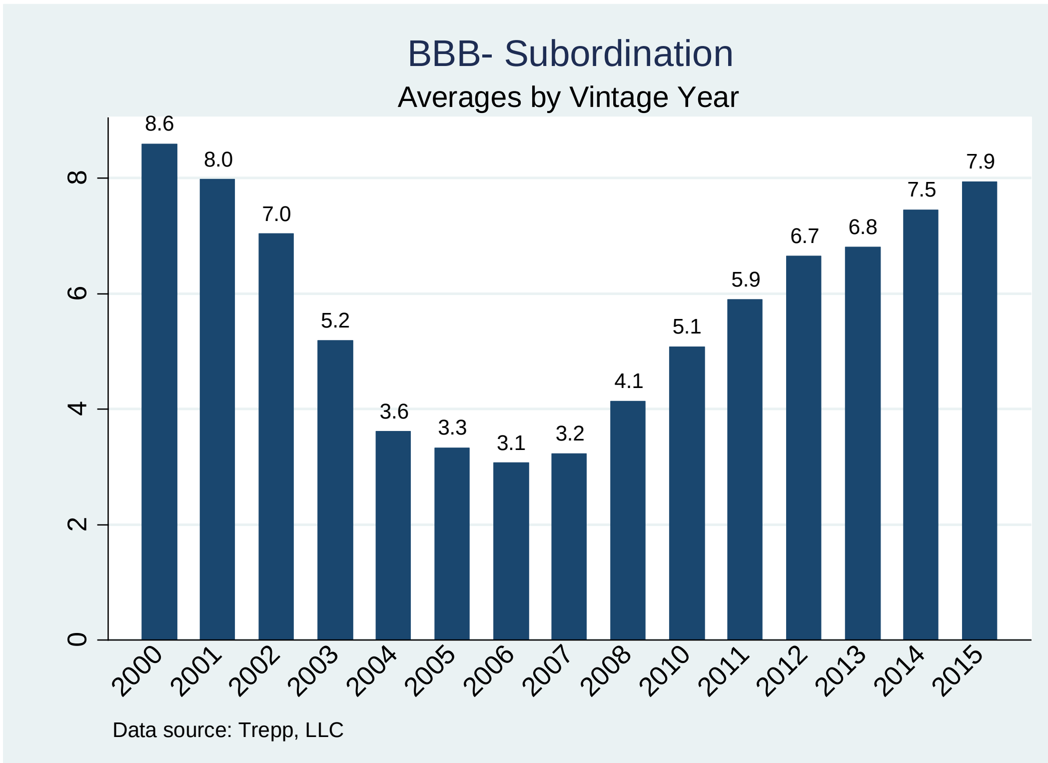
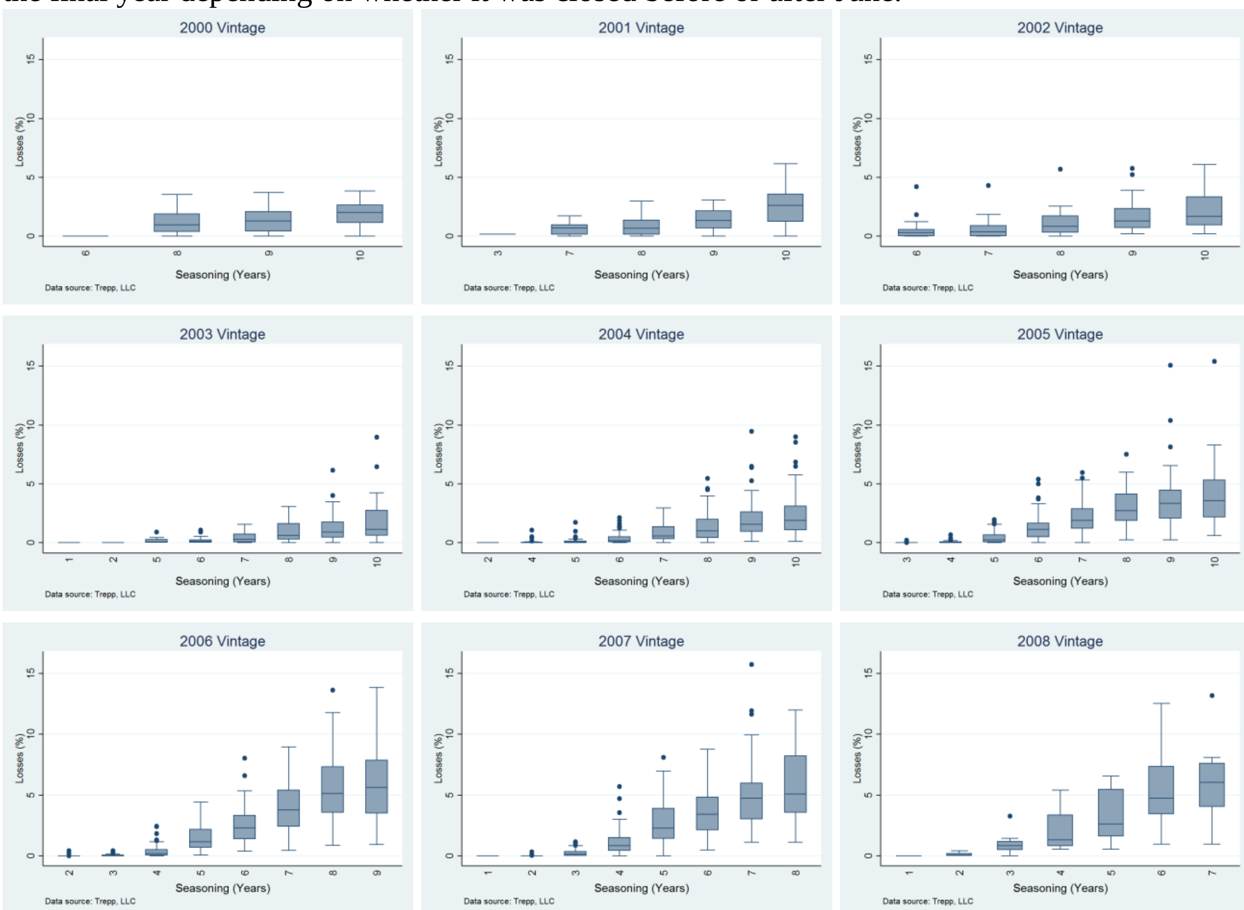
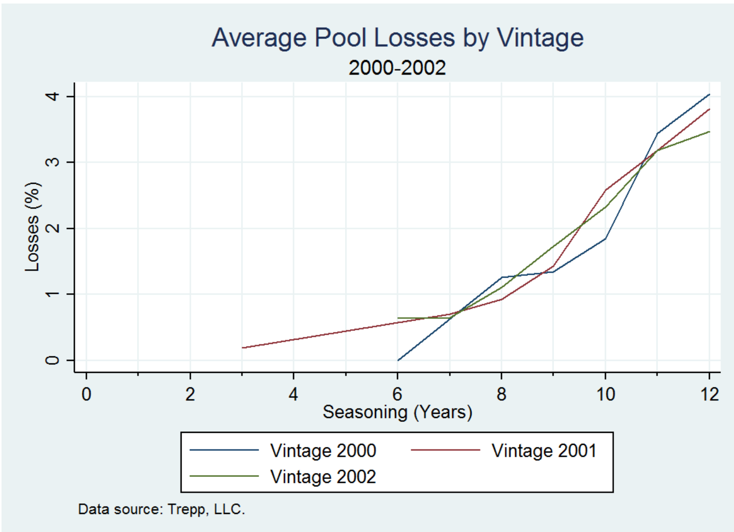


Figure 6. Cumulative Losses to the CMBS Trust.

Panel A: These charts show the dispersion in cumulative realized losses to the CMBS collateral pool through time for 2005 (left) and 2007 (right) vintage deals. The top edge of the box represents the 75th percentile, the bottom the 25th, and the middle line is the median value. The upper (lower) outer line represents the upper (lower) adjacent value, which is the 75th (25th) percentile plus (minus) 150% of the interquartile range. Dots represent outliers that are outside the upper and lower adjacent values. Note that some observations drop out of the histogram in the final year depending on whether it was closed before or after June.



Panel B: Aggregate Average Pool Losses by Vintage Year (2003-2007). Each line represents averages calculated by vintage year cohort.



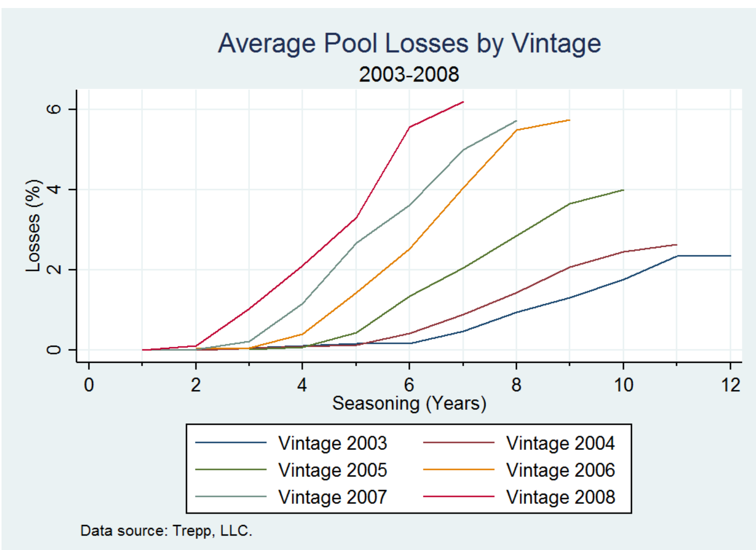


Figure 7. Losses relative to BBB- subordination level.

This chart presents a histogram of estimated loss severities relative to the triple-B minus subordination level of the deal, calculated as the realized losses to the collateral pool divided by the triple-B minus subordination level. The sample includes deals issued during the period 2000-2005.

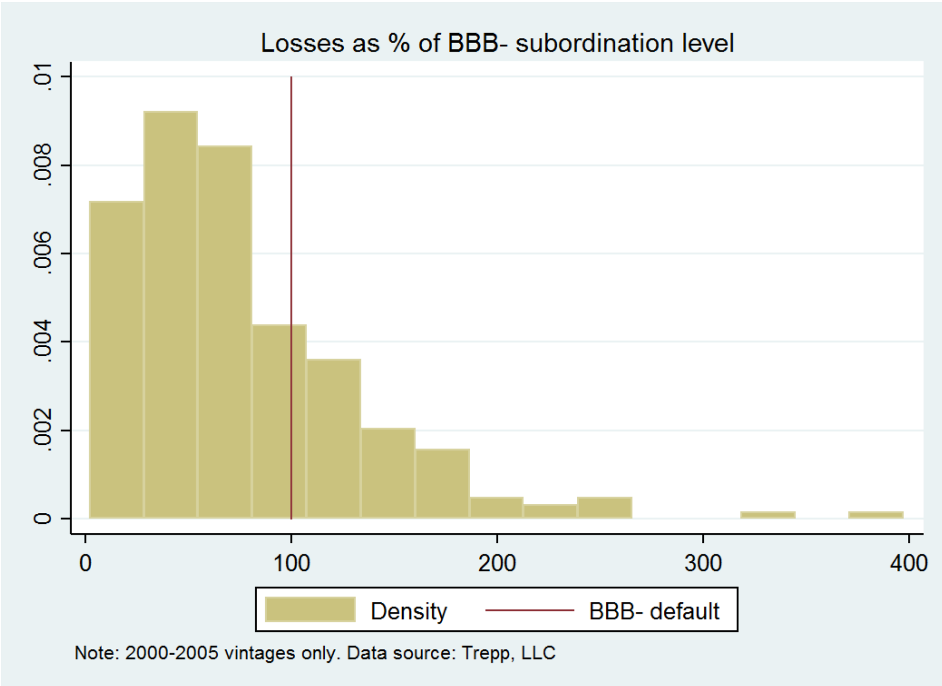
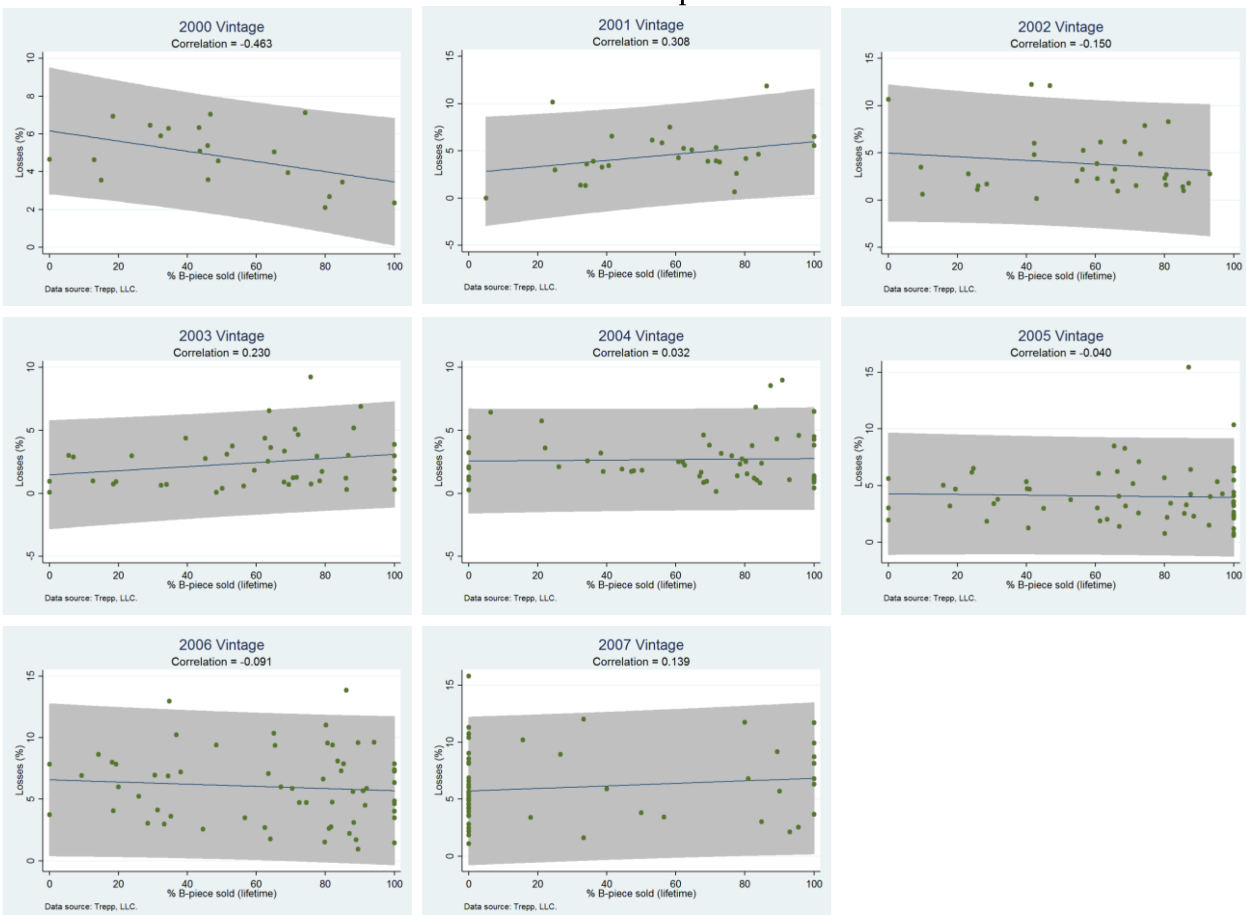


Figure 8. Risk-retention vs. realized losses.

These charts plot the univariate relationship between pool losses and the percentage of the B-piece bonds sold into CDOs. Pool losses are measured as of June, 2015 – the latest date in our sample period.

Panel A: Risk retention measured as the % of the B-piece sold over the lifetime of the deal.



Panel B: Risk retention measured as the % of the B-piece sold within 1 year of deal closing.

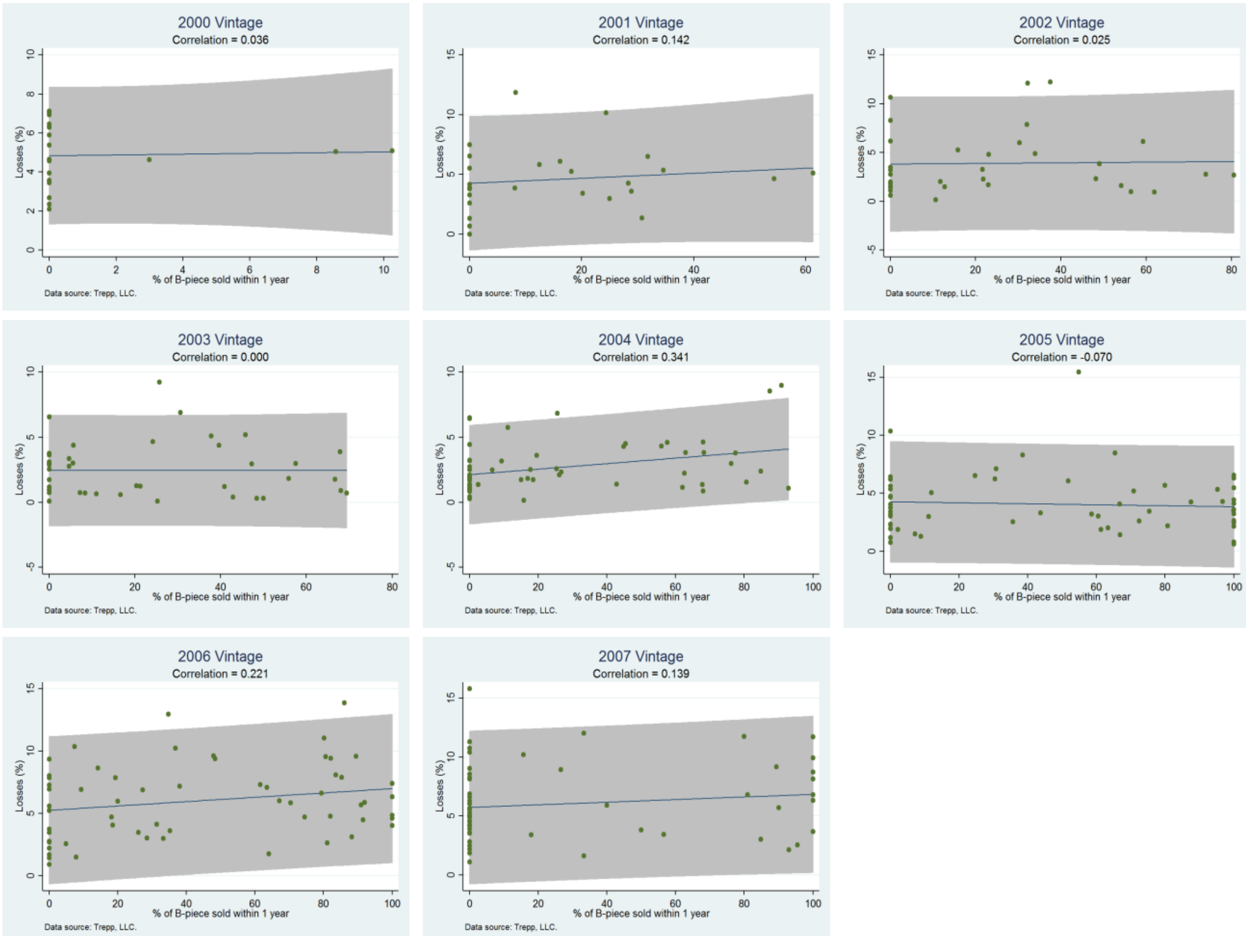
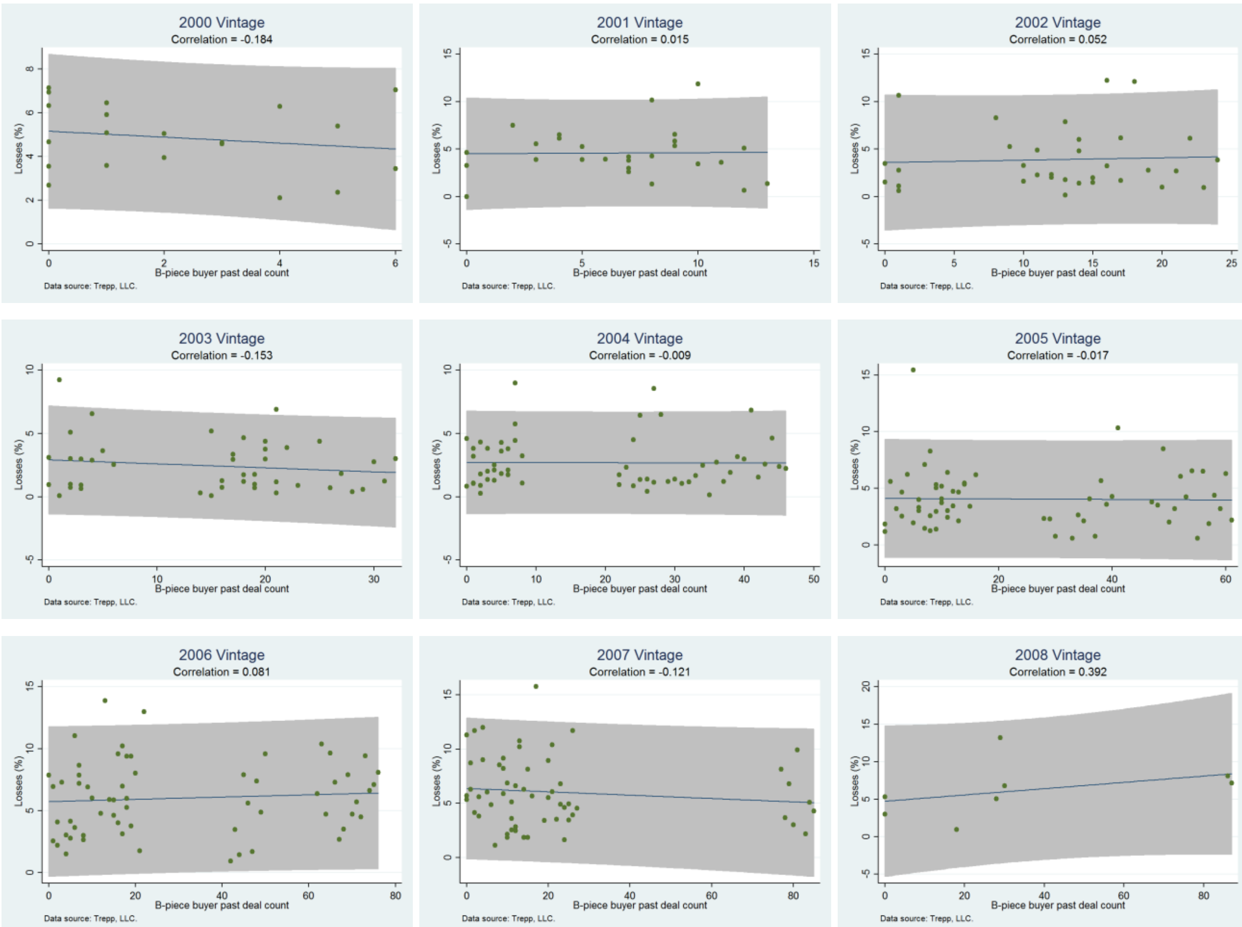


Figure 9. Past deal count vs. realized losses.

These charts plot the univariate relationship between pool losses and the past deal count of the B-piece buyer. Pool losses are measured as of June, 2015 – the latest date in our sample period.



Tables

Table 1. Summary Statistics.

Panel A presents aggregate deal-level summary statistics for deals issued during the period 2000-2015. The following variables are deal-level dummies: >2 Ratings, Type 144a, and >1 B-piece buyer. The Cutoff LTV and Cutoff DSCR (NCF) variables are calculated as value weighted averages for each deal. BBB- yield spread is an estimate of the initial yield spread (above Treasuries) on each deal's BBB- rated bond. Panels B and C present average summary statistics at the loan-level for loans that are included in our deal sample. Our final deal sample does not include any deals issued in 2009. Summary statistics for our measures of risk retention are in Panel D. % B-piece sold is measured as the proportion of the B-piece pledged to CDOs. % deal value retained is the amount pledged to CDOs as a percentage of total collateral pool value. Dollar exposure retained is the size of the B-piece (USD) minus the dollar value of any portions pledged to CDOs. All three measures of risk retention are taken one year-after closing as well as over the entire sample (i.e., as of 6/15). Data source: Trepp, LLC.

Panel A: Deal-level controls at cutoff date

	N	mean	std. dev.	minimum	maximum
Cutoff Balance (USD, Millions)	539	1,658.21	1,011.63	574.75	7,903.50
Cutoff LTV	539	66.64	4.22	53.69	75.57
Cutoff DSCR (NCF)	531	1.62	0.25	1.20	3.12
Cutoff AAA Subordination	539	13.53	6.92	0.00	28.83
Cutoff BBB- Subordination	537	5.24	2.11	1.75	10.50
Cutoff Asset Count	539	129.08	67.91	23.00	549.00
Top 10 Loans %	538	45.31	10.96	19.58	97.82
>2 Ratings	539	0.19	0.39	0.00	1.00
Type 144a	539	0.07	0.25	0.00	1.00
Months Seasoned	539	31.09	31.21	0.84	114.07
Fixed Interest %	538	100.00	0.00	100.00	100.00
>1 B-piece buyer	539	0.05	0.21	0.00	1.00
% Retail Unanchored	538	7.21	4.38	0.00	27.42
% Warehouse	538	0.00	0.02	0.00	0.48
% Industrial	538	5.16	4.30	0.00	36.17
% Office	538	27.97	11.43	0.00	69.07
% Mixed Use	538	3.18	4.23	0.00	32.82
% Other	538	0.95	2.33	0.00	15.69
% Multifamily	538	14.93	8.62	0.00	46.78
% Mobile Home	538	2.42	3.18	0.00	19.87
% Hotel (Limited)	538	3.36	3.63	0.00	22.25
% Hotel (Full)	538	4.77	4.38	0.00	24.61
% Hotel (Other)	538	0.27	1.21	0.00	11.08
% Healthcare	538	0.09	0.56	0.00	8.31
% Self Storage	538	2.48	2.66	0.00	20.44
% Credit Tenant Lease	538	0.08	0.36	0.00	3.80
% Undefined	538	1.37	9.77	0.00	100.00
BBB- Yield Spread	400	3.74	3.85	1.40	22.25

Table 1, continued

Panel B: Loan-level controls (at cutoff)					
Sample Period: 2000-2015	N	Mean	Std. Dev.	Min.	Max.
Note Rate At Securitization	73,405	5.978	1.048	2.300	17.50
Remaining Term At Securitization	74,003	113.3	24.95	1	360
Securitzation DSCR (NOI)	32,684	1.857	2.101	0.190	136
Securitization DSCR (NCF)	69,502	1.634	1.717	0.190	136
Securitization LTV	74,104	67.30	13.35	0.300	120.5
Securitization Occupancy	69,930	93.53	8.858	0.730	186.4
Cutoff Balance (Millions of USD)	74,837	12.78	26.71	0.00362	1,500
Deed of Trust (Y=1)	72,975	0.557	0.497	0	1
Distressed	75,016	0.150	0.357	0	1
Interest Only (Y=1)	75,016	0.116	0.320	0	1

Panel C: Loan-level variables by CMBS closing year

ClosingYear	Cutoff Balance (Millions of USD)	Note Rate At Securitization	Remaining Term At Securitization	Securitization DSCR (NCF)	Securitzation DSCR (NOI)	Securitization LTV	Securitization Occupancy	Interest Only (Y=1)	Deed of Trust (Y=1)	Distressed
2000	6.17	8.35	117.43	1.36	1.53	67.23	95.88	0.02	0.55	0.16
2001	7.07	7.77	112.98	1.4	1.42	68.59	96.21	0.02	0.59	0.16
2002	8.06	7.14	114.98	1.62	2.07	66.55	95.85	0.02	0.58	0.12
2003	9.48	5.91	114.57	1.96	2.28	66.28	95.36	0.05	0.56	0.09
2004	11.88	5.69	112.73	1.8	2.27	67.34	94.43	0.08	0.56	0.13
2005	12.57	5.48	114.45	1.71	2.13	66.93	93.55	0.12	0.56	0.17
2006	13.72	5.94	114.5	1.53	1.87	68.09	92.86	0.14	0.56	0.22
2007	16.02	5.95	111.8	1.4	1.63	69.31	93.19	0.29	0.56	0.24
2008	11.24	6.37	109.7	1.35	1.72	67.62	91.35	0.17	0.55	0.23
2010	19.61	5.7	104.05	1.55	1.81	65.35	93.75	0.06	0.58	0.01
2011	20.97	5.5	100.59	1.55	1.67	66.46	92.28	0.06	0.59	0.02
2012	18.79	5.1	107.76	1.63	1.8	64.63	90.22	0.06	0.55	0.01
2013	17.43	4.75	113.06	1.9	2.08	63.55	89.97	0.07	0.51	0
2014	16.26	4.79	112.27	1.85	2.03	65.55	90.61	0.08	0.51	0
2015	14.01	4.38	114.71	1.82	1.97	65.7	91.41	0.11	0.53	0
Total	**12.78**	**5.98**	**113.27**	**1.63**	**1.86**	**67.3**	**93.53**	**0.12**	**0.56**	**0.15**

Panel D: Risk retention measures					
	N	mean	std. dev.	minimum	maximum
% B-piece sold within 1 year	539	20.31	32.22	0.00	100.00
% B-piece sold (total)	539	39.10	38.72	0.00	100.00
Rolling average of % B-piece sold within 1 year	530	20.93	24.53	0.00	100.00
Rolling average of % B-piece sold (total)	530	39.55	34.93	0.00	100.00
% deal value retained at 1 year	539	4.46	2.65	0.00	10.50
% deal value retained as of 6/15	539	3.51	2.75	0.00	9.00
Dollar exposure retained at 1 year (USD, Millions)	539	60.03	33.04	0.00	159.41
Dollar exposure retained as of 6/15 (USD, Millions)	539	48.17	36.39	0.00	159.41

Table 2. Deal-level distress rates and loss severities.

Panel A presents deal-level distress rates. Distress rates are calculated as the average of the sum of the percentage of loans in each pool that are 60 days late, 90 days late, in foreclosure, or real estate owned (REO). Panel B presents deal-level cumulative bond losses. Vintage year is the closing year of the deal, and seasoning is the number of years elapsed since the closing date. Averages are calculated by taking monthly observation that is closest to N years from closing date. If that observation is more than 3 months (93 days) from the closing date, it is not included in the average, and samples may change across seasoning years. Data source: Trepp, LLC.

Panel A: Percentage of 60+, 90+, Foreclosed, and REO loans (equally weighted means)

	Seasoning									
Vintage	1	2	3	4	5	6	7	8	9	**10**
2000								2.52%	5.70%	**23.47%**
2001							1.04%	2.56%	4.60%	**29.73%**
2002						1.25%	1.84%	3.30%	3.86%	**27.31%**
2003					0.78%	1.60%	2.73%	2.67%	2.67%	**19.19%**
2004				1.27%	2.03%	3.84%	6.22%	4.69%	3.29%	**18.12%**
2005			0.89%	2.33%	5.86%	6.33%	6.28%	5.36%	4.60%	**19.04%**
2006		1.01%	3.38%	7.80%	8.86%	10.00%	8.50%	6.35%	6.20%	
2007	1.18%	3.04%	9.38%	11.34%	10.30%	11.28%	9.72%	8.56%		
2008	3.32%	10.36%	10.01%	9.15%	9.31%	7.46%	7.57%			

Panel B: Total cumulative bond losses (equally weighted means)

	Seasoning									
Vintage	1	2	3	4	5	6	7	8	9	**10**
2000								1.26%	1.35%	**1.85%**
2001							0.70%	0.93%	1.43%	**2.57%**
2002						0.64%	0.66%	1.11%	1.73%	**2.33%**
2003					0.16%	0.17%	0.46%	0.95%	1.32%	**1.77%**
2004				0.09%	0.13%	0.42%	0.90%	1.43%	2.07%	**2.45%**
2005			0.01%	0.06%	0.44%	1.35%	2.06%	2.86%	3.66%	**3.99%**
2006		0.03%	0.05%	0.40%	1.44%	2.52%	4.05%	5.49%	5.73%	
2007	0.00%	0.01%	0.22%	1.20%	2.68%	3.62%	4.99%	5.72%		
2008	0.00%	0.11%	1.03%	2.13%	3.31%	5.56%	6.18%			

Table 3. Multivariate analysis of CDO sale activity

This table reports the output of four regressions using the sample of deals issued during the years 2000-2008. The dependent variable is the amount of the B-piece sold into CDOs within one year after the initial deal closing date (columns (1) and (2)) and over the entire lifetime of the deal (columns (3) and (4)). BPB is a Special Servicing Firm is an indicator that is set to 1 for special servicing firms. BPB Past Deal Count (PDC) is the total number of deals in which the B-piece buyer has participated prior to the current deal, with PDC x vintage interaction terms are reported beneath. Cutoff Asset Count is the number of assets comprising the collateral pool. Top Ten Loans % is the percentage of the pool comprised by the top ten largest loans. Log(Cutoff Balance) is the log of the total collateral pool balance, and >1 B-piece Buyer is an indicator that is equal to one if there are two more B-piece buyers at issue. Estimated coefficients for Deal-level control variables, and Seasoning Controls are suppressed. Even numbered columns include B-piece buyer fixed effects. All regressions include vintage year fixed effects, and standard errors are clustered by deal.

	% of B-piece Sold into CDO			
	Before Anniversary		Lifetime	
	(1)	(2)	(3)	(4)
BPB is Special Servicing Firm	-9.9160*	-29.1800	2.2015	17.5078
	(0.0865)	(0.1898)	(0.7157)	(0.4261)
Vintage 2001	6.0178	-12.0989	31.4947**	24.0195*
	(0.6102)	(0.3215)	(0.0283)	(0.0961)
Vintage 2002	-10.8232	-19.7354	-24.6643	-17.1626
	(0.3284)	(0.1233)	(0.1269)	(0.2207)
Vintage 2003	-4.3264	-7.5740	-36.6247**	7.1578
	(0.7506)	(0.5940)	(0.0377)	(0.6332)
Vintage 2004	-0.9112	-14.7940	-30.0417	-1.7959
	(0.9577)	(0.4167)	(0.1407)	(0.9176)
Vintage 2005	-2.7040	-30.6461*	-25.6284	-7.8575
	(0.8709)	(0.0970)	(0.1921)	(0.6540)
Vintage 2006	-1.0028	-29.6172	-30.0978	-18.4550
	(0.9543)	(0.1419)	(0.1470)	(0.3232)
Vintage 2007	-9.0442	-43.3970*	-57.6158**	-50.3033**
	(0.5651)	(0.0584)	(0.0036)	(0.0173)
BPB Past Deal Count (PDC)	-0.5413	0.3134	4.3821	2.2246
	(0.6438)	(0.8638)	(0.1378)	(0.4562)
PDC x Vintage 2001	1.4339	2.8948*	-6.3143**	-3.9840
	(0.4334)	(0.0870)	(0.0420)	(0.1713)
PDC x Vintage 2002	3.0752**	2.8261*	-2.0957	-0.6260
	(0.0188)	(0.0621)	(0.4852)	(0.8245)
PDC x Vintage 2003	1.5829	0.9901	-2.7093	-2.4305
	(0.2030)	(0.5167)	(0.3662)	(0.3883)
PDC x Vintage 2004	0.9739	0.5817	-3.7564	-2.2739
	(0.4214)	(0.7113)	(0.2044)	(0.4226)
PDC x Vintage 2005	1.6176	1.3890	-3.8143	-1.9273
	(0.1771)	(0.3900)	(0.1970)	(0.5019)
PDC x Vintage 2006	1.0642	0.6675	-3.8433	-1.8063
	(0.3634)	(0.6801)	(0.1927)	(0.5305)
PDC x Vintage 2007	1.0450	0.6621	-3.9237	-1.7420
	(0.3684)	(0.6884)	(0.1836)	(0.5472)
Top 10 Loans %	-0.1817	-0.0143	-0.3718	-0.2270
	(0.4343)	(0.9505)	(0.1075)	(0.2420)
Cutoff Asset Count	0.0006	0.0244	-0.0365	0.0002
	(0.9879)	(0.5324)	(0.3468)	(0.9946)
Log(Cutoff Balance)	6.9316	5.5431	-6.1594	-5.1986
	(0.3934)	(0.5137)	(0.4289)	(0.4700)
>1 B-piece buyer	7.8381	3.6941	-7.0124	-14.2250
	(0.2973)	(0.5441)	(0.4778)	(0.1117)
Cutoff LTV	0.8252	0.4442	1.5318**	0.9933
	(0.2802)	(0.5807)	(0.0346)	(0.1387)
Cutoff DSCR (NCF)	3.9379	-2.4296	21.5037*	4.7000
	(0.7317)	(0.8204)	(0.0637)	(0.5760)
Cutoff BBB- Subordination	-4.4370**	-3.5770	-8.6721***	-7.3975***
	(0.0436)	(0.1548)	(0.0005)	(0.0016)
>2 Ratings	-12.3977**	-6.4281	-5.6514	-3.2943
	(0.0330)	(0.3092)	(0.3780)	(0.5714)
Months Seasoned (Cutoff)	0.0410	0.0811	-0.1079	-0.0266
	(0.5182)	(0.1639)	(0.1087)	(0.5688)
Constant	-166.4171	-108.8719	142.5570	122.2893
	(0.3253)	(0.5481)	(0.3935)	(0.4440)
Observations	362	362	362	362
R-squared	0.2880	0.4026	0.351	0.588
R-squared	0.288	0.403	0.3513	0.5885
Property Type Controls	YES	YES	YES	YES
Vintage Year Controls	YES	YES	YES	YES
BPB Dummies	NO	YES	NO	YES

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Full sample regressions with deal-level risk retention measures.

This table reports the output of twelve regressions using the full sample of deals issued during the years 2000-2015. The dependent variable is the cumulative realized loss on the CMBS collateral pool in Panel A, and our estimate of the loss severity on the B-piece in Panel B. The first three independent variables are our main measures of risk retention at the deal-level: % of the B-piece sold, % of total pool value retained, and total dollar exposure to the B-piece buyer. BPB is a Special Servicing Firm is an indicator that is set to 1 for special servicing firms. BPB Past Deal Count (PDC) is the total number of deals in which the B-piece buyer has participated prior to the current deal, with PDC x vintage interaction term coefficients suppressed. Cutoff Asset Count is the number of assets comprising the collateral pool. Top Ten Loans % is the percentage of the pool comprised by the top ten largest loans. Log(Cutoff Balance) is the log of the total collateral pool balance, and >1 B-piece Buyer is an indicator that is equal to one if there are two more B-piece buyers at issue. Estimated coefficients for Deal-level control variables, and Seasoning Controls are suppressed. Even numbered columns include B-piece buyer fixed effects. All regressions include vintage year fixed effects, and standard errors are clustered by deal.

Panel A Dependent Variable: Pool Losses (%)

	Pool Losses					
	(1)	(2)	(3)	(4)	(5)	(6)
% B-piece sold within 1 year	0.0057***	0.0035*				
	(0.0050)	(0.0759)				
% deal value retained at 1 year			-0.0544	-0.0051		
			(0.2204)	(0.9141)		
Dollar exposure retained at 1 year					-0.0034	-0.0016
					(0.1311)	(0.4406)
BPB is Special Servicing Firm	0.1647	0.2711	0.1450	0.2680	0.1377	0.2612
	(0.2228)	(0.2848)	(0.2885)	(0.2931)	(0.3126)	(0.3066)
BPB Past Deal Count (PDC)	-0.0238	-0.0062	-0.0430	-0.0028	-0.0314	-0.0059
	(0.8541)	(0.9662)	(0.7433)	(0.9845)	(0.8099)	(0.9678)
Top 10 Loans %	0.0086***	0.0086***	0.0086***	0.0086***	0.0086***	0.0086***
	(0.0013)	(0.0012)	(0.0013)	(0.0012)	(0.0013)	(0.0012)
Cutoff Asset Count	0.0018	0.0017	0.0019	0.0018	0.0019	0.0017
	(0.3875)	(0.4066)	(0.3677)	(0.3796)	(0.3623)	(0.3853)
Log(Cutoff Balance)	-0.1792	-0.1972	-0.1985	-0.1882	-0.0183	-0.1179
	(0.4362)	(0.3849)	(0.3904)	(0.4106)	(0.9405)	(0.6205)
>1 B-piece buyer	-0.3146**	-0.2604	-0.3164**	-0.2581	-0.3203**	-0.2618
	(0.0118)	(0.2236)	(0.0114)	(0.2271)	(0.0105)	(0.2219)
Cutoff LTV	0.0793***	0.0783***	0.0850***	0.0786***	0.0837***	0.0803***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
>2 Ratings	0.2337***	0.2343***	0.2336***	0.2342***	0.2338***	0.2343***
	(0.0041)	(0.0040)	(0.0041)	(0.0041)	(0.0041)	(0.0040)
Constant	-306.2670**	-304.2419**	-305.8373**	-304.2805**	-309.6911**	-305.6884**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	30,269	30,269	30,269	30,269	30,269	30,269
Deal Count	539	539	539	539	539	539
Property Type Controls	YES	YES	YES	YES	YES	YES
Seasoning Controls	YES	YES	YES	YES	YES	YES
BPB Dummies	NO	YES	NO	YES	NO	YES
R-squared (overall)	0.566	0.605	0.563	0.603	0.564	0.604

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Panel B Dependent Variable: B-piece Losses (%)

	B-piece Losses					
	(1)	(2)	(3)	(4)	(5)	(6)
% B-piece sold within 1 year	0.0755***	0.0450*				
	(0.0083)	(0.0943)				
% deal value retained at 1 year			-1.0716*	-0.4316		
			(0.0805)	(0.5088)		
Dollar exposure retained at 1 year					-0.0647**	-0.0409
					(0.0441)	(0.1119)
BPB is Special Servicing Firm	1.2404	3.8866	1.0667	3.7604	0.9122	3.6565
	(0.5045)	(0.1878)	(0.5690)	(0.2085)	(0.6286)	(0.2193)
BPB Past Deal Count (PDC)	1.1827	2.2665	0.8131	2.1390	1.0461	2.2005
	(0.4895)	(0.2610)	(0.6386)	(0.2869)	(0.5418)	(0.2726)
Top 10 Loans %	0.0664*	0.0662*	0.0666*	0.0663*	0.0665*	0.0663*
	(0.0691)	(0.0695)	(0.0680)	(0.0690)	(0.0684)	(0.0690)
Cutoff Asset Count	0.0593**	0.0661***	0.0600***	0.0669***	0.0603***	0.0667***
	(0.0103)	(0.0042)	(0.0098)	(0.0038)	(0.0093)	(0.0039)
Log(Cutoff Balance)	1.8128	0.2188	1.3601	0.0971	4.7986	2.1292
	(0.5533)	(0.9414)	(0.6593)	(0.9746)	(0.1425)	(0.4908)
>1 B-piece buyer	-1.6818	-2.9061	-1.7926	-2.9382	-1.8520	-2.9923
	(0.2828)	(0.2524)	(0.2567)	(0.2477)	(0.2403)	(0.2422)
Cutoff LTV	0.3290	0.2849	0.4463	0.3295	0.4156	0.3439
	(0.2675)	(0.3282)	(0.1627)	(0.3002)	(0.1756)	(0.2571)
>2 Ratings	-6.1504***	-6.1518***	-6.1502***	-6.1517***	-6.1485***	-6.1498***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	-2,627.0665	-2,597.4067	-2,615.1898	-2,591.8693	-2,688.5165	-2,633.9213
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	30,145	30,145	30,145	30,145	30,145	30,145
Deal Count	537	537	537	537	537	537
Property Type Controls	YES	YES	YES	YES	YES	YES
Seasoning Controls	YES	YES	YES	YES	YES	YES
BPB Dummies	NO	YES	NO	YES	NO	YES
R-squared (overall)	0.677	0.713	0.676	0.713	0.676	0.713

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Instrumental variable approach.

This table reports the output of our instrumental variable regressions using the full sample of deals issued during the years 2000-2015. Columns (1) and (2) present first-stage results for the second-stage regression models present in columns (3) and (4), respectively. The dependent variable in columns (1) and (2) is the % of the B-piece sold within one year. The dependent variable in the second-stage regressions in (3) and (4) is the cumulative realized loss on the CMBS collateral pool. Other control variables are the same as in Table 4. Columns (2) and (4) include B-piece buyer fixed effects, and all regressions include vintage year fixed effects. Standard errors are clustered by deal.

	1st Stage - % B-piece sold within 1 year		2nd Stage Pool Losses	
	(1)	(2)	(3)	(4)
Rolling average % B-piece sold within 1 year	0.6910***	0.4540***		
	(0.0000)	(0.0020)		
% B-piece sold within 1 year (instrumented)			0.0075	-0.0052
			(0.1641)	(0.6065)
BPB is Special Servicing Firm	-2.0916	-3.3566	0.1249	0.0184
	(0.5950)	(0.3270)	(0.4160)	(0.9472)
BPB Past Deal Count (PDC)	-0.7624	0.7766	-0.0023	0.0626
	(0.3390)	(0.5450)	(0.9881)	(0.6879)
Top 10 Loans %	-0.0189	-0.0173	0.0074**	0.0086***
	(0.8100)	(0.8200)	(0.0192)	(0.0037)
Cutoff Asset Count	0.0314	0.0432	0.0029*	0.0045***
	(0.3860)	(0.2370)	(0.0597)	(0.0011)
Log(Cutoff Balance)	-0.1376	-0.1165	-0.4416*	-0.5649**
	(0.9810)	(0.9860)	(0.0595)	(0.0106)
>1 B-piece buyer	1.0851	2.1937	-0.2523*	-0.0799
	(0.5560)	(0.4980)	(0.0676)	(0.7415)
Cutoff LTV	-0.1539	-0.1905	0.1182***	0.1184***
	(0.7230)	(0.6750)	(0.0000)	(0.0000)
>2 Ratings	-1.1176	-1.5473	0.0696	0.0454
	(0.5740)	(0.4550)	(0.3995)	(0.5958)
Constant	-1.3424	1.2321	-3.2336	-0.5168
	(0.9910)	(0.9930)	(0.4913)	(0.9153)
Observations	29,724	29,724	29,724	29,724
Deal Count	530	530	530	530
R-squared	0.454	0.4737	0.5861	0.6161
Property Type Controls	YES	YES	YES	YES
Seasoning Controls	YES	YES	YES	YES
BPB Dummies	NO	YES	NO	YES

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Pricing regression.

This table reports the output a regression using the full sample of deals issued during the years 2000-2015. The dependent variable is an estimate of the initial yield spread (above Treasuries) on each deal's triple-B minus rated bond. Control variables are as described in Table 4 and Table 5. Columns (2) and (4) include B-piece buyer fixed effects, and all regressions include vintage year fixed effects with robust standard errors.

	BBB- Yield Spread			
	(1)	(2)	(3)	(4)
Rolling average % B-piece sold within 1 year	-0.0113*	-0.0316***	-0.0100	-0.0300***
	(0.0944)	(0.0089)	(0.1221)	(0.0096)
BPB is Special Servicing Firm	0.3939	-1.5717	0.4193	-1.4100
	(0.3245)	(0.2471)	(0.2901)	(0.2879)
BPB Past Deal Count (PDC)	-0.0771	0.1101	-0.0392	0.2163
	(0.2546)	(0.5493)	(0.5938)	(0.2936)
Top 10 Loans %	0.0056	-0.0068	0.0106	-0.0004
	(0.7595)	(0.6887)	(0.5891)	(0.9815)
Cutoff Asset Count	0.0000	-0.0006	0.0006	-0.0000
	(0.9977)	(0.7882)	(0.8329)	(0.9868)
Log(Cutoff Balance)	-0.9242	-0.9474*	-0.6855	-0.6562
	(0.1125)	(0.0885)	(0.2232)	(0.2343)
>1 B-piece buyer	0.6173	2.1343*	0.6582	2.1198*
	(0.3056)	(0.0963)	(0.2729)	(0.0953)
Cutoff LTV	-0.0134	-0.0107	-0.0622	-0.0607
	(0.6777)	(0.7383)	(0.1428)	(0.1364)
Cutoff BBB- Subordination			0.4060**	0.4543**
			(0.0428)	(0.0288)
>2 Ratings	0.0211	-0.0087	-0.0754	-0.1601
	(0.9552)	(0.9756)	(0.8350)	(0.5959)
Type 144a	1.9405*	2.1217**	1.9207*	2.1093**
	(0.0691)	(0.0412)	(0.0720)	(0.0429)
Months Seasoned (Cutoff)	-0.0042	-0.0009	-0.0039	-0.0002
	(0.1363)	(0.7763)	(0.2116)	(0.9623)
Coupon: "Other, non-fixed"	-0.1769	0.0330	-0.2604	-0.0357
	(0.3393)	(0.8876)	(0.2078)	(0.8850)
Coupon: "WAC / Pass-through"	0.5091***	0.4781*	0.4123**	0.3776
	(0.0070)	(0.0798)	(0.0247)	(0.1672)
Constant	23.7657*	23.8805**	18.5928	16.2291
	(0.0567)	(0.0380)	(0.1224)	(0.1587)
Observations	396	396	396	396
R-squared	0.6916	0.7509	0.6949	0.7543
Vintage Dummies	YES	YES	YES	YES
Property Type Controls	YES	YES	YES	YES
BPB Dummies	NO	YES	NO	YES
Coupon Type	All	All	All	All

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Bibliography

AKERLOF, G. A. 1970. The market for" lemons": Quality uncertainty and the market mechanism. *The quarterly journal of economics***,** 488-500.

AMBROSE, B. W. & SANDERS, A. B. 2003. Commercial mortgage-backed securities: prepayment and default. *The Journal of Real Estate Finance and Economics,* 26**,** 179-196.

AMBROSE, B. W., SANDERS, A. B. & YAVAS, A. 2009. Special servicers and adverse selection in informed intermediation: Theory and evidence. Working Paper, Pennsylvania State University.

AN, X., DENG, Y., NICHOLS, J. B. & SANDERS, A. B. 2013. Local Traits and Securitized Commercial Mortgage Default. *The Journal of Real Estate Finance and Economics,* 47**,** 787-813.

AN, X., DENG, Y., NICHOLS, J. B. & SANDERS, A. B. 2014. What is Subordination About? Credit Risk and Subordination Levels in Commercial Mortgage-backed Securities (CMBS). *The Journal of Real Estate Finance and Economics***,** 1-23.

ASHCRAFT, A. B., GOORIAH, K. & KERMANI, A. 2014. Does Skin ‐ in ‐ the ‐ Game Affect Security Performance? Evidence from the Conduit CMBS Market. *Evidence from the Conduit CMBS Market (May 15, 2014)*.

BLACK, L. K., CHU, C. S., COHEN, A. & NICHOLS, J. B. 2012. Differences across originators in CMBS loan underwriting. *Journal of Financial Services Research,* 42**,** 115-134.

CIOCHETTI, B. A., DENG, Y., LEE, G., SHILLING, J. D. & YAO, R. 2003. A proportional hazards model of commercial mortgage default with originator bias. *The Journal of Real Estate Finance and Economics,* 27**,** 5-23.

DEMARZO, P. M. 2005. The pooling and tranching of securities: A model of informed intermediation. *Review of Financial Studies,* 18**,** 1-35.

ESAKI, H., L'HEUREUX, S. & SNYDERMAN, M. 1999. Commercial mortgage defaults: An update. *Real Estate Finance,* 16**,** 81-86.

FURFINE, C. H. 2014. Complexity and Loan Performance: Evidence from the Securitization of Commercial Mortgages. *Review of Corporate Finance Studies***,** cft008.

GAN, Y. H. & MAYER, C. 2006. Agency conflicts, asset substitution, and securitization. National Bureau of Economic Research.

GHENT, A. & VALKANOV, R. 2013. Advantages and disadvantages of securitization: evidence from commercial mortgages. Working paper.

HAMBLY, A. 2015. Countdown to 2017 - The Great Wall of Maturities. *CRE Finance World,* Volume 17.

KEYS, B. J., MUKHERJEE, T. K., SERU, A. & VIG, V. 2008. Did securitization lead to lax screening? Evidence from subprime loans. *Evidence from Subprime Loans (December 25, 2008). EFA*.

MINTON, B. A., STULZ, R. & WILLIAMSON, R. 2009. How much do banks use credit derivatives to hedge loans? *Journal of Financial Services Research,* 35**,** 1-31.

MYERS, S. C. & RAJAN, R. G. 1995. The paradox of liquidity. National Bureau of Economic Research.

OFFICE OF THE COMPTROLLER OF THE CURRENCY, T. O. B. O. G. O. T. F. R. S. B. F. D. I. C. F. U. S. S. 2014. Credit Risk Retention.

RIDDIOUGH, T. J. 2011. Can securitization work? Economic, structural and policy considerations. *Economic, Structural and Policy Considerations (August 31, 2011). Hong Kong Institute for Monetary Research Working Paper*.
RIDDIOUGH, T. J. & ZHU, J. 2015. Risk and Information Tranching, Security Governance, And Incentive Compatible Capital Structure Design. *Working Paper*.
SNYDERMAN, M. P. 1991. Commercial mortgages: Default occurrence and estimated yield impact. *The Journal of Portfolio Management*, 18**,** 82-87.
TITMAN, S. & TSYPLAKOV, S. 2010. Originator Performance, CMBS Structures, and the Risk of Commercial Mortgages. *The Review of Financial Studies*, 23**,** 3558-3594.
TU, C. C. & EPPLI, M. 2002. Extension risk in commercial mortgages. *Real Estate Finance*.
TU, C. C. & EPPLI, M. J. 2003. Term default, balloon risk, and credit risk in commercial mortgages. *The Journal of Fixed Income*, 13**,** 42-52.
VANDELL, K. D., BARNES, W., HARTZELL, D., KRAFT, D. & WENDT, W. 1993. Commercial mortgage defaults: proportional hazards estimation using individual loan histories. *Real Estate Economics*, 21**,** 451-480.
YILDIRIM, Y. 2008. Estimating default probabilities of CMBS loans with clustering and heavy censoring. *The Journal of Real Estate Finance and Economics*, 37**,** 93-111.