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CMBS Market Evolution and Emerging Risks *

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Abstract

We study the evolution of the private label CMBS market from one dominated by broadly diversified long-term, fixed-rate conduit securitizations to one dominated in 2021-22 by undiversified short-term, floating-rate single-asset, single-borrower (SASB) securitizations. Twenty-five years of stable bond returns and exceptionally low losses help explain the growth and standardization of the SASB market following the Global Financial Crisis. Historically low interest rates and pandemic-era uncertainties help explain the recent dominance of short-term, floating-rate SASBs. Factors contributing to their strong performance have weakened considerably recently, exposing them to emerging risks, making their recent dominance unsustainable.

Keywords: Commercial Mortgage-Backed Securities (CMBS), single-asset, single-borrower (SASB), Conduit, Bond Return, Deal Loss

JEL Classifications: D12, D63, G21, G50

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1 Introduction

Perhaps no fixed-income market has experienced more change in recent years than the commercial real estate (CRE) securitization market, yet the causes and implications of these changes have yet to be studied in the academic literature. A recent paper by Glancy et al. (2022) describes the CRE loan market as segmented between shorter term, floating-rate CRE loans dominated by banks, with 10-year fixed-rate loans going to private label commercial mortgage-backed securities (PL CMBS), and loans with longer maturities going predominantly to life insurers. This was indeed a good characterization of the pre-Global Financial Crisis (GFC) CRE market and perhaps as late as 2017, the last year studied in that paper.

But the once dominant broadly diversified long-term, fixed-rate conduit[1] CMBS that financed nearly a quarter of the entire CRE market in 2007 is now a diminished presence. Instead, short-term, floating-rate single-asset, single-borrower (SASB) CMBS, whose structures are near mirror images of conduits, dominated PL CMBS issuance in 2021-22 (Figure 2).[2] In this paper, we examine factors that brought about this evolution. We then show how factors that contributed to SASBs superior performance have weakened considerably recently. These factors and other structural features of SASBs make them especially susceptible to emerging risks in the post-pandemic economy.

For our empirical analysis, we construct a novel database combining three of the most authoritative sources of CMBS information to analyze PL CMBS bond returns and deal losses over the past 25 years. Our data include all cash distributions for every conduit and SASB bond, purchase prices on all CMBS investment-grade bonds, and a panel of all CMBS loans. For the first time in the literature, we calculate returns and analyze losses over the entire modern CMBS market from its early roots in 1998 through 2022, encompassing the GFC, the COVID-19 pandemic, and the beginnings of the Federal Reserve's rate-hiking cycle in 2022.

Our central findings are that regulatory and market frictions combined with 25 years of stable bond returns and exceptionally low losses for SASBs contributed to their standardization and post-GFC growth. Pandemic era dislocations and excep-

[1] Conduit securitizations comprise a large number of income-earning CRE loans to a large number of different borrowers broadly diversified across office, hotels, multifamily, retail, industrial, mixed use, and other properties.

[2] SASB securitizations are either a single loan on a standalone property or a portfolio of properties that operate as a single credit. They are made to a single borrower and are mostly single industry in the same geographic locales.

tionally low interest rates then led to the dominance of short-term, floating-rate SASBs in 2021-22. Regulatory restrictions and risk management practice limit banks and insurers holding loans of the size securitized in SASBs, which offer more efficient and timely execution than "club loans" financed through risk-sharing agreements at these firms or through "split notes" securitized across multiple conduit deals. Since CRE loans generally do not trade, alternative financing vehicles to SASBs for large loans are limited. However, factors contributing to SASBs strong performance have weakened considerably recently, exposing them to emerging risks, making their recent dominance unsustainable.

Analyzing bond returns in a manner similar to Cordell, Roberts, and Schwert (2023), we find that for CMBS conduit securities issued between 1998 and 2009, so-called CMBS 1.0 deals, their investment-grade bonds suffered severe underperformance relative to similarly rated and maturity matched corporate bonds. BBB rated conduit bonds underperformed by a full 29%, A rated bonds 20%, AA rated 15%, and AAA rated by 2%. In contrast, CMBS 1.0 fixed-rate SASB mezzanine bonds, those rated BBB to AA, outperformed corporates by 1%-7%, with similar performance for AAA rated conduit bonds. Floating rate SASBs performed similarly to corporates across all bond classes, with significantly better performance of 4% of BBB rated bonds (Table 6). For returns after 2010, so-called CMBS 2.0 deals, all mezzanine bond conduit and SASB cohorts outperformed or performed similarly to corporates. While AAA bonds have generally underperformed corporates, they offer stable, call-protected securities, making them attractive to insurers, who have held more than a third of all PL CMBS bonds in recent years (Table A2).

To better understand these differences in bond returns, we examine the determinants of CMBS 1.0 security losses, which drove relative return performance. Summing up cash distributions for PL CMBS principal write downs, we find life-to-date losses of $66.3 billion for all PL CMBS, 99% of which are concentrated in conduit securitizations, 95% in CMBS 1.0. In contrast, SASB 1.0 securities had only 100 basis points (bps) of loss and only 20 bps of life-to-date losses in CMBS 2.0 transactions from 2010-2022 (Table 8).

Analysis of CMBS risk factors shows a significantly less risky risk profile for SASB 1.0 deals than their conduit 1.0 counterparts across most major risk dimensions, including lower loan to value (LTV) ratios, higher debt service coverage ratios (DSCRs),[3] and much simpler structures (Table 9). For our multivariate analysis, we

[3] A DSCR is the ratio of annual net operating income to total annual debt payments. DSCRs

find these factors combined with a national CRE price and vacancy rate series explain most of the variation in CMBS 1.0 losses (Table 10).

The CMBS 1.0 era coincided with several developments that led to mounting conduit CMBS bond losses, increasing exposure for CMBS securities. Rating agencies reduced CMBS subordination levels for investment-grade bond classes up to 2007, leaving even AAA bonds exposed (Figure 3, An et al. (2014), Levitin and Wachter (2013), Stanton and Wallace (2018)). The issuance of large volumes of CRE collateralized debt obligations (CRE CDOs) allowed B-piece buyers to re-securitize their bonds and pass risks on to CDO investors (Ashcraft, Gooriah, and Kermani (2019)), causing a surge in the demand for B-pieces, driving down yields, and further weakening underwriting standards (CRE Finance Council (2022)). This increased demand fueled extraordinary growth in conduit issuance after 2004 to such an extent that by 2007, PL CMBS funded a quarter of the entire CRE market (Figure 1 and Figure 5). SASB 1.0 securitizations did not face these same pressures. Credit support for SASB AAA bonds was very deep (Figure 3, Panel D) and SASB deals did not rely on financing from CRE CDOs.

The massive losses suffered by PL CMBS led to the shutdown of the PL CMBS market in 2008-09. When the market reemerged in 2010, the strong performance of SASB securities led to the standardization of CMBS 2.0 SASB securitizations, as they expanded in size and form. Fixed rate SASBs retain many of the same structural features of conduits. SASBs also come in short-term, floating-rate form, with flexible refinancing options. They begin with initial terms of two to three years. Then they have options to extend in one-year increments for two to five years; most reach final maturity in five years. Thus, SASBs run the gamut from short-term floating rate to long-term fixed rate.

The emergence of SASBs is also due to regulatory restrictions and market frictions, made more severe by pandemic-era disruptions. Loan-to-one borrower limits and risk management practice make almost all SASB loans too large for any single regulated financial entity to finance. For large CRE loans, very large conduit deals provided a ready source of financing pre-GFC. After the collapse of the CMBS market in 2008-09, conduit deals became much smaller in size. We will show that some large CRE loans too large for a single conduit deal increasingly got placed through "split notes" among deals in CMBS 2.0 securities (Figure 7). Uncertainties during the pandemic

significantly above 1.0 suggests the properties are generating enough income to cover the debt service payments.

caused a sharp drop in long-term debt financing, limiting that option.[4] As a result, very large CRE loans increasingly got placed in SASBs.[5] Finally, this desire for shorter term financing combined with record low interest rates helped fuel the growth of short-term, floating-rate SASBs in 2021-22.

Historically low interest rates and rapidly rising CRE prices over most of the CMBS 2.0 era masked risks of SASB securitizations, which may be coming to the fore with recent interest-rate rises and declining CRE prices. We will show that as SASB 2.0 deals became standardized, they also became significantly riskier than SASB 1.0 securitizations across most major risk dimensions (Table 9). Unique to SASB deals, around a third are funded with subordinated mezzanine loans, which further raises LTVs and debt-servicing costs, which we explore in Section 5.3. While conduit deals remained broadly diversified, SASBs made some concentrated intertemporal industry bets. In the early 2010s, SASBs concentrated financing in some large regional retail malls and office properties from 2016-21 (Figure 3). Many of their CMBS bonds have recently been downgraded, clear up to AAA (Figure 6).

Since CRE loans do not trade, this illiquidity will pose special challenges for short-term floating-rate SASBs. Around two-thirds of SASBs face initial or final maturities in 2023-24. Floating rate SASB deals are further exposed to interest rate risk via requirements that they buy interest rate caps to hedge that risk. But caps are purchased only for the initial two- to three-year terms. As SASBs exercise their options to extend terms, they must repurchase these caps, whose costs have skyrocketed since the onset of the Federal Reserve's rate-hiking cycle, an issue we highlight in Section 5.4. We argue that these combined risks will make the superior historical performance of SASB securitizations unsustainable.

Our empirical evidence builds on prior academic research, adding a new chapter to the evolution of the PL CMBS market. An and Vandell (2014) and Geltner et al. (2014) describe the origins of the CMBS market, explaining how non-performing CRE loans at Savings and Loans got structured as CMBS in the early 1990s. Dealers started applying this credit-enhancing technology first to "trophy" SASB pools (CRE Finance Council (2022)), then to larger pools of conduits starting in 1997, ushering in the modern PL CMBS market. An, Deng, and Gabriel (2011) further explain how

[4] Conduit issuance was so low in 2021 that the CMBX.15 indexes, created to track the CMBS market, did not have enough qualifying conduit deals, requiring them to use some seasoned conduit deals from 2020. See Bank of America, *CMBS Weekly*, January 14, 2022.

[5] Between them, banks, insurers and securities currently finance 90% of the CRE market (Figure 1, Panel B), suggesting alternative funding sources for large CRE loans are limited.

conduit deals that comprise a large number of originate-to-distribute loans gained popularity in late 1990s and 2000s. They argue that, compared to CMBS backed by portfolio loans, CMBS backed by conduit loans enjoyed a price premium because they mitigate the information asymmetries between issuers and investors.

Along with Stanton and Wallace (2018), Furfine (2014) and others, we show how ratings inflation and regulatory capital changes fueled the growth of larger and riskier conduit 1.0 structures, contributing to massive losses and the shutdown of the market in 2008-09.[6] Our contribution is to examine what emerged after 2010 in the latest chapter in the evolution of the PL CMBS market and the emerging risks made manifest in the first phase of the Federal Reserve's interest rate hiking cycle in 2022.

The remainder of this paper is organized as follows. Section 2 provides an overview of the CRE securitization market and evolution of CMBS conduit and SASB structures that guide our empirical analysis. Section 3 describes our data sources and sample construction. Section 4 compares CMBS 1.0 and 2.0 conduit and SASB bond returns to similarly rated and maturity matched corporate bonds and examines underlying factors that drove disparities. Section 5 explores emerging risks among SASB deals and the broader CMBS market. Section 6 concludes.

2 CMBS Market Evolution

2.1 Overview of the CRE Securitization and PL CMBS Markets

We begin with a market overview of the growth of CRE securitizations from the start of our sample in 1998, when they were a small fraction of CRE, to 2022, when they were its second largest source of financing behind banks, displayed in Figure 1. The primary source for CRE is the Federal Reserve's Schedule Z.1, Financial Accounts of the U.S. Due to accounting changes and definitional differences, we adjust figures using data from the Mortgage Bankers Association (MBA) and Intex.[7]

As described in An and Vandell (2014), Geltner et al. (2014), and CRE Finance

[6] Black et al. (2012) studied the ex post performance of CMBS and CRE loans underwritten by different types of originators between 1999 and 2007 and argued balance-sheet lenders underwrote higher quality loans.

[7] We found significant undercounting of PL CMBS by some $167 billion at year-end 2022. According to the MBA's 2022 Q4 report, the Federal Reserve adjusted its balances of CMBS down and REITs up by some $130 billion starting in 2013:Q2 due to a FAS 167 accounting change, which led to "a significant distortion of the size of the CMBS and REIT markets." We adjust figures back to account for this, using Intex as our source for CMBS balances. Our approach is corroborated by industry sources. See Bank of America *CMBS Weekly*, April 21, 2023.

Council (2022), the CMBS market had its beginnings following the savings and loan (S&L) crisis, when the Resolution Trust Corporation (RTC) was formed in 1989 to dispose of assets seized from failed S&Ls. The earliest deals were seasoned deals, SASBs, multifamily properties, and pools of small-balance loans. (See Table A1.) As this inventory dwindled, dealers started applying this credit-enhancing technology to "trophy" SASB properties, then to pools of smaller CRE loans that became the modern conduit structures (see CRE Finance Council (2022)). The first conduit deal was issued in 1997, according to Green Street.[8]

The rapid growth of PL CMBS in the 2000s was fueled by regulatory and rating agency actions that simultaneously reduced capital requirements and increased the share of highly rated securities in CMBS. In 2002 risk-based capital requirements were reduced by 80% for AA and AAA rated CMBS bonds (Frame and White (2007)).[9] Stanton and Wallace (2018) attribute this change to reducing spreads between CMBS and similarly rated corporate bonds. By 2007 the AA and AAA rated portions of PL CMBS conduit securitizations reached 90%, fueling the growth of PL CMBS conduit structures and the size of individual deals (Figure 3, Panel B).

As a result, led by conduit securitizations, the PL CMBS market grew rapidly in the mid-2000s, so that by the end of 2007, it financed almost a quarter of the entire CRE market (Figure 1, Panel B). Including Agency Multifamily MBS, CRE securitizations provided funding for around 30% of the entire CRE market, second only to banks. It has maintained that share ever since.[10]

Large losses suffered primarily in conduit pools led to a collapse in PL CMBS issuance between 2008-09. When the market reemerged in 2010, CMBS 2.0 conduit structures became smaller and less highly leveraged, as we show below. But the biggest change has been the growth, then dominance, of SASBs. SASB issuance volumes surpassed 40% by 2017, reaching 70% by 2021 (Figure 2, Panel A), the largest single post-GFC issuance year. What is more, SASB debt evolved increasingly into short-term, floating-rate securitizations to the point where they became in 2021-22 the dominant form of all PL CMBS issuance at 63%, dominating both conduit

[8]Conduit deals also took the form of "fusion" deals, defined as pools where the largest loan exceeds $50 million, or the 10 largest loans make up 30% or more of the pool. Since virtually all deals meet these criteria today, we refer to all pooled *permanent* loans placed into multi-borrower transactions as conduits.

[9]See also Federal Reserve System 12 CFR Parts 208 and 225.

[10]Note that the composition of securitizations shifted increasingly to the three Agencies, Fannie Mae, Freddie Mac, and Ginnie Mae, through securitizations of multifamily CMBS, as shown in Figure A1 and to a lesser extent to CRE collateralized loan obligations (CRE CLOs), as shown in Figure 1, Panel B.

(30%) and fixed-rate SASB deals (7%) (Figure 2, Panel B). Since conduit and SASB securitizations dominate PL CMBS,[11] we focus on these two very different structures, describing their structural features next before analyzing their performance.[12]

2.2 Traditional Conduit CMBS Structures

Conduit deals comprise large numbers of income-earning CRE loans broadly diversified across office, hotel, multifamily, retail, industrial, mixed use and other industries (Figure 3, Panel A). With conduits, a large number of tranches, which are bonds with different repayment priorities, coupons and maturities, are issued and sold to investors.

To illustrate the special features of the traditional conduit structure, we describe a representative sample deal in Table 1 and in Figure 4. This 2005 $4.2 billion deal, JPMCC 2005-LDP5, had a total of 33 separate securities financing 195 loans divided into three groups, or pools, whose cash flows can operate independently of each other within the securitization. Within the three pools, payments and loss recoveries are allocated sequentially from the top of the deal structure to the bottom, common for any traditional senior-subordinate structure.[13]

A defining feature of conduit CMBS securities is the creation of a class of call-protected, long-term, fixed-rate and very low-risk AAA securities, designed to deliver very stable cash flows.[14] The senior-most bond, A-1, labeled the "fast pay" bond, absorbs any amortization of principal early on, carrying weighted average lives (WALs) of three years or less. Once A-1 pays down, support bonds similar to A-SB stabilize cash flows to the senior bonds junior to A-1, absorbing mainly additional amortization, loss recoveries, and any prepayments, so as to make bullet-like payouts to the A-2 to A-4 bonds (Figure 4). Bond dollar sizes and WALs of the A-2, A-3 and A-4 bond classes are tied to the balances of the 5-, 7- and 10-year loans in the primary pool, respectively.[15] This group of bonds make up the senior class of bonds in conduit

[11] As shown in Figure 2 conduit and SASB deals made up 91% of the nearly $2 trillion in total issuance since 1998, 98% since 2010. They made up 99% of year-end 2022 PL CMBS deal balances.

[12] The 'Other' category in Figure 2 includes large loan and floating-rate, multiple-borrower CMBS, but these are too small to analyze statistically. There are other forms, with assets involving leases, seasoned collateral, resecuritizations, or distressed sales, but these are excluded from our analysis to provide a more homogenous sample of CRE *permanent* loans.

[13] For a more detailed description of a hypothetical deal, see Tarwasokono (2008).

[14] CMBS loans in conduit deals have strong prepayment protections. These come in the forms of defeasance, lock outs, prepayment penalties, or yield maintenance agreements ((Sanders, 2005) and An and Vandell (2014)).

[15] A-2FL was a floating-rate bond pari passu with the fixed-rate A-2 bond. For bond A-2FL,

deals, carrying subordination levels of 30% or more.

Another common feature of conduit CMBS is the creation of more junior classes of AAA bonds, A-M and A-J in Table 1, that carry much lower subordination levels, 12.88% for bond A-J. These come about from pressures from investors on rating agencies to lower subordination levels during periods of especially strong performance, which came in unprecedented form in the mid-2000s and in a more limited way in later CMBS 2.0 deals (Figure 3, Panel B).[16]

A major disadvantage of AAA CMBS relative to corporate CLOs is the absence of "coverage tests" that protect more senior bondholders. Coverage tests are provisions in CLOs used to assess the adequacy of cash flows generated by the assets to meet the obligations of the bondholders.[17] Coverage tests fail when the collateral pool deteriorates beyond established thresholds. They work by repurposing interest payments to more senior bondholders until coverage tests are passed, thus deleveraging the capital structure for more senior bondholders, protecting them against principal loss. No such protections exist for CMBS.

Principal losses arise when a loan defaults and is either liquidated with a partial recovery, released from the deal at a discounted payoff, or modified with a lower principal balance. Recoveries are allocated to the senior-most bonds first. As shown in Figure 4, losses from the primary and multifamily pools are allocated first to the junior-most NR bond in a "bottom-up" fashion, up through more senior bonds. The HG class of bonds supports a single loan to the Houston Galleria Mall and is a separate, standalone pool.[18]

A feature unique to CMBS is that there is no equity tranche to absorb losses and capture excess interest, or "excess spread," between the collateral pool and debt tranches. Instead, principal losses are absorbed by the bonds, with any excess interest payments allocated to a separate interest only (IO) class of bonds. The notional balance of an IO tranche is often equal to the total principal balance of the primary pool, as in class X-1(IO).[19] Figure A2 shows how interest payments from the deal get allocated to the IO Class. Figure A3 plots the weighted average coupon (WAC) of

JPMorgan engaged in a swap contract for investors preferring floating-rate AAA bonds.

[16] CRE Finance Council (2022) quotes rating agency sources as referring to these bonds as "natural AAAs." See also An, Cordell, and Nichols (2020).

[17] See Cordell, Roberts, and Schwert (2023)).

[18] This $130 million loan is an example of how large CRE loans were funded pre-GFC. Post-GFC, conduit deals got too small to fund loans of this size in a single deal, helping give rise to SASBs.

[19] Planned amortization class (PAC) bonds can be added with pre-defined schedules to stabilize interest cash flows for these bonds, as was done with bond X-2 (IO).

the loans in the deal, showing how WACs can change over the life of the deal.

Placing the NR and non-investment-grade bonds in a first-loss position means that additional rights are assigned to these "B-piece" investors, as they are described. They are the "controlling class" under the terms of the pooling and servicing agreements (PSAs) with rights to reject loans from the initial pool and appoint the special servicer assigned to working out delinquent loans, among other rights (CRE Finance Council (2022), Glancy, Kurtzman, and Loewenstein (2022)). Riddiough (1997) sees this control as key to the optimal design and governance of ABS.

Combining different pools into these conduit securitizations made PL CMBS conduit deals the primary structure for all manner of funding for CRE. More large loans also got placed into these deals, greatly increasing deal size and concentrating their risks.[20] As a result, deal sizes grew significantly up through 2007. In Figure 5, we plot box and whisker plots for deals by vintage, which shows the outsized growth of conduit deals from 2005 to 2007. Never before or since were PL CMBS deal sizes so large. Later we will show that these three vintages generated almost three-quarters of all CMBS losses.

Conduits reached their apex in 2005-2007, when they dominated all other forms of CRE securitizations. After massive losses and the shutdown in the market from 2008-09, rating agency subordination levels for investment grade bondholders became much stricter (Figure 3, Panel B), establishing the CMBS 2.0 era starting in 2010. Underwriting of CRE loans in conduit pools became much more conservative, while traditional conduit deal structures became simpler and much smaller in size, even as they maintained their broadly diversified, long-term, fixed-rate form. But another consequential development of the PL CMBS 2.0 era has been the growth and standardization the SASB structures, particularly short-term floating-rate ones (Figure 2). We discuss these next.

2.3 Growth and Standardization of SASB Securitizations

As discussed, SASB securitizations are not new. Some of the earliest CMBS transactions were SASBs (Table A1). CRE Finance Council (2022) notes that SASBs "are usually the first type of CMBS issued in any new market." Our CMBS 1.0 sample includes 112 SASB deals. These deals mostly involved large properties such as major

[20]In our sample deal, loans were broadly diversified across office (45%), retail (25%), multifamily (20%), and small shares of other property types, but the 10 largest loans made up 45% of the collateral pool, making the deal much more concentrated than might appear from industry concentrations.

central city office buildings and hotels or "fortress" shopping centers, most of which performed well, even following the GFC.

With the reemergence of PL CMBS in 2010, SASB 2.0 securitizations became more standardized, growing in size, number and form. Standardization also brought on a broader, and riskier, mix of properties in SASB securitizations, such as our sample deal whose collateral was Motel 6 properties described next.

In Table 2 we show the deal structure and characteristics of a representative post-GFC floating-rate SASB deal, MOTEL 2017-MTL6. What is striking about this deal is how different it is from the traditional conduit structure in Table 1, or even CMBS 2.0 conduit deals today. This deal is a $2.08 billion senior portion of a $2.3 billion floating-rate debt package originated on 460 Motel 6 properties, owned by Blackstone, the largest single CRE borrower today. Thus, the deal is a single loan to a single borrower concentrated in a single industry. The deal contains only 11 bonds with a single group instead of 33 with 3 groups. There is one AAA bond instead of nine.

Because SASBs are prone to idiosyncratic risks, they typically have higher credit enhancement levels. The subordination level for this AAA SASB bond was 67.4% instead of 12.8% for the A-J bond in the conduit deal, obviously reflecting changing rating agency rules for CMBS 2.0 deals, but also much higher subordination levels for SASB generally (Figure 3, Panel D). The deal was floating rate instead of fixed rate. At issuance, the deal had an initial two-year term with options to extend up to three years, which it did for two years before paying off. The final maturity of the deal was four years, instead of almost 14 years for the conduit deal, including extensions.

As described in academic and industry studies, there are several reasons for the emergence, then dominance, of SASBs.

Limited Financing Vehicles for Large CRE Loans. Regulated banks and insurers are by far the largest CRE lenders at over 60% (Figure 1, Panel B), but regulatory and risk management constraints limit the size of CRE loans any one firm will finance. Glancy et al. (2022) show loan size for the largest banks at the 99th percentile is $127 million; the *first* percentile for SASB 2.0 deals is $162 million. Banks and insurers do finance some large CRE loans through risk sharing agreements in so-called "club loans," which industry sources tell us are much less common today, in part due to SASBs.[21]

Securitization is the next most common form of financing for CRE at 30% (Figure

[21] There are no sources for club loans we are aware of.

1, Panel B), and financing options are limited beyond these.[22] Since CRE loans do not trade, their illiquidity makes them unsuitable for mutual funds. Pre-GFC, very large loans could be placed into multi-billion dollar "fusion" conduit deals, as we saw with the Houston Galleria loan in Table 1. Post-GFC, average deal size decreased to $1 billion. With smaller conduit deal sizes, larger loans became increasingly placed into SASBs (see CRE Finance Council (2022)). Alternative financing in the CMBS space involves risk sharing among conduit deals, generally through pari-passu financing arrangements, as we will show below. But when conduit issuance dropped sharply during the pandemic, this option became limited, helping fuel SASB growth.

More Payment Options. As discussed, conduit CMBS are almost exclusively 10-year, fixed deals with call-protected loans. SASBs also offer these same terms, but also offer shorter floating-rate terms with very flexible payment options. Floating rate SASB deals have initial terms of two to three years with options to extend in annual increments for an additional two to five years, providing borrowers flexibility to refinance and reissue. Hotels, with cash flows that change daily, are financed more with SASB debt, as shown in Figure 3. In recent years, CRE Finance Council (2022) notes that large institutional investors, who are the primary SASB borrowers, prefer lesser call protection and the option to refinance before final maturity.[23]

Less Complex Deal Structures. Furfine (2014) highlights the complexity of conduit structures as a reason for their poor performance pre-GFC, as represented by the number of tranches in the deals. Conduit 1.0 deals had an average of 24 tranches in each deal, compared with 11 for SASBs. Conduit 2.0 deals average 18 tranches compared with 9 for SASBs (Table 9).

Since a SASB is a single loan on a standalone property or portfolio of properties, it operates as a single credit. This simplifies the servicing of the SASB loan. In our deal of 460 Motel 6 properties, failure of any single property will not require any action on the part of the CMBS special servicer, who manages delinquent accounts. For the loan to default requires default of enough Motel 6 properties to put at risk the payment of its debt service. With conduit deals, failure of any loan in the deal is handled by the special servicer. With simpler tranche structures and a single borrower, the master and special servicers are often the same in SASB deals, simplifying servicing

[22] Ghent and Valkanov (2016) show that from a large sample of bank and securitized loans, loans in the highest decile have a 43% chance of being securitized, whereas the ones in the lowest decile have only a 1% chance.

[23] This point is also made in Bank of America *CMBS Weekly*, January 14, 2021.

and default management.[24]

Faster Execution. The issuance of conduit deals involves originating and pooling dozens of CRE loans. Since SASBs involve a single credit to a single borrower, time from loan origination to deal issuance (i.e., time-to-market) is much faster. For our CMBS 2.0 sample, time-to-market took an average of 2.2 months for the average conduit deal, 0.5 months for a SASB deal (Table 9).

Ease of Analysis. Due to information asymmetries involved in originating large numbers of loans in conduit pools, Sanders (2005) notes the need for pricing discounts to be applied to conduit deals, while Titman and Tsyplakov (2010) find higher credit spreads in conduit deals from originators with large negative stock returns prior to origination. Since SASB securities involve a single loan, property financials can be much more straightforward to analyze, potentially limiting discounts. CRE Finance Council (2022) cites ease of analysis as contributing to increased issuance.

However, ease of analysis did not seem to contribute to better measurement of SASB net operating income (NOI) projections. Griffin and Priest (2023) analyzed NOIs in the first year of CRE loans in CMBS 2.0 securities, finding systematic overstatements in them not captured fully in security pricing. While their sampling methodology mainly captures CRE loans in conduit deals,[25] their sample does include 162 SASB loans versus 10,905 loans in conduit pools. They find that 48.15% of SASB loans have first-year NOI overstatement of at least 5% relative to 40.44% for conduit loans.[26] Griffin and Priest (2023) note this as an emerging risk in CMBS 2.0 securitizations, the subject of Section 5.

3 Data

3.1 Primary CMBS Data Sources

Our primary data sources are three of the most authoritative sources on CMBS security and loan information: Intex Solutions, Green Street and Trepp. Intex is the leading provider of information on structured finance products, providing data directly from trustees, the third-party financial institutions responsible for enforcing the indenture that governs the securitizations. We rely on Intex to provide our data

[24] According to Green Street, Master and Special Servicers are the same in half of SASB deals, but only 11% in conduit deals, 5% in conduit 2.0 deals (Table A3).

[25] To insure they are correctly reporting incomes, they restrict their sample to single property addresses, which limits their SASB sample.

[26] We thank Alex Priest for doing these computations for us.

on cash distributions for each security, including bond losses.

We supplement our Intex data with information from Green Street, which provides a rich array of CMBS deal and tranche characteristics at origination, including such data as weighted average LTVs and DSCRs; weighted average maturities (WAMs); number of properties and loans; shares of holdings across 10 different industries;[27] names of issuers, borrowers, "B-piece" buyers, master and special servicers; and detailed commentary on each deal. Most important for our return analysis, each deal has pricing at issuance for almost all of the investment-grade bonds.

For our CMBS loan analysis, our primary source is Trepp, which provides a panel of loan-level information on CMBS loans. Data include a full array of borrower, loan, and property characteristics as well as variables that include the amounts and share of the largest loans in each deal and geographic concentrations. They also include additional tables, such as a property table that includes address information on multi-property loans and a "split notes" table that includes information on loans with risk-sharing agreements across various CMBS deals and other investors. Trepp also contains many of the same fields as Green Street and Intex to fill missing values.

From these three sources we merge each deal via a Bloomberg ticker, unique to all datasets, to obtain a comprehensive database for all CMBS deals between 1998 and 2022. We start our sample in 1998, the first year Trepp starts reporting. This is also the time around when the PL CMBS market fully matured into its modern form.[28]

We concentrate our study on conduit and SASB securitizations, which make up 91% of the nearly $2 trillion in total issuance since 1998, 98% since 2010. Figure A4 Panels A and B compare issuance volumes of conduit and SASB deals between 1998 and 2021 from our Intex and Green Street sources to those of the Securities Industry and Financial Markets Association (SIFMA), which collects the data independently.[29] What these comparisons show is that our sample captures a near-census of all conduit and SASB issuance between 1998 and 2021.[30]

Table 3 summarizes our conduit and SASB issuance sample by vintage, providing issuance balances and total and completed bond counts for each vintage. CMBS

[27]These industries include offices, hotels, multifamily, retail, industrial, self-storage, mixed use, healthcare, mobile home, and other.

[28]As noted, the first deal in Green Street classified in the modern "conduit/fusion" form was in 1997. For completeness, we report all pre-1998 PL CMBS deals and balances in Table A1.

[29]SIFMA's sources include Dealogic, Thomson Reuters, and Bloomberg.

[30]Note that there are some years when issuance volumes do not match. This is because of imperfect matching, as there are other types of CMBS that may not be matched perfectly among Intex, Green Street and SIFMA.

conduit issuance grew rapidly from $74 billion in 2004 to $188 billion by 2007. Note that the number of bonds stayed around the same, the deals just got much bigger, growing from an average size of under $1 billion in 2004 to $3.25 billion by 2007. The GFC all but eliminated any deal issuance in 2008 and 2009.[31] The GFC led market participants to delineate CMBS 1.0 and CMBS 2.0 securitizations, which for our study consists of CMBS 1.0 deals issued between 1998-2009 and CMBS 2.0 consisting of deals issued from 2010-2022.

Table 3 also contains counts of completed bonds for conduit and SASB deals fully paid down by December 2022. Since CMBS bonds are rarely traded, we need complete cash flow distributions for each bond to compute returns. Conduit deals typically have a maturity of 10 years, while SASB deals range from two to 10 years, depending upon their structures. Thus, while CMBS 1.0 conduit and SASB deals are almost all completed, a much larger share of SASB bonds are completed for CMBS 2.0 than for conduits. Nonetheless, since we are focused on bond returns, many early-pay and shorter maturity AAA conduit bonds are fully paid off, so they can be included in our bond analysis below.

3.2 CMBS Loss Information

Our primary source for deal loss data for conduit and SASB securitizations is from Intex, supplemented by Trepp. Since Intex has full cash-flow distributions on all PL CMBS bonds in our sample, we have complete loss information for all loans that have matured or been liquidated. For losses on active deals, we use any principal write down recorded up to year-end 2022 in our loss numbers and analysis. For bond returns, we only calculate them for bonds that have fully paid off or been written down. We crosscheck and supplement loss information from Intex with Trepp.

3.3 Supplementary Information

For industry CRE balance information, we use data from the Federal Reserve Flow of Flow of Funds and Intex for PL CMBS securitizations. Information on Agency and Nonagency Multifamily CMBS in Table A1 is sourced from *Inside Mortgage Finance*.

To construct our benchmark return indexes for CMBS floating-rate debt tranches, we use daily bond-level quote data from Bank of American Merrill Lynch and interest rate swap data from Bloomberg. To benchmark our fixed-rate CMBS, we use the

[31] Only 13 deals totaling $14 billion were completed in all of 2008-09; no conduit deals were issued between July of 2008 and May of 2010.

Intercontinental Exchange (ICE) nonfinancial corporate bond indices. Discussion of our valuation methodology is described in Section A1.

We also use three commercial property price indices for our regression equation and correlation analysis. We source these indices from Green Street, Real Capital Analytics (RCA), and Coldwell Banker Richard Ellis (CBRE) Corporation. Green Street provides a national CRE price index, which is our primary measure used in our regression equations; the others we use to test for robustness. Section 5.1 examines correlations in the CBRE and RCA property type indices for different time periods. A detailed discussion of these indexes is found in Section A3.

4 CMBS Performance

4.1 Bond Returns

In this section we evaluate CMBS bond performance by computing internal rates of return (IRRs) on CMBS bonds and their Public Market Equivalents (PMEs) to comparably rated and maturity matched corporate bonds, using swaps to synthetically adjust corporate bond returns for comparisons with floating-rate SASB deals.

We gather from Green Street issuance/purchase prices of CMBS bonds. Only investment-grade bonds can be included for analysis, as the IOs and noninvestment-grade credit classes are generally either held by the issuers or privately placed, and thus there is no issuance/purchase price recorded. Table 4 presents summary statistics of the purchase prices. AAA CMBS bonds were usually purchased near par, but BBB CMBS bonds could be purchased with significant discounts.

We also gather from Intex a panel of all cash distributions for CMBS bonds. Since we do not have traded prices of bonds that have not been paid off or liquidated, we require full distributions for each CMBS bonds in our sample.

Table 5 presents IRR calculations for all completed CMBS conduit and SASB bonds. Completed bonds are either fully paid off or liquidated with losses suffered. Panel A presents results for all fixed-rate conduit and SASB bonds segmented by ratings for CMBS 1.0 and 2.0 eras, while Panel B reports results for floating-rate SASB bonds. There are generally no floating-rate conduit bonds.[32]

Since higher ratings imply lower risk, returns should show an inverse monotonic pattern by credit rating, reflecting compensation for increasing amounts of credit risk

[32]There were 54 floating-rate CMBS 1.0 conduit bonds and seven for CMBS 2.0, but these were constructed from swaps like bond A-2FL in Table 1, so we do not include them in our analysis.

for lower rated bonds. What stands out in Panel A is the opposite sequence for CMBS 1.0 conduit bond returns, driven by large losses suffered by subordinated bonds in conduit deals during the GFC, discussed below. The other three cohorts show this inverse relationship between ratings and returns, including the CMBS 1.0 fixed-rate SASB deals, which have the highest IRRs of any cohort.

In Panel B, we show IRRs for floating-rate SASB bonds. These follow the expected pattern, reflecting the low credit losses in SASB deals. But SASB bonds show lower IRRs than their fixed-rate counterparts, owing to compensation for rate and prepayment risk and longer maturities of fixed-rate bonds.

In Table 6 we present PMEs in the same format as IRRs in Table 5. We benchmark CMBS fixed-rate bonds against similarly rated and maturity matched corporate bond indexes from ICE. Floating-rate SASB bonds have an effective maturity of less than one year. To devise a benchmark, we construct synthetic floating-rate corporate bond returns by swapping the fixed coupon payments into floating payments using interest-rate swaps in the manner done for CLO returns in Cordell, Roberts, and Schwert (2023). See Section A1 for a detailed description of our methodology.

Results for PMEs follow the patterns observed for IRRs. CMBS 1.0 conduit returns are statistically significantly below their corporate bond benchmarks for every rating category, reflecting the poor relative performance of bonds backed by CRE properties relative to the broader corporate bond market. BBB-bond returns are 29% below their benchmarks, reflecting the full impact of the GFC on the most credit sensitive investment-grade part of CMBS. A rated bonds had returns 20% lower, AA rated bonds 15% lower, and AAA bonds 2% lower. Alternatively, fixed-rate SASB 1.0 bonds performed comparably to corporate bonds, with slight underperformance of AAA bonds and over-performance of the mezzanine classes ranging from 2% to 7%.

For CMBS 2.0 conduit returns, AAA rated bonds also underperformed their corporate bond counterparts, but mezzanine bonds significantly outperformed. Returns were 8% higher for the AA bonds, 15% higher for A rated bonds, and 13% higher for BBB bonds. Note that A and BBB conduit bonds were purchased with significant discounts, as we show in Table 4, which could reflect under-pricing of those bonds due to the stigma effect from CMBS 1.0. Note also that conduit mezzanine bonds have only 16-26 observations between them, as only the small number of deals originated before 2013 have paid down. SASB 2.0 securitizations have more with maturities under 10 years and more observations. Their fixed-rate bonds underperformed corporate bonds for the AAA and AA rated bonds and were comparable for the A and BBB rated bonds.

Table 6 Panel B reports PMEs for floating-rate SASB deals. We compare floating-rate SASB bond PMEs to floating-rate corporate bond returns by swapping their fixed-rate cash flows using the maturity matched swap rate at issuance, as described above. SASB bond returns are comparable to corporates, with over-performance of 4% for SASB 1.0 bonds, 1% to 2% for mezzanine SASB 2.0 bonds.

This completes our overall assessment of CMBS 1.0 and 2.0 bond returns. One additional feature of bond returns that stands out is that AAA bonds underperformed their corporate bond benchmarks in all six cohorts. One reason is that CMBS bonds are call protected, while Becker et al. (2022) show that about one-fifth of investment-grade corporate bonds have call features, potentially increasing their value. The call protection appears to be especially appealing to regulated insurance companies, who desire predictable long-term cash flows. Table A2 shows that in 2021 insurers held 34% of all PL CMBS bonds. Life insurers held a quarter of the market, mostly AAA.

A more relevant comparison of CMBS AAA bond performance comes from comparing them with AAA asset-backed securities (ABS) bonds because other ABS are closer substitute than corporate bonds. For this, we report PMEs versus the Bloomberg US ABS Floating Rate Total Return Index along with the auto, credit card, home equity and student loan components of the index. Since these are floating rate, the only comparison we do is with the floating-rate SASB AAA bonds. Since the index returns are available beginning in May 2005, we exclude CMBS issued before 2005 from the sample. Results in Table 7 show that SASB AAA CMBS bond returns consistently outperformed the Total Return Index and most of its ABS components. SASBs outperformed auto and home equity in both CMBS 1.0 and 2.0 subperiods and credit cards in the CMBS 2.0 subperiod. Returns were comparable for student loan AAA ABS in both periods.

4.2 CMBS Deal Losses

CMBS bond cash returns depend upon the performance of loans in the CMBS pools. Therefore, to better understand the returns in the prior section, in this section we examine the risk profiles of loans in the CMBS pools and the determinants of losses in the CMBS structures that drive returns.

Results for losses by conduit and SASB deals divided between CMBS 1.0 and 2.0 rating eras are reported in Table 8. What these results show is that 99% of the $66.3

billion of CMBS losses to date are from conduit deals, with 95%, or $62.9 billion (7.8% by issuance volume), concentrated in CMBS 1.0. At the bottom of Table 8 we show that nearly three-quarters of all losses are concentrated in 2005-2007 vintages. The preponderance of CMBS 2.0 losses is also concentrated in conduit deals, another $2.8 billion of life-to-date losses.

It is noteworthy that SASB 1.0 deals experienced only a 1% loss rate following the GFC. Losses in conduit deals were almost eight times higher. During the CMBS 2.0 era, when underwriting of conduit deals was much more conservative, conduit life-to-date deal losses of $2.7 billion are still substantially above the $0.1 billion of SASB losses.

Comparing some of the main observable risk characteristics of the four CMBS 1.0 and 2.0 Conduit and SASB deal cohorts, several features stand out in Table 9. First, CMBS 1.0 conduit deals are by far the riskiest cohort, averaging significantly higher weighted average LTVs (69%), significantly lower weighted average DSCRs (1.5), and, as we saw from Table 8, dominate all cohorts in terms of losses, averaging $227 million per deal. As a measure of complexity cited in the literature (Furfine (2014)), the number of tranches in each deal averaged 24.[33] Average deal size was also by far the largest of any cohort at $1.7 billon. CMBS 1.0 conduit deals also averaged the largest number of loans (189) and properties (250) of any cohort. As for diversification, the popular Herfindahl-Hirschman Index $HHI_{j,t} = \sum_{i=1}^{n} s_i^2$ is computed where s_i is the share of loans in industry i in deal j at issuance year t scaled to 100. The HHI is 26.7 for conduit 1.0 deals.

Second, the SASB CMBS 1.0 cohort is significantly less risky than its conduit counterpart across most observable risk characteristics, due in part to how concentrated deals were. Differences in means between SASB and conduits are reported in the second-to-last column of Table 9. All differences are statistically significant, most at the 1% level. For the SASB 1.0 cohort, weighted average LTVs were the lowest of any cohort at 53%, with DSCRs averaging 2.4, 60% higher than its conduit 1.0 counterpart. As we saw from Table 2, SASB deal structures are far simpler, averaging 11 tranches per deal. SASB 1.0 deals were also much smaller, averaging $566 million, $1.1 billion smaller than conduit 1.0 deals. Most were only a single loan, with a smaller number of properties (mean 136 with a median of 28). Another big difference is their market concentration, with a HHI of 98, meaning almost all the deals

[33]Number of tranches is one of six variables Ghent, Torous, and Valkanov (2019) use to construct their complexity measure for PL MBS. They find securities in more complex deals default more and have lower realized returns.

were concentrated in a single industry. Despite this lack of diversification, SASB deal losses averaged only $18 million per deal (100 bps), which industry sources attribute to investments in select so-called "trophy" properties that largely survived the GFC.

Massive losses suffered by conduit 1.0 deals significantly changed their risk profiles in CMBS 2.0 deals across almost every major risk dimension. Differences in means are summarized in the last column of Table 9. As shown, average conduit deal size dropped by 70% to almost $1 billion. The average number of loans declined to 59 and number of properties to 111. Weighted average LTVs declined by 8 percentage points to 60%, while DSCRs rose by 40% to 2.1. Conduit deals also became less complex, with the average number of tranches dropping to 18. Conduit deals also became more diversified with the HHI dropping to 24. Counter to these risk trends, the share of IO loans increased by 15 percentage points to 71%.

As SASB structures became more standard, SASB 2.0 deals went out on the risk spectrum, with deal sizes increasing to $602 million and LTVs increasing to 60%, now insignificantly different from conduit 2.0 deals. And they are almost all exclusively interest only (IO), a 33 percentage point increase over 1.0 deals. Reflecting the growth of short-term floating-rate SASB deals, WAMs declined significantly, from 72 months to 62 months, with a median WAM of 24 months. SASB deals also became more concentrated, with the number of properties in the average deal declining by 74 to 62, with the median number of properties declining from 28 to 10.

4.3 Risk Drivers

Analyzing determinants of losses in CMBS 1.0 loans and securities has dominated academic research on PL CMBS performance.[34] What has not been studied is the determinants of CMBS deal performance inclusive of SASBs. In this section we conduct multivariate analysis to analyze differences in deal losses between CMBS 1.0 conduit and SASB securitizations. Due to right censoring of active CMBS 2.0 deals, we are unable to conduct this analysis on CMBS 2.0 deals, so we will use our regression results to inform us about the performance of these deals as they reach maturity in the current market.

We consider three broad categories of factors. First, as discussed in the prior section, SASB loans have significantly less risky characteristics in CMBS 1.0 deals. Therefore, stricter underwriting could have contributed to the loss disparity. Second,

[34] See An et al. (2014), Black, Krainer, and Nichols (2020), Wong (2018), and Ashcraft, Gooriah, and Kermani (2019).

the regional CRE market differences exposed conduit and SASB deals to different risks. Third, the structures of SASB deals, e.g., the number of loans, the number of underlying properties, and the number of deal tranches, are significantly different from those of conduit deals. The complexity of deal structures could affect both screening and loan workouts, contributing further to loss differences.

To study how these factors impact losses, we estimate deal-level loss regressions with our combined sample of SASB and conduit 1.0 deals. These data include information on deal losses, deal terms, and information on the underlying loans and properties. We use the total principal loss percentage as our dependent variable. We control for industry type by using the percentage of each deal that is retail, hotel, office, etc. We also use the Green Street National Commercial Property Price Index (CPPI) to capture property value appreciation or depreciation. CBRE provides a vacancy rate index to determine change in vacancy from deal start. For time varying parameters, we measure at deal start and at the last distribution date in the sample to determine changes. Other variables are taken at origination. Our sample includes over 400 CMBS 1.0 Deals.

To study losses, we employ the following loss model:

$$log(IntexPrincipalLossPct) = \alpha + \beta * SASB + \gamma * X_i + \epsilon$$

where $SASB$ is a primary variable of interest and an indicator for Section 5 deals, X is a vector of controls for losses, and ϵ is the error term. Our model includes controls for deal DSCR, LTV, number of properties, number of tranches, and WAM. We then add controls for the change in Green Street National CPPI, and the change in market vacancy from deal origination.

Table 10 presents our regression results. We focus on CMBS 1.0 deals since these deals have mostly all paid down. Large shares of CMBS 2.0 deals have not paid off, making them subject to right censoring. We will use information from our CMBS 1.0 regression results to inform us of risk in active CMBS 2.0 securities. The first column of Table 10 shows the raw difference in deal losses as a percentage of deal principal balance at the time of deal issuance. Consistent with our prior discussion, SASB deals incurred almost 5 percentage point lower losses. In Column 2 of the table, we add underwriting variables such as original average LTVs and DSCRs. As we can see, higher LTVs are associated with higher deal losses, while higher DSCRs are associated with lower deal losses, consistent with existing literature. LTV and DSCR explain a big part of loss differences between SASB and conduit deals.

In column 3 of Table 10, we add variables related to deal structure such as number of underlying properties, number of tranches, and the weighted average maturity of the deal. We do find the number of properties and the number of tranches to be positively associated with deal losses.[35] They also help explain much of the deal loss differences between conduit and SASB deals, as the SASB dummy is no longer significant.

In columns 4 and 5, we add a measure of the CRE market environment each deal is exposed to. Column 4 adds a control for property price appreciation/depreciation using the Green Street National CPPI. Since conduit deals are often diverse in geography and property type, the national index was preferred; however, we also tested using RCA and CBRE property-type indices. (Section 5.1 presents a discussion of these indices and correlations among property types.) In column 5, we measure vacancy change as the change in a market vacancy index provided by CBRE. CBRE provides MSA and national measures of market vacancy. We assign the MSA vacancy to deals concentrated in one MSA and the national index to all others. We find fewer losses as property values appreciate and more losses as vacancy rates rise. The SASB indicator remains insignificant.

Note that this simple model explains a large portion of the variation in CMBS deal losses, as evidenced by the R-Squared in our regressions. More importantly, the stark difference between conduit and SASB deal losses are explained by the risk factors and controls in our model. As discussed previously, in the CMBS 1.0 era, SASB deals have more conservative underwriting. These underwriting factors combined with the national index of CRE prices and vacancy rates explain more than half of the deal loss differences between SASB and conduit deals.[36] In sum, stricter underwriting contributed significantly to SASBs' superior performance in CMBS 1.0. We will discuss how relaxation of underwriting standards in SASB 2.0 increases their emerging risks in the next section.

It is also noteworthy that property type and geographic diversification did not really save conduit 1.0 deals from the CRE market meltdown. From another perspective, SASB deals did not suffer more than conduit deals despite SASBs' lack of diversification across property type and geography. In Table A4, Panel A, we show

[35] Note that SASBs can, and do, have numerous properties associated with the loan, or group of loans. What determines it as "single asset" is that this group of properties operate as a single credit.

[36] We also tested a large number of other variables, such as the prevalence of Master and Special Servicers being the same, which Ambrose, Sanders, and Yavas (2016) found a significant driver of performance. It may be that the SASB indicator picked this effect up.

that the price indices of different property types were almost perfectly correlated in the CMBS 1.0 era, which explains the lack of diversification benefit mentioned above. However, in recent years, the correlations of different property types have declined significantly or even turned negative, as we show in Table A4, Panel B. This change will have important implications for the relative performance of SASB and conduit CMBS going forward, which we discuss next.

5 Emerging Risks

Through the end of 2022, SASB CMBS has shown stable bond returns and exceptionally low losses relative to conduits. Yet the modern SASB securitization emerged post-GFC, a period characterized by historically low interest rates and stable, then rapidly rising, CRE prices. SASB structures have yet to be tested under the rising interest rate and declining CRE price conditions prevailing today. As shown in Figure 6, the first signs of risk in CMBS 2.0 are emerging in rating agency downgrades. Some $3.8 billion of SASB AAA bonds have been downgraded since 2020 versus $1 billion for AAA conduits, even though conduit balances were a third higher at year-end 2022.

In this section we examine emerging risks in the current CRE market, of which SASB structures are especially prone. First, we examine property concentration risks. Then we examine systemic risk by analyzing the increased use of "split" CRE loans across multiple CMBS deals. Next, unique to SASB securitizations, we examine the effects of subordinated mezzanine loans on LTVs and DSCRs. Next, for those floating-rate SASB deals reaching initial and interim maturities, we discuss implications of the requirement that they purchase increasingly expensive interest rate caps on their debts. Finally, we examine shares of CMBS hitting their "maturity walls."

5.1 Property Concentrations

As shown by the HHIs in Table 9, while property type concentrations have declined in conduit 2.0 deals, SASB deals remain almost exclusively single industry. What is more, CRE Finance Council (2022) notes the tendency for the SASB market to make large inter-temporal industry bets, most notably large regional malls in the early 2000s. As shown in Figure 3, retail properties made up 45% of SASB securitizations between 2012-2013 with many hitting final maturity in the present high interest rate environment. Of the 17 10-year fixed-rate SASB retail deals still active, 11 have faced downgrades, eight with downgrades of the AAA bonds. Office properties comprised over a third of SASB deals between 2016 and 2021, many short-term floating rate. Of the 58 active SASB deals issued, 13 have been downgraded, five with AAA downgrades.

While industry diversification did not benefit CMBS 1.0 conduit deals, property diversification may be important in the current CRE market.[37] In Table A4 we compute correlations across industry sectors with two different commercial property price indices, displaying results during two three-year market downturns, the first following the GFC in 2008-2010 and the second the most recent three-year period that roughly coincides with the onset of the pandemic in Q3 2020 through Q2 2023, five quarters into the Federal Reserve's latest rate-hiking cycle. We show an almost perfect correlation among industry sectors in 2008-2010, but much more variation in correlations in the current downturn. A more detailed discussion of these indices is in Section A3.

5.2 Systemic Risk

We have highlighted the efficiency of SASBs for financing large CRE loans. Another way large CRE loans are financed is through "split notes" in risk-sharing agreements, where large loans are split among different CMBS deals, both conduit and SASB, with risks generally spread pari passu among particular classes of notes.[38] As shown in Figure 7, use of split notes was limited in CMBS 1.0 but has become widespread in CMBS 2.0 deals, especially among conduits. By 2016, over 40% of loans in conduit pools were split across different deals. Even SASB deals, as large as the loans were, frequently split their loans among pools of other SASB and conduit deals. A particularly extreme example loan is displayed in Figure A6, where a $3 billion loan to two Las Vegas casinos is split into four classes of securities across 21 deals, five SASB and 16 conduits.

A challenge in assessing the risks in deals with large balances of split notes is that the LTVs and DSCRs are reported for the particular class of notes being split, potentially understating risks. So for our casino loan, the 18 conduit A Notes get reported with LTVs of 35.5%, far below the 65% total LTV of the deal. Our understanding

[37]Studies of diversification benefits to REITs is also mixed. Benefield, Anderson, and Zumpano (2008) study diversified and specialized REITs, and their results indicate some benefit to diversification; however, this benefit is primarily when markets are performing well. Ro and Ziobrowski (2011) finds no performance benefits for specialized REITs and that specialized REITs have greater market risks.

[38]These have become so prevalent that Trepp has designed a separate "Split Notes" table that contains information on them, which we use here.

from examining deal documents of loans split among SASB and conduit deals, DSCRs are also reported at the note level, not the total loan level, which means that some large loans in conduit pools have overstated DSCRs.

The widespread use of split notes in SASB deals raises potential systemic risk in PL CMBS. What also makes it concerning is that rating agency practice is to evaluate risk at the individual deal level, implicitly assuming deals are independent of each other in terms of their risks, potentially ignoring systemic risks in ratings.

5.3 Hidden Mezzanine Junior Liens in SASB Securitizations

Another source of risk we identified in SASB deals is the inclusion of a mezzanine loan, or group of loans, junior to the CMBS deal, that are separate loans secured by the borrower owning the property, not by the CRE loan itself. As such, they do not appear in property records on the CRE loans in the deals, nor are they figured into deal financials.[39]

To investigate the prevalence of mezzanine loans in SASB deals, we took the 434 SASB deals active at year-end 2022 and searched the Green Street narrative deal descriptions for the word "mezzanine," which yielded 134 deals with mezzanine loans supporting them, around a third of all deals.[40] In all three of our data sources, LTVs and DSCRs are reported only for the SASB deal, not taking into account the mezzanine loan. For conduit A Note holders, LTVs and DSCRs of the A Notes get averaged into conduit deals at the Note level, not at the total LTV or total debt coverage levels.

Figure A7 presents the debt structure of a representative deal. Absent the mezzanine loan, the LTV is 66% and the DSCR is 1.69; when including it, the LTV increases to 84% and the DSCR decreases to 1.15, resulting in a much riskier loan. For the two A Notes in the conduit deals, the LTV of 29.7% and DSCR of 3.85 are what get averaged into the two conduit deals when reporting their deal weighted average LTVs and DSCRs. To analyze the impact of this, we computed the reported deal weighted average LTVs and the *total* combined LTVs of the 134 deals with mezzanine debt. Total LTVs were 71%, 13 percentage points higher than the reported weighted aver-

[39]See CRE Finance Council (2022) and "The Clearest Sign Yet That Commercial Real Estate Is in Trouble," *Wall Street Journal*, November 13, 2023.

[40]Green Street provides detailed commentary for most deals, inclusive of mention of the mezzanine loan term, rates and spreads for SASB deals. We confirmed our numbers with our industry sources. Green Street does not provide such detail for the large pool of loans in conduit deals, so we limit our analysis to SASB deals.

age deal LTVs of 58%. We did not have DSCR data including the mezzanine loans to do a similar exercise on DSCRs. For the conduit deals, it would be very difficult to "look back" on a large split note in the conduit deal to recompute weighted average LTVs and DSCRs for deals with large numbers of split notes from SASB deals with mezzanine loans in them. These are largely hidden to investors, or perhaps even to rating agencies rating the deals.[41]

While the mezzanine class provides credit protection for the SASB deal, default risk should be more consistent with the total LTV. More important are the DSCRs, as all debt needs to get paid for the deal to stay performing. Therefore, these mezzanine loans, largely hidden for investors, increase debt service burdens of borrowers, potentially increasing credit risk and extension risk if the SASB loan cannot be refinanced. These mezzanine loans also affect interest rate cap requirements on floating-rate deals, discussed next.

5.4 Costly Interest Rate Cap Costs

SASB floating-rate deals require borrowers to purchase interest rate caps to hedge rate risk. But caps are purchased only for the *initial* two- or three-year term of the deals. If borrowers choose to extend loan terms for another two or three years, they are typically required to purchase a new interest rate cap for the maturity of each extension, generally one year.[42] Prior to the Federal Reserve rate-hiking cycle, cap costs were de minimis at just a few basis points but they now are far higher. Industry publications recently priced the cost for the outstanding SASB deals and claimed the cheapest one-year cap at existing rates of 101 bps, far higher for riskier deals.[43]

The pricing of interest-rate caps are more nuanced, as they are determined by a deal's NOI, DSCR, original strike rate, and target strike rate in the event they exercise their option to extend. SASB deals with high NOIs and DSCRs can have very low cap costs, while those with low NOIs and DSCRs can have very high cap costs. Our methodology for valuing interest rate caps is described in Section A2.

[41] The desire to market "low-leverage pools" was clearly stated in an industry article. "And it works because the reality is that a lot of people on the buy side tend to focus on the weighted average statistics." See "Conduit Issuers Split Loans Into More Pieces," *Commercial Mortgage Alert*, December 1, 2017.

[42] Pooling and servicing agreements (PSAs) do have performance criteria before extension options can be exercised and require interest rate caps through the life of the deals. How these are handled are issues special servicers must confront.

[43] See JPMorgan *CMBS Weekly*, October 14, 2022 and *Securitized Products Weekly*, April 14, 2023.

In Figure 8, we provide two representative active floating-rate SASB deals and compute their cap costs as if they were extending on June 2023, one deal with high DSCRs and the other low. In the case of the high DSCR loan, annual NOIs are substantial relative to the annual debt service costs, requiring little in the way of additional hedging income to meet a 1.1 DSCR minimum target, so the cap strike rate is a high 8.94% using the "Interest Rate Cap Pricer" from Pensford.[44] The cost of interest rate cap is 13 bps annually, just over 1% of NOI.

The low DSCR loan does not cover its debt service, so the cap strike rate is a very low 1.99%, which suggests they need substantial income to cover their debt service. Pooling & Servicing rules set a maximum of the computed Cap Strike Rate or the original cap rate, in this case a 3% rate, which is the cap rate used. The new cap costs are 234 bps, or 35% of total income, making this interest rate cap unaffordable.

As rates rise and debt service increases, NOIs of floating-rate SASB deals will come under stress, increasing interest rate cap costs. This is another area that needs further study.

5.5 The Maturity Wall

As CMBS deals reach maturity, they need to be refinanced, hitting what is called the "maturity wall." In the current market, where interest rates are far higher than rates on maturing loans, refinancing that debt may require borrowers to put up larger down payments or negotiate for extensions. This risk is especially high for SASB deals, as almost all are IO, but also for conduits as over 70% are IO.

To analyze these risks, we report in Table 11 the years all active CMBS deals reach final maturity and SASB deals reach initial maturities. Of special note are deals hitting their maturity walls sooner. Just over 20% of conduit and SASB deals reach that point in 2023-24. Conduit deals are more evenly distributed thereafter, while SASB deals are concentrated in 2026-27, as $133 billion (51%) of SASB deals reach final maturity in those years, reflecting high issuance volumes in 2021-22.

Unique to floating-rate SASB deals, $111 billion will reach their initial two- or three-year terms in 2023-24. Options to extend an additional two or three years are not automatic. An inspection of PSAs shows that it is common for certain conditions to be met to extend the deal, including no event of default, a replacement interest rate cap agreement is in place, borrowers have satisfied minimum capital expenditure

[44]Pensford provides their model free of charge. JPMorgan used their model for their own computations. See JPMorgan *Securitized Products Weekly*, April 14, 2023.

investments, and any mezzanine loans are paid off or extended similarly. As discussed above, meeting interest rate cap agreements can be problematic, meaning extensions will require approvals of special servicers. In cases where cap costs are punitive, additional concessions are required of borrowers from special servicers. For intermediate extensions where interest rate caps are not purchased, industry sources tell us special servicers have been requesting an additional 12 months of reserves be posted before granting extensions.

6 Conclusions and Discussion

This study provides the first large sample empirical study of the evolution of the modern private label CMBS market from its pre-GFC dominance of long-term, fixed-rate broadly diversified conduit securitizations to one dominated in 2021-22 by undiversified SASB securitizations, providing new insights into that evolution and the emerging risks. We show that massive losses suffered by conduit securitizations following the GFC have absorbed 95% of all PL CMBS losses suffered to date, resulting in a collapse in issuance of PL CMBS between 2008-09. Returns relative to comparably rated and maturity matched corporates generated returns ranging from 2% to 29% below corporates. Multivariate analysis confirms the riskiness of conduit loans as primary determinants of these losses.

What reemerged post-GFC were smaller and less risky conduit securitizations, and maintaining their broadly diversified industry and geographic forms. In contrast, as post-GFC SASB issuance grew and became more standardized, SASBs became larger, more highly leveraged, and riskier along most risk dimensions. Industry sources cite SASBs' flexible financing terms, faster execution and limited financing options for large CRE loans as key reasons for their growth. We confirm these findings and also show that SASBs' strong, stable PMEs and exceptionally low losses are also reasons for their growth. Pandemic era dislocations resulted in much less issuance of long-term CMBS. Rather, the market shifted over to short-term floating-rate SASB structures, which represented almost two-thirds of all PL CMBS in 2021-22.

However, rising interest rates, declining CRE property prices and recent rating agency downgrades show that factors contributing to SASBs' strong performance have weakened significantly in recent years, exposing them to emerging risks. We show that intertemporal sector bets in retail in the early 2010s and office properties in 2016-21 have resulted in significant downgrades of SASB bonds, clear up to AAA.

We also find that around a third of SASB deals include one or more subordinated mezzanine loans and show these deals are much more highly leveraged with higher debt servicing costs, adding potentially hidden risks to investors looking only at deal-level information. Required interest rate caps on floating-rate SASB deals impose additional risks, since interest rate caps are secured only for the initial term of the deals. Rate rises during the Federal Reserve's rate-hiking cycle have made these caps unaffordable for some SASBs and raises refinancing risks as they reach final maturity.

Due to uncertainties around future interest rates and CRE prices, our research raises many questions. How large will SASB losses from these emerging risks grow? How much will a less highly correlated CRE market relative to 2008-10 help conduit deal performance and hurt SASB performance? And what changes will a market with higher interest rates bring to PL CMBS? Answers to these questions will have profound implications for the future of CRE securitization and CRE lending.

References

Ambrose, Brent W, Anthony B Sanders, and Abdullah Yavas. 2016. "Servicers and mortgage-backed securities default: Theory and evidence." *Real Estate Economics* 44 (2):462–489.

An, Xudong, Larry Cordell, and Joseph B Nichols. 2020. "Reputation, information, and herding in credit ratings: Evidence from CMBS." *The Journal of Real Estate Finance and Economics* 61:476–504.

An, Xudong, Yongheng Deng, and Stuart A Gabriel. 2011. "Asymmetric information, adverse selection, and the pricing of CMBS." *Journal of Financial Economics* 100 (2):304–325.

An, Xudong, Yongheng Deng, Joseph Nichols, and Anthony Sanders. 2014. "What is subordination about? Credit risk and subordination levels in commercial mortgage-backed securities (CMBS)." *The Journal of Real Estate Finance and Economics* 51:231–253.

An, Xudong and Kerry Vandell. 2014. "Commercial mortgages and commercial mortgage-backed securities." In *Public Real Estate Markets and Investments*, edited by H Kent Baker and Peter Chinloy, chap. Commercial Mortgages and Commercial Mortgage-Backed Securities. Oxford University Press, 157–177.

Ashcraft, Adam B, Kunal Gooriah, and Amir Kermani. 2019. "Does skin-in-the-game affect security performance?" *Journal of Financial Economics* 134 (2):333–354.

Becker, Bo, Murillo Campello, Viktor Thell, and Dong Yan. 2022. "Credit risk, debt overhang, and the life cycle of callable bonds." *Swedish House of Finance Research Paper* (18-16).

Benefield, Justin, Randy Anderson, and Leonard Zumpano. 2008. "Performance differences in property-type diversified versus specialized real estate investment trusts (REITs)." *Review of Financial Economics* 18 (2):70–79.

Black, Lamont K., Chenghuan S. Chu, Andrew Cohen, and Joseph B. Nichols. 2012. "Differences across originators in CMBS loan underwriting." *Journal of Financial Services Research* 42:115–134.

Black, Lamont K, John R Krainer, and Joseph B Nichols. 2020. "Safe collateral, arm's-length credit: Evidence from the commercial real estate market." *The Review of Financial Studies* 33 (11):5173–5211.

Cordell, Larry, Michael R. Roberts, and Michael Schwert. 2023. "CLO performance." *The Journal of Finance* 78 (3):1235–1278.

CRE Finance Council. 2022. "CMBS E-Primer 2022 Edition." https://www.pathlms.com/crefc/courses/36508.

Frame, W Scott and Lawrence J White. 2007. "Charter value, risk-taking incentives, and emerging competition for Fannie Mae and Freddie Mac." *Journal of Money, Credit and Banking* 39 (1):83–103.

Furfine, Craig. 2014. "Complexity and loan performance: Evidence from the securitization of commercial mortgages." *The Review of Corporate Finance Studies* 2 (2):154–187.

Geltner, David M., Norm G. Miller, Jim Clayton, and Piet Eichholtz. 2014. *Commercial Real Estate Analysis and Investments*. Mbition LLC, 3rd ed.

Ghent, Andra and Rossen Valkanov. 2016. "Comparing securitized and balance sheet loans: Size matters." *Management Science* 62 (10):2784–2803.

Ghent, Andra C, Walter N Torous, and Rossen I Valkanov. 2019. "Complexity in structured finance." *The Review of Economic Studies* 86 (2):694–722.

Glancy, David, John R Krainer, Robert J Kurtzman, and Joseph B Nichols. 2022. "Intermediary segmentation in the commercial real estate market." *Journal of Money, Credit and Banking* 54 (7):2029–2080.

Glancy, David, Robert J Kurtzman, and Lara Loewenstein. 2022. "Loan modifications and the commercial real estate market." *Board of Governors of the Federal Reserve System FEDS Working Paper* .

Griffin, John M and Alex Priest. 2023. "Is COVID Revealing a Virus in CMBS 2.0?" *The Journal of Finance* 78 (4):2233–2276.

Gupta, Arpit, Vrinda Mittal, and Stijn Van Nieuwerburgh. 2022. "Work from home and the office real estate apocalypse." *NBER working paper* .

Levitin, Adam and Susan Wachter. 2013. "The commercial real estate bubble." *Harvard Business Law Review* 3:83–118.

Riddiough, Timothy J. 1997. "Optimal design and governance of asset-backed securities." *Journal of Financial Intermediation* 6 (2):121–152.

Ro, SeungHan and Alan Ziobrowski. 2011. "Does Focus Really Matter? Specialized vs. Diversified REITs." *The Journal of Real Estate Finance and Economics* 42:68–83.

Sanders, Anthony B. 2005. "Commercial Mortgage Backed Securities." In *Handbook of Fixed Income Securities*, edited by Frank Fabozzi, chap. Commercial Mortgage-Backed Securities. Irwin Professional Pub., 7th ed., 615–628.

Stanton, Richard and Nancy Wallace. 2018. "CMBS subordination, ratings inflation, and regulatory-capital arbitrage." *Financial Management* 47 (1):175–201.

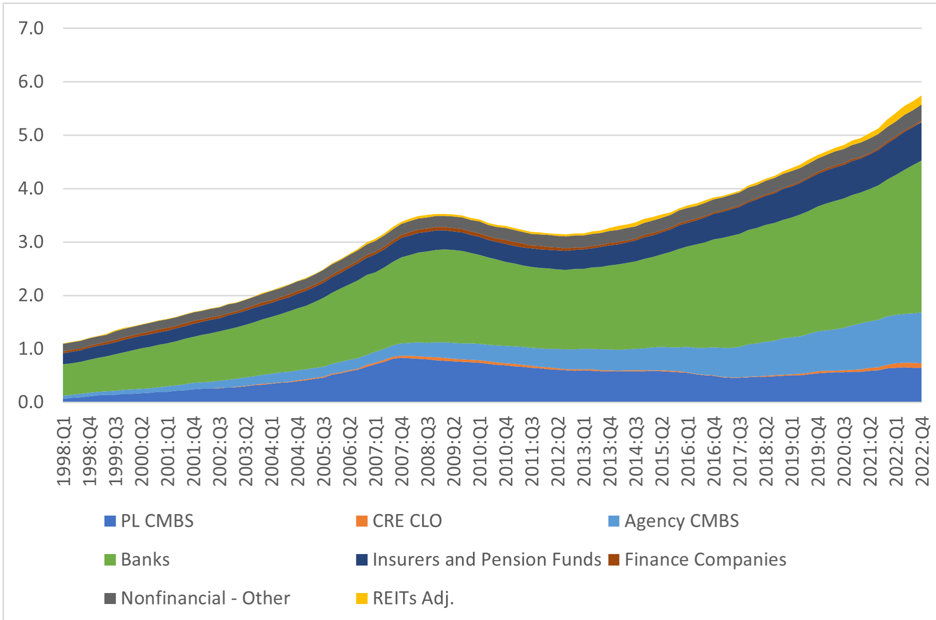
Tarwasokono, Pearry. 2008. "Be prepared: A primer on conduit CMBS and derivatives." Bank of America.

Titman, Sheridan and Sergey Tsyplakov. 2010. "Originator performance, CMBS structures, and the risk of commercial mortgages." *The Review of Financial Studies* 23 (9):3558–3594.

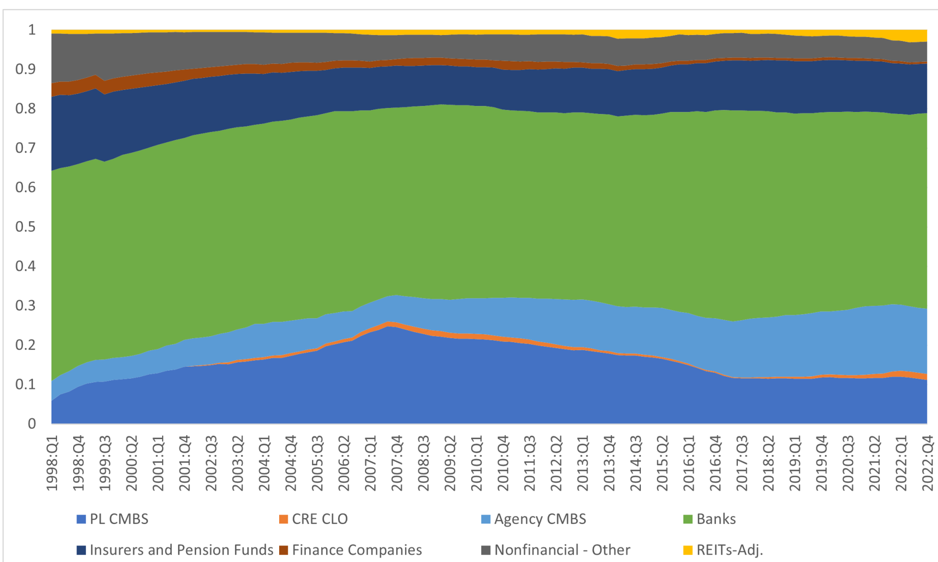
Wong, Maisy. 2018. "CMBS and conflicts of interest: Evidence from ownership changes for servicers." *Journal of Finance* 73 (5):2425–2458.

Figure 1. CRE Market by Lender 1998-2022

(a) CRE Total Dollars by Lender ($ Trillions)



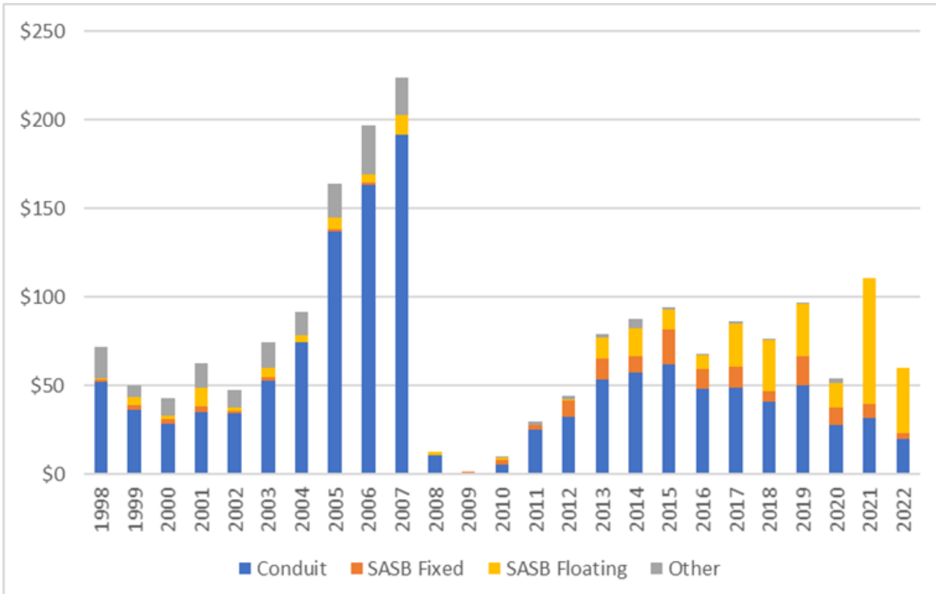
(b) CRE Market Shares by Lender Type



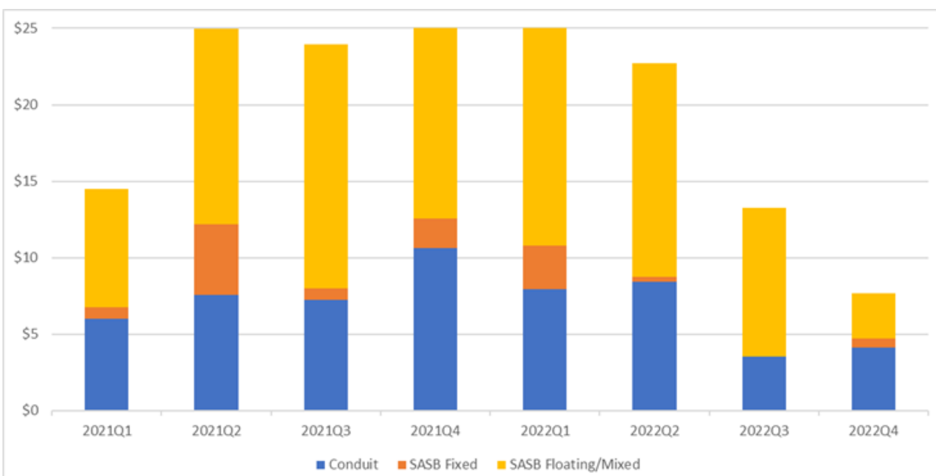
Notes: These figures plot the growth of the commercial real estate (CRE) market by total dollars and market shares of major lenders from 1998 to 2022.
Sources: Federal Reserve Schedule Z.1, FR Y-9C Bank Holding Company call reports and Intex for PL CMBS and CRE CLOs

Figure 2. Total Private Label CMBS Issuance by Vintage

(a) 1998-2022



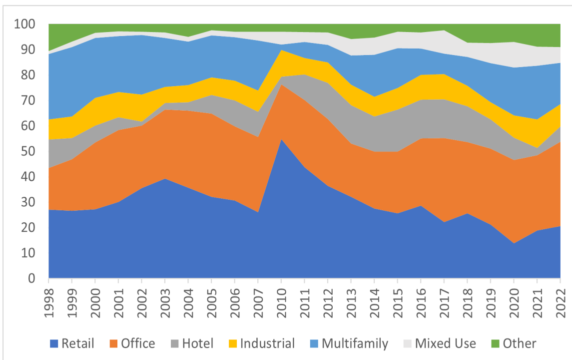
(b) 2021-2022



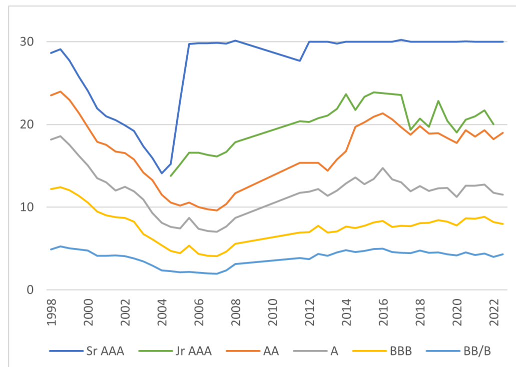
Notes. These figures present total issuance volumes of private label CMBS by vintage and by major CMBS deal type: conduit, single-asset, single-borrower (SASB), and Other. Other includes a small amount of large loan and floating rate, multiple borrower CMBS. Small numbers of SASB mixed rate deals are included as floating.
Source: Green Street

Figure 3. Collateral Composition and Debt Subordination Levels of Conduit and SASB CMBS Securitizations

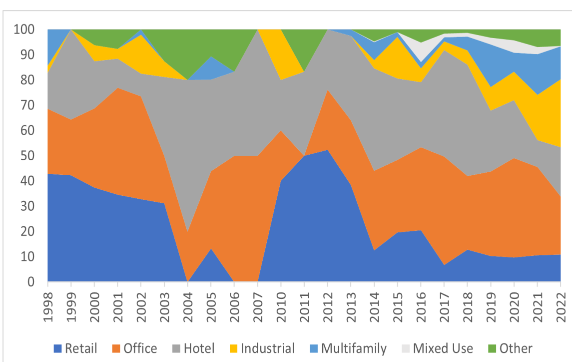
(a) Collateral Composition, Conduit Deals



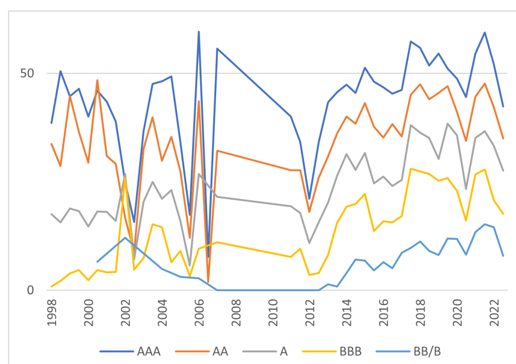
(b) Debt Subordination, Conduit Deals



(c) Collateral Composition, SASB Deals



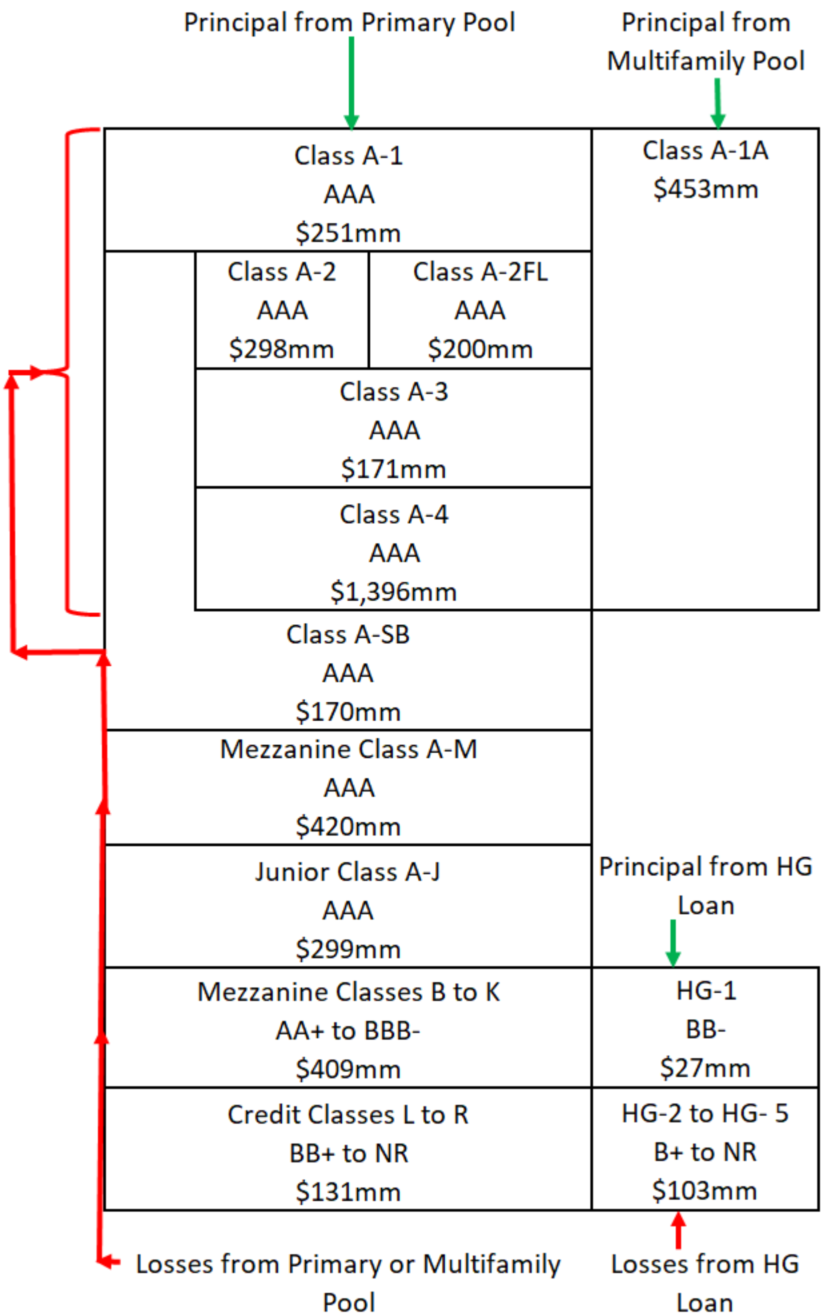
(d) Debt Subordination, SASB Deals



Notes: This figure displays the composition of CMBS collateral for the major industries of CMBS collateral and the subordination levels by rating for the CMBS debt. SASB = single-asset, single-borrower.

Sources: Green Street and Intex

Figure 4. The Allocation of Principal

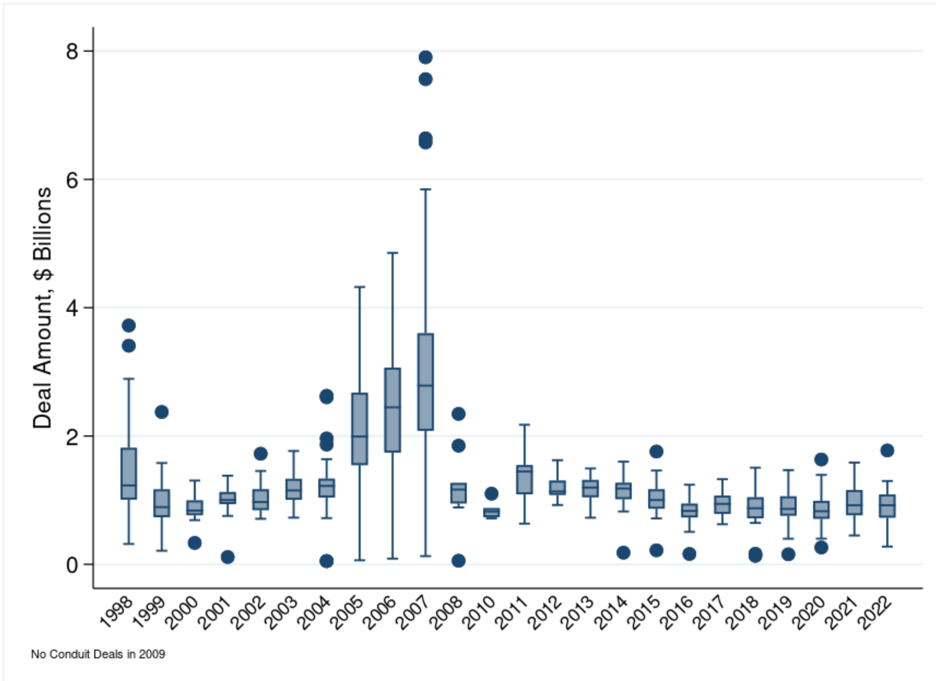


Notes: This figure depicts the allocation of principal for deal JPMCC 2005-LDP5 from details in Table 1. This deal is representative of pre-GFC senior-subordinated structures. Principal payments (the green lines) generally get allocated first to the senior-most AAA bonds at the top of the capital structure, while losses (the red lines) flow up from the bottom of the structure. Note that principal payments for the multifamily pool A-1A get allocated exclusively to A-1A but losses flow up from the bottom similar to losses from the primary pool. Principal payments and losses for the Houston Galleria (HG) bonds are exclusive to the HG classes.

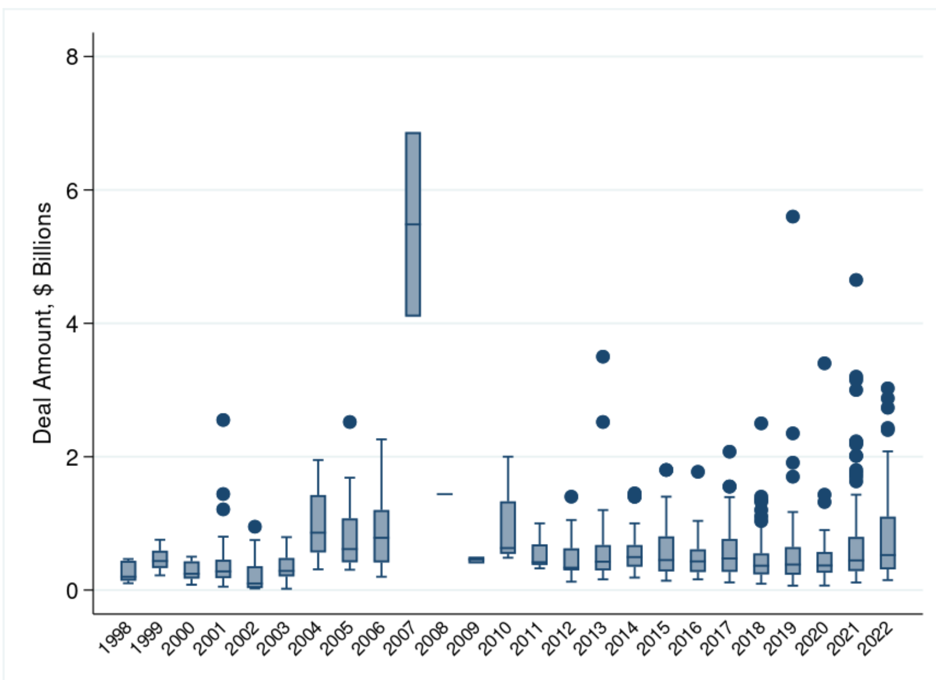
Sources: Intex and Green Street

Figure 5. Box and Whisker Plots for Conduit and SASB Deal Vintages 1998-2022

(a) Distribution of Deal Amounts for Conduit



(b) Distribution of Deal Amounts for SASB

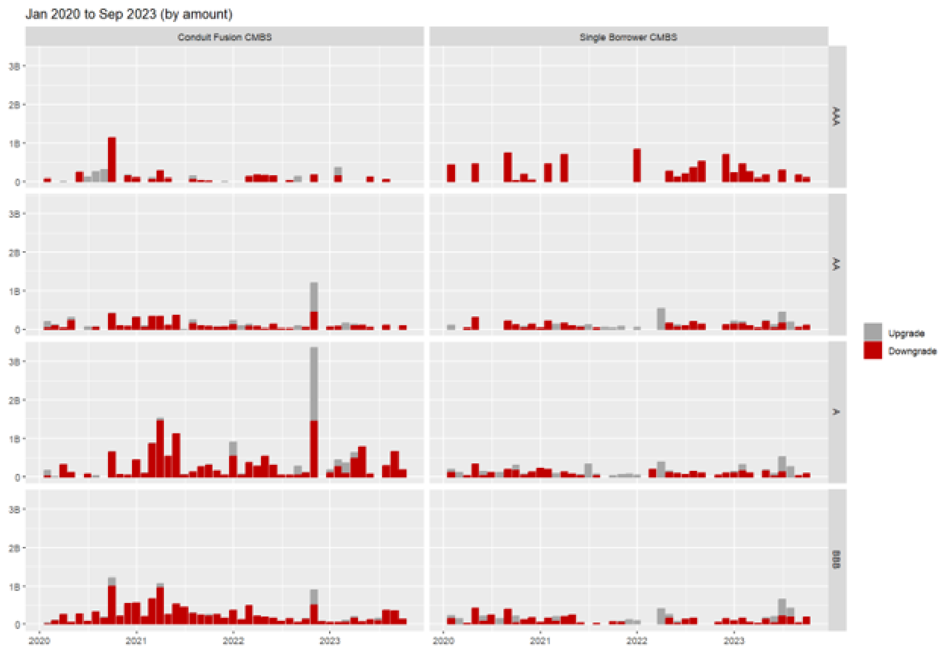


Notes: This figure produces box and whisker plots for Conduit and single-asset, single-borrower (SASB) deals between 1998 and 2022. The line at the center of the box is the median and the edges of the box are the 25th and 75th percentiles. Whiskers are adjacent values, while dots represent outliers.

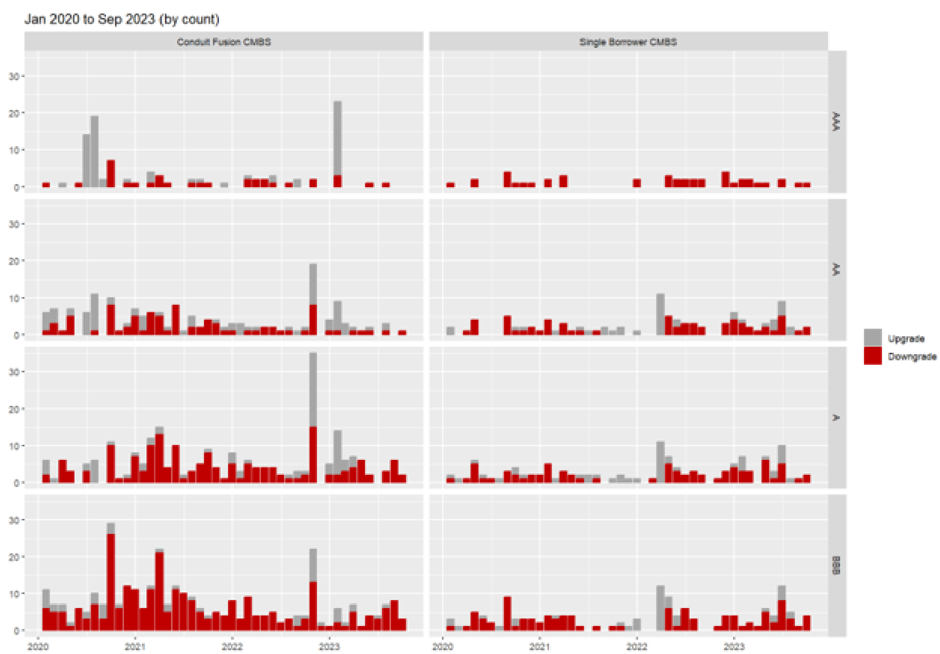
Sources: Green Street and Intex

Figure 6. Rating Downgrades and Upgrades for Conduit and SASB CMBS
Jan 2020-September 2023

(a) Rating Actions by Bond Balances ($ Billions)

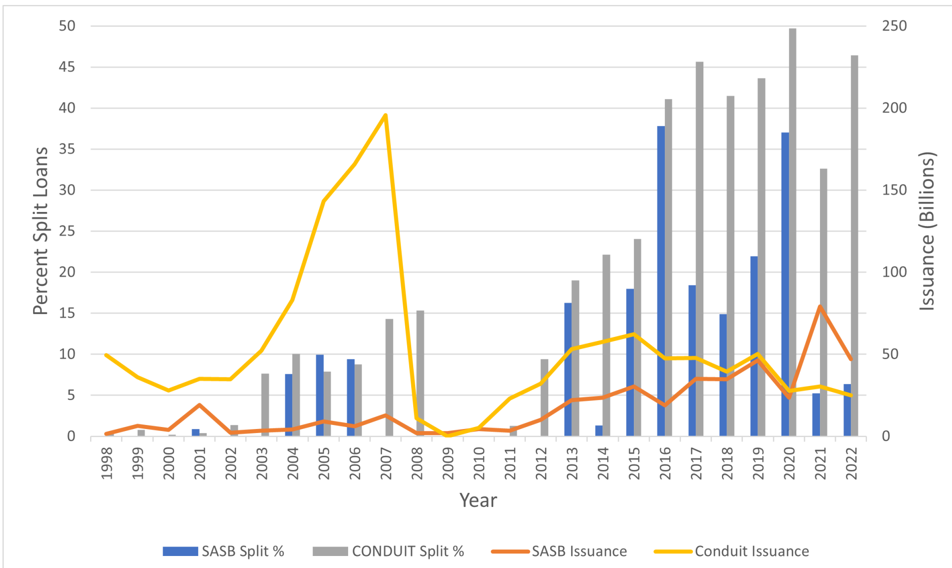


(b) Rating Actions by Counts



Notes: This figure provides dollar balances and counts by month of rating agency downgrades (in red) and upgrades (in gray) for investment grade (BBB to AAA) Conduit and single-asset, single-borrower (SASB) deals from 2020 to September 2023.
Source: Intex

Figure 7. Split Note Loan Shares and Issuance by Deal Type



Notes: This figure plots annual issuance volumes of conduit and SASB deals and their dollar share of loans that are "split" among two or more deals. SASB = single-asset, single borrower.
Source: Trepp

Figure 8. Interest Rate Capital Costs in 2023 Market

High DSCR Loan

Bloomberg ID	WFCM 2021 SAVE		

	Balance	Index	Margin
Senior Loan Balance	342,212,630	SOFR_1MO	2.96
Mezz Loan Balance	0	N/A	0

Current Annual NOI	44,824,493
Current Annual Debt Service	28,384,758
Current DSCR	1.58
Cap DSCR Target	1.1
Solved Cap Strike	8.94
New Max Cap Strike	8.94
New Cap Cost ($)	460,000
New Cap Cost (% of loan Bal)	0.13%
New Cap Cost (% of NOI)	1.03%

Low DSCR Loan

Bloomberg ID	GSMS 2021-ROSS		

	Balance	Index	Margin
Senior Loan Balance	691,000,000	SOFR_1MO	3.14
Mezz Loan Balance	150,000,000	SOFR_1MO	9.94

Current Annual NOI	55,990,076.92
Current Annual Debt Service	81,424,900
Current DSCR	0.69
Cap DSCR Target	1.05
Solved Cap Strike	1.99
New Max Cap Strike	3.00
New Cap Cost ($)	19,640,000
New Cap Cost (% of loan Bal)	2.34%
New Cap Cost (% of NOI)	35.08%

*New cap priced as of 6/29/2023 assuming a 12mo term.

Notes: This figure computes interest rate capital costs for two representative floating rate single-asset, single borrower (SASB) loans, one with a high debt service coverage ratios (DSCR), one with a very low one. Computations are done following the approach described in Section A2. Final capital cost calculations are done with a model developed by Pensford Financial found at: https://www.pensford.com/resources/cap-pricer

Sources: Pensford Financial, Intex, Green Street

Table 1. Sample Conduit CMBS Deal

Notes: This table lists the set of securities and their characteristics for deal JPMCC 2005-LDP5, a representative pre-GFC conduit security. Class distinguishes the different securities, each of which receives an Initial Rating based on the lowest rating among Moody's, S&P and Fitch. Original Amount is the balance of the security at issuance. The n in the interest only (IO) bonds represents notional values. Subordination is the credit protection provided to each security. Price is the original purchase price of each security available for investment grade bonds. Coupon is the promised interest rate on the security, with Coupon Type being either fixed or floating. Original weighted average life (WAL) is the expected maturity at issuance of each bond, while ex post WALs are actuals. Realized Principal Losses is the original bond balance less principal returned to bondholders.
Sources: Green Street and Intex

Class	Initial Rating	Class	Original Amount ($ Mil.)	Subordination (%)	Price ($)	Coupon (%)	Coupon Type	Original WAL	Ex Post WAL	Realized Principal Losses ($)
A-1	AAA	Sr. AAA	250.56	30	100	5.0	Fixed	2.980	4.417	0.0
A-1A	AAA	Agency	453.075	30	100	5.2	Fixed	8.19	9.833	0.0
A-2FL	AAA	Sr. AAA	200	30	100	1mo LIBOR + .125%	Floating	4.55	6.417	0.0
A-2	AAA	Sr. AAA	297.502	30	101	5.2	Fixed	4.900	8.083	0.0
A-3	AAA	Sr. AAA	171.451	30	100	5.2	Fixed	7.080	9.083	0.0
A-4	AAA	Sr. AAA	1395.87	30	100	5.2	Fixed	9.670	9.833	0.0
A-SB	AAA	Sr. AAA	169.455	30	100	5.2	Fixed	6.900	9.083	0.0
A-M	AAA	Mezz AAA	419.702	20	100	5.2	Fixed	9.960	10.000	0.0
A-J	AAA	Jr. AAA	299.038	12.88	100	5.3	Fixed	9.960	10.333	0.0
B	AA+	Mezz	26.231	12.25	100	5.3	Fixed	9.960	10.500	0.0
C	AA	Mezz	73.448	10.5	100	5.3	Fixed	9.960	11.167	0.0
D	AA-	Mezz	41.97	9.5	100	5.3	Fixed	9.960	11.167	0.0
E	A+	Mezz	20.985	9	100	5.3	Fixed	9.960	11.333	0.0
F	A	Mezz	52.463	7.75	99	5.3	Fixed	9.960	13.000	0.0
G	A-	Mezz	36.724	6.88	99	5.3	Fixed	9.960	13.000	0.0
H	BBB+	Mezz	52.463	5.63	96	5.3	Fixed	9.960	13.333	0.7
J	BBB	Mezz	41.97	4.63	94	5.3	Fixed	10.030	13.000	42.0
K	BBB-	Mezz	62.955	3.13	90	5.3	Fixed	10.050	13.000	63.0
L	BB+	Credit	26.232	2.5		4.9	Fixed	10.05	11.000	26.2
M	BB	Credit	15.739	2.13		4.9	Fixed	10.05	11.000	15.7
N	BB-	Credit	15.738	1.75		4.9	Fixed	10.05	6.833	15.7
O	B+	Credit	5.247	1.63		4.9	Fixed	10.05	6.583	5.2
P	B	Credit	5.246	1.5		4.9	Fixed	10.05	6.583	5.2
Q	B-	Credit	10.493	1.25		4.9	Fixed	10.05	10.917	10.5
R	NR	Credit	52.463	0		5.0	Fixed	13.82	4.250	52.5
X-1(IO)	AAA	IO	$4,197n	NA		NA	Fixed	8.160	11.000	NA
X-2(IO)	AAA	IO	$4,113n	NA		NA	Fixed	8.160	7.083	NA
HG-1	BB-	Group 3	27	15.83		5.6	Fixed	10.05	9.333	0.0
HG-2	B+	Group 3	24	12.55		5.6	Fixed	10.05	9.333	0.0
HG-3	B	Group 3	40.8	9.62		5.6	Fixed	10.05	9.333	0.0
HG-4	B-	Group 3	32.4	4.65		5.6	Fixed	10.05	9.333	0.0
HG-5	NR	Group 3	5.8	0.71		5.6	Fixed	10.05		0.0
HG-X	Ba3	Group 3 IO	$130n	NA		NA	Fixed	10.05		NA

Table 2. Sample Single-Asset, Single-Borrower (SASB) CMBS Deal

Notes: This table lists the set of securities and their characteristics for deal MOTEL 2017-MTL6, a representative post-GFC SASB structure. Class distinguishes the different securities, each of which receives an Initial Rating based on the lowest rating among Moody's, S&P and Fitch. Original Amount is the balance of the security at issuance. The n in the interest only (IO) bonds represents notional values. Original Subordination represents the credit protection provided to each security. Price is the original purchase price of each security available for investment grade bonds. Coupon is the promised interest rate on the security, with Coupon Type being either fixed or floating. Original weighted average life (WAL) is the expected maturity at issuance of each bond. This security paid off after three years. Realized Principal Losses is the difference between the original bond balance and principal returned to bondholders.
Sources: Green Street and Intex

Class	Initial Rating	Original Amount ($ Mil.)	Subordination (%)	Price ($)	Coupon Spread (bps)	Coupon Type	Original WAL	Realized Principal Losses ($)
A	AAA	641.8	67.4	100	92	Floating	1.93	0
B	AA-	226.7	55.9	100	119	Floating	1.93	0
C	A-	167.2	47.5	100	140	Floating	1.93	0
D	BBB-	221.0	36.3	99.75	215	Floating	1.93	0
E	BB-	348.5	18.6	99.75	325	Floating	1.93	0
F	B-	316.4	2.5	99.75	425	Floating	1.93	0
G	NR	49.7	0.0	99.75	575	Floating	1.93	0
RR Interest	NR	62.3	NA		NA	Floating	1.93	0
RR Certificate	NR	41.5	NA		NA	Floating	1.93	0
X-CP (IO)	BBB-	1005.3n	NA		NA	Floating		0
X-EXT(IO)	BBB-	1256.7n	NA		NA	Floating		0

Table 3. CMBS Sample Characteristics

Notes: This table summarizes our CMBS sample from Intex by vintage for all conduit and single-asset, single-borrower (SASB) deals issued from 1998 to 2022. Issuance dollars are total amount of deal balances by vintage. Bond count is the total number of CMBS bonds issued. Completed bonds are those that have either fully paid down or been liquidated. CMBS 1.0 refers to issuance from 1998 to 2009, while CMBS 2.0 refers to issuance from 2010 onward.
Sources: Green Street and Intex

Vintage	Conduit Issuance ($ Bil.)	Conduit Bond Count	Completed Conduit Bonds	SASB Issuance ($ Bil.)	SASB Bond Count	Completed SASB Bonds
1998-2002	181.1	2,756	2,743	26.8	512	506
2003	49.8	880	874	4.2	92	92
2004	74.2	1,353	1,325	3.8	40	35
2005	133.2	1,564	1,520	4.0	65	35
2006	162.0	1,622	1,564	3.8	71	71
2007	188.5	1,530	1,443	14.3	32	32
2008	10.8	217	201	1.4	3	3
2009	-	-	-	1.4	14	14
2010	5.1	70	52	4.4	27	27
2011	24.8	252	170	3.2	43	43
2012	32.2	391	236	8.9	112	94
2013	53.1	714	160	22.8	278	196
2014	57.4	914	137	22.9	288	232
2015	61.9	1,069	128	30.8	395	226
2016	46.3	963	111	22.1	259	150
2017	48.5	908	95	39.2	523	276
2018	39.3	764	42	37.2	619	174
2019	49.3	1,015	18	52.1	656	111
2020	27.2	591	-	33.2	346	84
2021	30.4	617	1	83.3	952	50
2022	23.8	496	-	47.2	400	-
CMBS 1.0	800	9,922	9,670	60	829	788
CMBS 2.0	499	8,764	1,150	407	4,898	1,663
Total	1,299	18,686	10,820	467	5,727	2,451

Table 4. Purchase Prices of Completed Investment Grade Conduit and SASB CMBS Bonds

This table reports purchase price statistics by original rating category for CMBS conduit and single-asset, single-borrower (SASB) bonds that paid off or liquidated by year-end 2022. Source: Green Street

Panel A: Fixed Rate CMBS Bonds

Rating	Price	StDev	p10	p25	p50	p75	p90	N
Conduit 1.0 (1998-2009)								
AAA	100.19	1.43	99.92	100.25	100.50	100.50	100.55	1690
AA	99.51	3.67	97.94	100.00	100.50	100.50	100.55	647
A	98.83	5.02	96.24	99.16	100.50	100.50	100.54	709
BBB	96.39	6.82	90.86	95.00	98.31	100.49	100.50	814
SASB 1.0 (1998-2009)								
AAA	100.14	0.56	100.00	100.00	100.03	100.50	100.50	41
AA	99.98	1.00	98.61	100.00	100.49	100.50	100.50	44
A	99.95	0.98	99.23	99.99	100.17	100.50	100.55	51
BBB	98.97	2.49	95.53	99.25	100.00	100.10	100.50	45
Conduit 2.0 (2010-2022)								
AAA	101.26	1.33	100.00	100.00	101.00	103.00	103.00	736
AA	100.02	2.88	95.96	99.92	101.00	101.85	102.25	26
A	97.12	4.37	89.62	94.37	99.09	100.53	101.00	20
BBB	90.68	7.99	80.87	84.09	94.04	96.53	98.25	14
SASB 2.0 (2010-2022)								
AAA	101.45	1.40	100.00	100.00	101.00	103.00	103.00	71
AA	101.50	1.31	100.00	100.00	101.54	102.99	103.00	59
A	100.92	1.40	99.52	100.00	100.11	102.37	103.00	54
BBB	99.52	2.03	96.77	98.60	100.00	100.43	101.69	58

Panel B: Floating Rate CMBS Bonds

Rating	Price	StDev	p10	p25	p50	p75	p90	N
SASB 1.0 (1998-2009)								
AAA	100.00	0.00	100	100	100	100	100	64
AA	99.99	0.04	100	100	100	100	100	64
A	99.99	0.05	100	100	100	100	100	56
BBB	99.73	1.00	99.93	100	100	100	100	64
SASB 2.0 (2010-2022)								
AAA	99.95	0.35	99.8106	100	100	100	100	149
AA	99.90	0.58	99.8774	100	100	100	100	139
A	99.88	0.73	99.9628	100	100	100	100	135
BBB	99.83	1.07	99.7215	100	100	100	100	140

Table 5. Internal Rates of Return of Completed Conduit and SASB CMBS Bonds

This table reports internal rates of return (IRRs) statistics by original rating category for CMBS conduit and single-asset, single-borrower (SASB) bonds that closed by year-end 2022. Weighted average lives (WALs) and mean bond purchase prices are also provided.
Sources: Intex and Green Street

Panel A: Fixed Rate CMBS Bonds

Rating	WALs	Price	Mean IRR	StDev	p10	p25	p50	p75	p90	N
Conduit 1.0 (1998-2009)										
AAA	8.16	100.19	5.28	1.27	4.14	4.82	5.38	5.84	6.32	1690
AA	10.62	99.51	1.30	9.38	-11.08	3.85	5.19	5.79	6.71	647
A	10.64	98.83	-0.41	11.18	-16.13	-5.99	5.19	5.95	7.13	709
BBB	10.11	96.39	-7.12	19.15	-34.27	-16.91	5.01	6.24	7.67	814
SASB 1.0 (1998-2009)										
AAA	9.13	100.14	6.12	1.14	4.77	5.39	6.27	6.73	7.49	41
AA	9.63	99.98	6.33	1.06	5.08	5.58	6.47	7.18	7.73	44
A	9.04	99.95	6.75	1.09	5.27	5.80	6.89	7.66	7.99	51
BBB	8.77	98.97	7.39	1.18	5.95	6.27	7.44	8.17	9.08	45
Conduit 2.0 (2010-2022)										
AAA	5.25	101.26	2.39	1.15	1.28	1.54	2.22	2.96	3.91	736
AA	9.83	100.02	5.32	0.74	4.64	4.80	5.13	5.68	6.52	26
A	10.24	97.12	6.20	0.67	5.62	5.72	5.94	6.66	7.15	20
BBB	10.07	90.68	7.06	1.55	5.85	6.19	6.66	8.08	8.92	14
SASB 2.0 (2010-2022)										
AAA	5.02	101.45	2.93	0.89	1.85	2.28	2.75	3.39	4.12	71
AA	4.91	101.50	3.63	1.04	2.55	2.79	3.34	4.44	4.93	59
A	4.78	100.92	4.13	1.22	2.86	3.12	3.77	5.04	5.66	54
BBB	4.76	99.52	4.71	1.29	3.27	3.71	4.38	5.86	6.54	58

Panel B: Floating Rate CMBS SASB Bonds Versus
Synthetic Floating-Rate Corporate Bonds

Rating	WALs	Price	Mean IRR	StDev	p10	p25	p50	p75	p90	N
SASB 1.0 (1998-2009)										
AAA	3.78	100.00	1.59	11.88	2.02	2.32	2.88	3.67	5.52	64
AA	3.91	99.99	1.82	8.11	2.20	2.49	3.00	4.18	5.64	64
A	3.09	99.99	2.27	12.77	2.75	2.98	3.55	5.34	5.83	56
BBB	2.83	99.73	5.00	1.79	3.64	4.00	4.72	5.88	7.19	64
SASB 2.0 (2010-2022)										
AAA	2.54	99.95	2.12	0.76	1.16	1.46	2.03	2.72	3.07	149
AA	2.53	99.90	2.61	0.86	1.55	1.98	2.47	3.17	3.66	139
A	2.58	99.88	2.94	0.89	1.92	2.38	2.80	3.43	4.01	135
BBB	2.62	99.83	3.54	1.99	2.34	2.89	3.56	4.28	5.00	140

Table 6. Public Market Equivalents (PMEs) Versus Corporate Bonds

This table reports PMEs for fixed- and floating-rate CMBS bonds versus corporate bonds. For fixed-rate bonds, we maturity adjust ICE nonfinancial corporate bond indexes by ratings to match the conduit and single-asset, single-borrower (SASB) fixed-rate bonds and report results in Panel A. In Panel B, we report comparisons for floating-rate SASB bonds by rating category. Floating-rate corporate bond returns are based on swapping fixed-rate cash flows using the maturity matched swap rate at issuance. Details are in Section A1. We report the performance of rating category against each benchmark, with the sample split between conduit and SASB into CMBS 1.0 (1998-2009) and CMBS 2.0 (2010-2022). We construct a t-test of the null hypthesis that the PME equals one. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.
Sources: Intex and Green Street

Panel A: Fixed-Rate CMBS Bonds Versus
Maturity Matched Fixed-Rate Corporate Bonds

Rating	WALs	Mean	StDev	p10	p25	p50	p75	p90	N
Conduit 1.0 (1998-2009)									
AAA	8.16	0.98***	0.05	0.92	0.94	0.96	0.98	1.02	1690
AA	10.62	0.85***	0.26	0.40	0.89	0.98	1.00	1.03	647
A	10.64	0.80***	0.29	0.34	0.47	0.96	1.00	1.04	709
BBB	10.11	0.71***	0.35	0.25	0.35	0.90	1.01	1.08	814
SASB 1.0 (1998-2009)									
AAA	9.13	0.98***	0.03	0.94	0.96	0.98	1.00	1.03	41
AA	9.63	1.02*	0.05	0.97	0.98	1.01	1.04	1.07	44
A	9.04	1.02**	0.05	0.97	0.99	1.02	1.05	1.06	51
BBB	8.77	1.07***	0.07	0.98	1.03	1.07	1.09	1.18	45
Conduit 2.0 (2010-2022)									
AAA	5.25	0.94***	0.05	0.89	0.91	0.94	0.96	0.99	736
AA	9.83	1.08***	0.09	1.00	1.01	1.05	1.17	1.19	26
A	10.24	1.15***	0.11	1.04	1.06	1.11	1.24	1.28	20
BBB	10.07	1.13***	0.15	1.01	1.05	1.08	1.20	1.35	14
SASB 2.0 (2010-2022)									
AAA	5.02	0.95***	0.06	0.87	0.91	0.94	0.99	1.01	71
AA	4.91	0.98**	0.06	0.92	0.93	0.97	1.02	1.06	59
A	4.78	1.00	0.06	0.94	0.95	0.99	1.03	1.09	54
BBB	4.76	1.00	0.06	0.94	0.96	0.99	1.02	1.08	58

Panel B: Floating Rate CMBS SASB Bonds Versus
Synthetic Floating-Rate Corporate Bonds

Rating	WALs	Mean	StDev	p10	p25	p50	p75	p90	N
SASB 1.0 (1998-2009)									
AAA	3.78	0.99	0.16	0.98	0.99	1.00	1.03	1.06	64
AA	3.91	0.99	0.13	0.97	0.99	1.00	1.05	1.07	64
A	3.09	0.99	0.13	0.98	0.99	1.00	1.03	1.05	56
BBB	2.83	1.04***	0.06	0.99	1.00	1.04	1.07	1.11	64
SASB 2.0 (2010-2022)									
AAA	2.54	1.00	0.03	0.96	0.97	0.99	1.01	1.04	149
AA	2.53	1.01**	0.03	0.98	0.98	1.00	1.02	1.05	139
A	2.58	1.01***	0.04	0.97	0.98	1.01	1.03	1.07	135
BBB	2.62	1.02**	0.09	0.96	0.98	1.01	1.04	1.09	140

Table 7. Performance of AAA Rated SASB Floating Rate CMBS Relative to Other ABS

This table reports statistics on the performance of AAA rated CMBS floating-rate single-asset, single-borrower (SASB) tranches relative to AAA rated tranches of other classes of asset-backed securities (ABS). The sample contains completed deals that paid down their senior debt by December 2022. We report the public market equivalents (PMEs) versus the Bloomberg US ABS Floating Rate Total Return Index along with the auto, credit card, home equity and student loan components of the index. The index returns are available beginning in May 2005, so we exclude CMBS issued before 2005 from the sample. We report the performance of AAA-rated floating rate SASB tranches against each benchmark. We construct a t-test of the null hypothesis that the PME equals one. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively. WALs = weighted average lives of CMBS deal cohorts.

Sources: Intex and Green Street

ABS Type	WALs	Mean	StDev	p10	p25	p50	p75	p90	N
CMBS 1.0 (2005-2009)									
ABS	7.17	1.04**	0.15	1.00	1.02	1.04	1.04	1.07	69
Auto	7.17	1.09***	0.16	1.00	1.08	1.09	1.10	1.15	69
Credit Card	7.17	0.99	0.14	0.96	0.97	0.98	1.00	1.03	69
Home Equity	7.17	1.16***	0.18	1.00	1.13	1.16	1.19	1.22	69
Student Loans	7.17	1.03	0.15	0.99	1.01	1.03	1.04	1.06	69
CMBS 2.0 (1998-2009)									
ABS	2.81	1.01***	0.02	1.00	1.00	1.01	1.01	1.02	156
Auto	2.81	1.02***	0.02	1.00	1.01	1.01	1.02	1.03	156
Credit Card	2.81	1.02***	0.02	1.00	1.01	1.01	1.02	1.03	156
Home Equity	2.81	1.05***	0.04	1.02	1.03	1.04	1.07	1.09	156
Student Loans	2.81	1.00	0.02	0.98	0.99	1.00	1.01	1.02	156
Full Sample									
ABS	4.15	1.02***	0.08	1.00	1.00	1.01	1.03	1.04	225
Auto	4.15	1.04***	0.10	1.00	1.01	1.01	1.08	1.10	225
Credit Card	4.15	1.01*	0.08	0.97	1.00	1.01	1.02	1.03	225
Home Equity	4.15	1.08***	0.11	1.02	1.03	1.06	1.13	1.19	225
Student Loans	4.15	1.01	0.08	0.98	0.99	1.00	1.02	1.04	225

Table 8. CMBS Deal Issuance and Losses

Notes: This table summarizes lifetime and life-to-date losses on all CMBS conduit and SASB deals from 1998 to 2022, segmented by CMBS 1.0 and 2.0 rating eras, with the CMBS 1.0 era from 1998-2009 and CMBS 2.0 era from 2010-2022. We use Intex as the primary source for losses on all bonds. For bonds not yet paid down or liquidated Intex provides life-to-date losses. SASB = single-asset, single-borrower.
Sources: Intex and Green Street

CMBS Issuance and Deal Losses 1998-2022

Rating Type	Deal Type	Number of Deals	Issuance ($Bil.)	Losses ($Bil.)	Loss %	Share of Total (%)
CMBS 1.0	Conduit	474	802	62.9	7.8	94.9
	SASB	112	63	0.6	1.0	1
CMBS 2.0	Conduit	503	502	2.7	0.5%	4.1
	SASB	634	382	0.1	0.0%	0.2
Full sample	Conduit	977	1,304	65.6	5.0%	98.9
	SASB	746	445	0.7	0.2%	1.1
Grand Total		1,723	1,749	66.3	3.8%	100.0
2005-2007	Conduit	192	486	49.3	10.1%	74

Table 9. CMBS 1.0 and 2.0 Deal Risk Stratifications of Conduit and SASB Securitizations

This table lists the major observable risk characteristics of CMBS deals issued for Conduit and SASB securitizations for CMBS 1.0 (1998-2009) and CMBS 2.0 (2010-2022) cohorts. All values are weighted averages by deal size where applicable. LTV = weighted average loan to value ratio; DSCR = weighted average debt service coverage ratio; WAM = weighted average maturity; HHI = Herfindahl-Hirschman Index $HHI_{j,t} = \sum_{i=1}^{n} \hat{s}_i^2$ where s_i is the share of loans in industry i in deal j at issuance year t scaled to 100. Industries include office, hotel, multifamily, retail, industrial, and other. *, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.
Sources: Intex, Green Street, and Trepp

Panel A: Conduit and SASB 1.0 (1998-2009)

Deal Characteristics	Conduit CMBS 1.0			SASB CMBS 1.0			Difference in Means	
	Mean	SD	Median	Mean	SD	Median	Conduit vs. SASB	Conduit 2.0 vs. 1.0
Deal Size	$1,692	$1,114	$1,287	$566	$839	$366	1126.7***	-694.5***
LTV	69	4	70	53	8	51	15.4***	-8.5***
DSCR	1.5	0.2	1.5	2.4	1	2.2	-0.9***	0.6***
Number of Loans	189	92	169	2	6	1	186.9***	-130***
Number of Prop.	250	134	226	136	202	28	115***	-140***
Number of Tranches	24	5	24	11	5	11	12.6***	-5.6***
WAM (in Months)	111.4	15.1	110	72.6	65.1	47	38.8***	-0.1
Deal Losses ($ Mil.)	226.7	238.4	146.8	17.5	63.1	0	209.2***	-220.4***
Deal Loss Pct	7.8	5.1	6.9	0.6	4.5	0	7.2***	-7.3***
# of Ratings	2.2	0.4	2	2.4	0.7	2	-0.2**	0.8***
Industry HHIs	26.7	5.7	25.7	98	10.2	100	-71.3***	-2.6***
Share IO loans	56.0	31.9	66.1	63.8	47.6	100	-7.8*	15.3***
Time to Market	3.0	2.1	2.0	1.2	2.1	1	1.8***	-0.8***

Panel B: Conduit and SASB 2.0 (2010-2022)

Deal Characteristics	Conduit CMBS 2.0			SASB CMBS 2.0			Difference in Means	
	Mean	SD	Median	Mean	SD	Median	Conduit vs. SASB	SASB 2.0 vs. 1.0
Deal Size	$997.7	$276.5	$971.5	$603.1	$574.6	$415.0	394.6***	37.6
LTV	60	5	61	60	12	60	0.3	6.6***
DSCR	2.1	0.5	1.9	3	1.2	2.7	-0.9***	0.6***
Number of Loans	59	19	57	1	1	1	58.0***	-1*
Number of Prop.	111	54	100	62	119	10	49***	-74***
Number of Tranches	18	3.2	18	8.7	2.8	9	9.3***	-2.3***
WAM (in Months)	111.3	6.3	113	51.3	40.9	24	60.0***	-21.3**
Deal Losses ($ Mil.)	6.3	15.1	0	0.2	3.9	0	6.1***	-17.3**
Deal Loss Pct	0.5	1.3	0	0	0.8	0	0.5***	-0.6
# of Ratings	3	0.4	3	2	0.5	2	1.0***	-0.4***
Industry HHIs	24.1	7.5	22.8	98.1	8.5	100	-74.0***	0.1
Share IO loans	71.3	23.2	76.4	97.2	16.4	100	-25.9***	33.4***
Time to Market	2.2	2.1	2	0.5	1.2	0	1.7***	-0.7***

Table 10. Determinants of CMBS 1.0 Losses

In this table, we examine losses on loans in CMBS 1.0 securitizations. The dependent variable is the Intex loss percentage for each deal. We include an indicator for SASB loans and find these loans incurred significantly fewer losses for the simplest regression including LTV and DSCR. However, this significance disappears as more controls are added for deal characteristics, such as number of properties and a national CRE price index. Property Value Change is calculated using a national weighted average property price index from Green Street. Other indices from CBRE and RCA were also tested yielding similar results. t-Statistics are in parentheses. Significance levels are indicated by *p<0.10, **p<0.05, ***p<0.010. SASB = single-asset, single-borrower, LTV = loan-to-value ratio, DSCR = debt-service-coverage ratio. Sources: Intex, Green Street, and Trepp

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
SASB indicator	-5.233***	-2.225*	1.440	0.356	0.998
	(0.932)	(1.342)	(1.017)	(1.031)	(0.970)
LTV		0.127*	0.166***	0.191***	0.219***
		(0.077)	(0.048)	(0.047)	(0.045)
DSCR		-1.514**	-0.670	-0.646	0.092
		(0.762)	(0.460)	(0.452)	(0.434)
Properties			0.004***	0.005***	0.003**
			(0.002)	(0.002)	(0.001)
Tranches			0.319***	0.201***	0.168***
			(0.037)	(0.046)	(0.044)
WAM			0.004	0.000	-0.001
			(0.007)	(0.007)	(0.007)
Property Value Change				-1.459***	-3.404***
				(0.347)	(0.410)
Vacancy Change					0.768***
					(0.099)
Constant	6.794***	0.248	-12.374***	-8.774**	-10.124***
	(0.391)	(5.850)	(3.990)	(4.008)	(3.764)
R^2	0.060	0.078	0.326	0.353	0.432
N	499	476	444	444	444

Table 11. Maturity Schedules of CMBS Active Deals

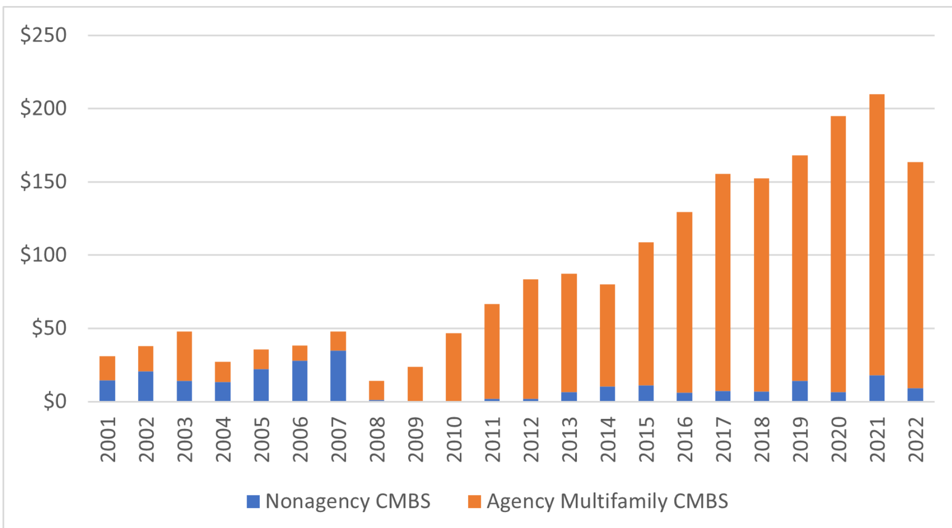
In this table we report the year conduit and SASB deals still active at year end 2022 reach maturity. Columns 2 through 5 report dollar amounts and shares of conduit and SASB deals reaching final maturity. Columns 6 and 7 report the share of floating rate SASB deals reaching their initial maturity, which are the first two or three years of their five year terms. SASB = single-asset, single-borrower.

Sources: Intex, Green Street and Trepp

Maturity Year	Conduits ($Bil.)	Shares %	SASB - Final Maturity($Bil.)	Shares %	SASB - Initial Maturity($Bil.)	% Total SASB
2023	35.2	10	22.5	9	64.4	24
2024	38.6	11	35.0	13	46.3	18
2025	41.5	12	20.4	8		
2026	44.0	13	78.0	30		
2027	41.9	12	55.7	21		
2028	34.4	10	6.4	2		
2029	46.3	13	17.2	7		
2030	36.4	10	16.2	6		
2031	22.4	6	7.5	3		
2032	6.8	2	2.1	1		
2034			0.7	0		
2035			1.9	1		
2023-2035	347.5	100	263.4	100	110.7	

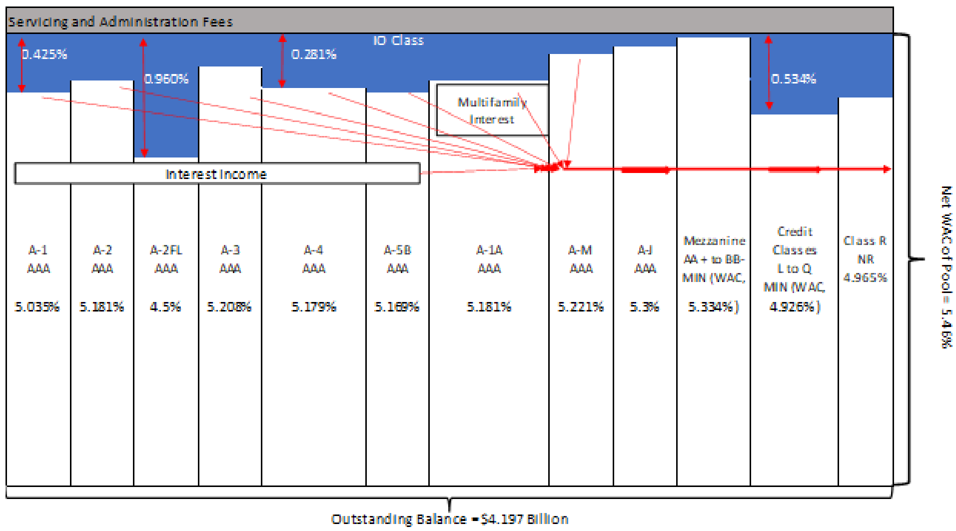
Appendices

Figure A1. Multifamily Private Label and Agency CMBS Issuance by Year



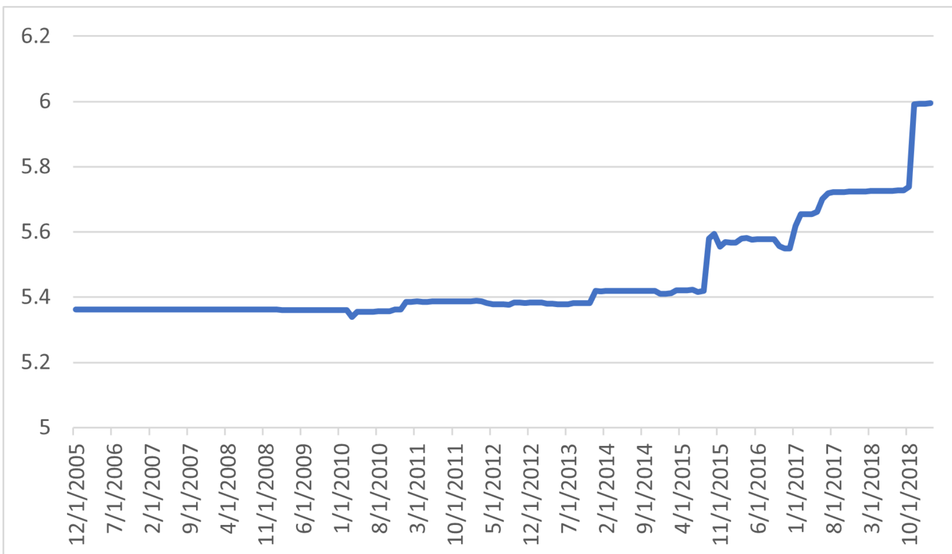
Notes: This figure plots issuance volumes of private label and Agency multifamily CMBS by issuance year. Agency CMBS represents CMBS issued by Fannie Mae, Freddie Mac, and Ginnie Mae. Source: *Inside Mortgage Finance*.

Figure A2. Allocation of Interest for JPMCC 2005-LDP5



Notes: In this figure we illustrate the monthly distribution of CMBS interest income. The width of the diagram represents the outstanding principal balance of the underlying collateral pool and the height represents the weighted average coupon (WAC) in the first month, excluding Servicing and Administration Fees, which are paid out before any bondholders receive payments, represented by the grey rectangle at the very top of the diagram. Each of the major principal classes is also represented along with their WACs. Their total balances equal the total balance of the principal pool plus the balance of the A-1A multifamily AAA class, as illustrated in Figure 5. The difference between interest from the mortgage pool and interest distributions to the principal bonds, which is represented by the blue region at the top of the box, equates to the monthly payment to the interest only (IO) bond or bonds. The IO bond "strips" the excess interest from each of the bonds. Note that the "interest box" varies each month with bond balances and interest paid on the loan pool, as shown in Figure A3.
Source: Intex

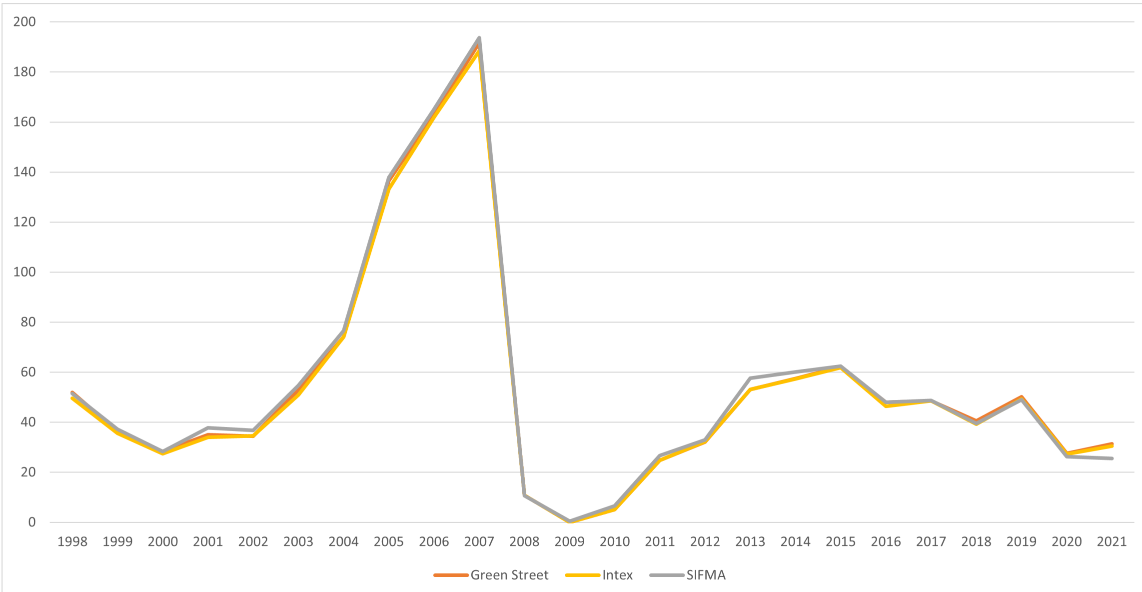
Figure A3. WAC for JPMCC 2005-LDP5



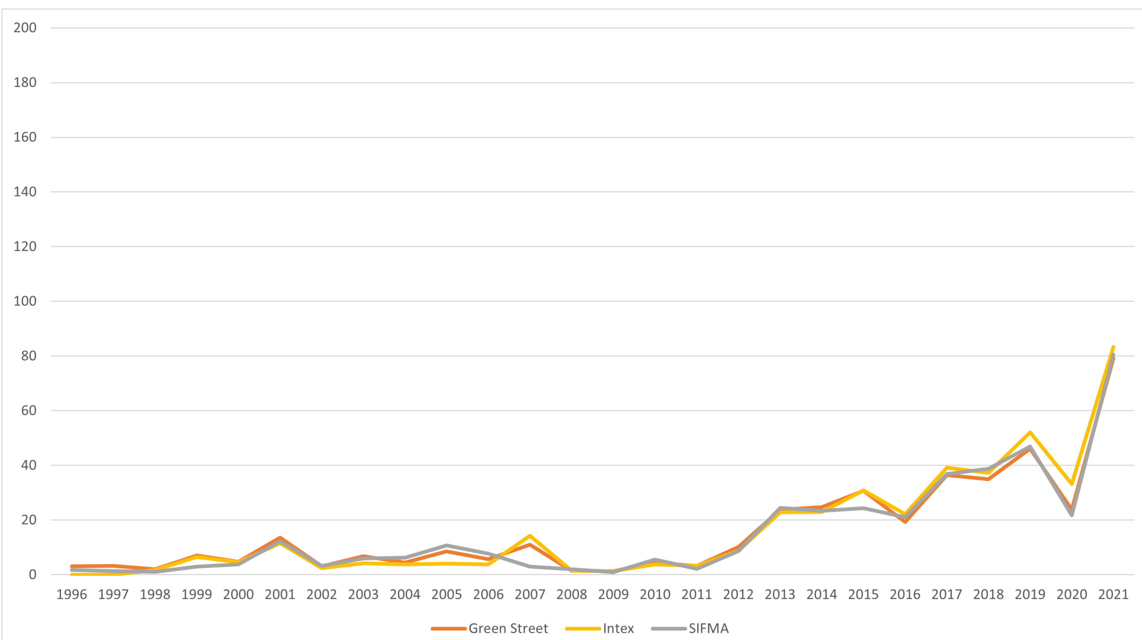
Notes: This figure shows the net weighted average coupon (WAC) of the interest only (IO) tranche for JPMCC 2005-LDP5. Here we plot the monthly weighted average coupon (WAC) of the IO class of bonds paid out to IO bondholders over the life of the deal. Note that as the deal pays down and defaulting loans are modified and extended, the WAC increases over time, especially after 10 years, when the pool was originally set to mature.
Source: Intex

Figure A4. Annual Private Label CMBS Issuance Volumes by Source

(a) Total Annual Issuance of Conduit Securitizations by Source 1998-2021



(b) Total Annual Issuance of SASB Securitizations by Source 1998-2021



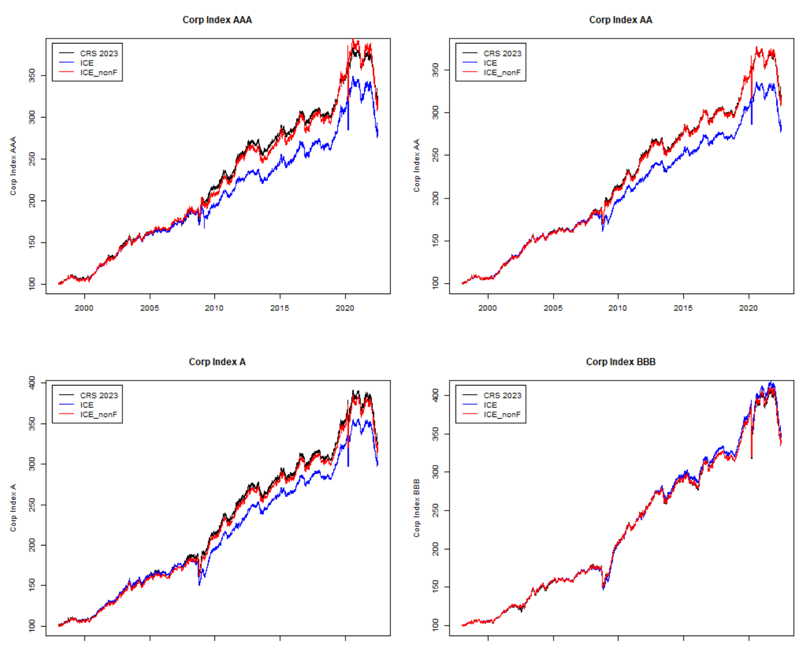
Notes: This figure compares our sample of annual CMBS issuance volumes from Green Street and Intex against those provided by the Securities Industry and Financial Markets Association (SIFMA).

A1 Constructing Corporate Benchmarks for Fixed and Floating Rate CMBS Securities

Corporate bonds are a natural benchmark for CMBS bonds, provided appropriate adjustments are made to maturity match corporates and fixed-rate CMBS bonds. Cordell, Roberts, and Schwert (2023) used daily bond-level quotes from Bank of America Merrill Lynch (BAML) and vanilla interest rate swap data from Bloomberg to construct their benchmarks. They restricted their sample to nonconvertible bonds from nonfinancial firms. By matching daily bond returns over the same time period to CMBS bond returns, we are able to obtain comparable maturities for each return series. For fixed-rate CMBS conduit bonds, maturities range from two to three years for "fast pay" AAA bonds to 10 years or more for some AAA and lower rated bonds.

As an alternative to the daily bond quotes from BAML, we tested several different corporate bond indexes from Intercontinental Exchange (ICE) against the BAML returns, as the ICE indexes are more straightforward to implement. As shown in Figure A5 below, the ICE nonfinancial (`ice_nonf`) corporate bond indexes, labeled "CRS 2023," are a near perfect match to the BAML quotes, ensuring comparability to results from the two sources. (The ICE index including financial firms in blue is much farther off.)

Figure A5. Corporate Benchmark Indexes for CMBS Securities, 1998-2022



The ICE nonfinancial corporate indices used are C0A1, C0A2, C0A3, and C0A4 for AAA, AA, A, and BBB securities, respectively. As a check for comparability, we ran our fixed-rate CMBS bonds both ways and confirmed our public market equivalent (PME) estimates in Table 6 were within 1-6 basis points of each other, except for the conduit AAA bond cohorts, which were 15-20 bps apart. The larger spread is likely driven by the fact that when using individual bond returns, there are not enough AAA bonds, so Cordell, Roberts, and Schwert (2023) also used some AA rated bonds. The ICE AAA bond index is a pure AAA rated index, so these can drive differences. In all cases, the indexes are very close substitutes for each other.

Since corporate bond indexes are fixed rate, to construct a comparable corporate floating-rate index, we construct floating-rate corporate returns by swapping the fixed-rate coupons into floating with interest rate swaps from Bloomberg. We could not find a way to swap out an entire index, so we use daily bond-level quotes from BAML and interest rate swap data from Bloomberg to construct these benchmarks in the same way as in Cordell, Roberts, and Schwert (2023).

Figure A6. Contributing Deals and Split Notes for MGM Grand and Mandalay Bay Loan

Split Notes for MGM Grand and Mandalay Bay Las Vegas Loan

Loan Information:

		LTVs
Fixed Rate Loan	$3,000,000,000	
A- Piece	$1,634,200,000	35.5%
B-Senior	$430,100,000	44.9%
B-Junior	$374,300,000	53.0%
C- Piece	$561,400,000	65.2%
Property Value	$4,600,000,000	
Total LTV	65%	

A- Piece Bonds

Bloomberg ID	BX 2020-VIVA	BX 2020-VIV2	BX 2020-VIV3
Deal Type	SASB	SASB	SASB
Amount	$670,139	$794,861	$1,000,000

B- Senior Bonds

Bloomberg ID	BX 2020-VIVA	BX 2020-VIV2	BX 2020-VIV3
Deal Type	SASB	SASB	SASB
Amount	$176,372	$208,629	$429,715,000

B- Junior Bonds

Bloomberg ID	BX 2020-VIVA	BX 2020-VIV2
Deal Type	SASB	SASB
Amount	$153,490	$374,146,511

C - Piece Bond

Bloomberg ID	BX 2020-VIVA
Deal Type	SASB
Amount	$561,400,000

Remaining A- Piece Bonds

BX 2020-VIV4	**BX 2021-VIV5**	**BMARK 2020-B18**
SASB	SASB	Conduit
$550,000,000	$113,347,000	$65,000,000
BMARK 2020-B19	**BMARK 2020-B20**	**BMARK 2020-B21**
Conduit	Conduit	Conduit
$80,000,000	$70,000,000	$75,000,000
BMARK 2020-B22	**BMARK 2021-B23**	**BMARK 2021-B24**
Conduit	Conduit	Conduit
$75,000,000	$75,000,000	$79,985,667
BBCMS 2020-C8	**BBCMS 2021-C9**	**BBCMS 2021-C10**
Conduit	Conduit	Conduit
$69,500,000	$58,000,000	$49,000,000
CSAIL 2021-C20	**DBJPM 2020-C9**	**GSMS 2020-GSA2**
Conduit	Conduit	Conduit
$39,055,333	$50,000,000	$65,000,000
MSC 2021-L5	**WFCM 2020-C58**	**WFCM 2021-C59**
Conduit	Conduit	Conduit
$36,347,000	$45,000,000	$36,500,000

Notes: This figure provides the Bloomberg identifiers, deal type, and loan amounts for all CMBS deals that financed the $3 billion loan to fund two Las Vegas hotel and casino properties, ordered by seniority. The loan to value (LTV) ratios are also calculated for each class of loans, with liability split pari passu across each class. SASB = single-asset, single-borrower.
Sources: Trepp, Green Street and Yahoo Finance

Figure A7. Debt Structure for Centre 425 Bellevue Property

Debt Structure for Centre 425 Bellevue Property

Loan Information:			LTVs	DSCRs
	Fixed Rate Loan	$266,050		
	A Notes	$94,000	29.7%	3.85
	B Note	$114,450	66.0%	1.69
	Mezzanine Loan	$57,600	84.2%	1.15
	Appraised Value	$316,000		
	Total LTV	84%		

A Notes

Bloomberg ID	**NCMS 2018-ALXA**	**UBS 2017-C5**	**CSAIL-2017-CX10**
Deal Type	SASB	Conduit	Conduit
Amount ($Thousands)	$10,000	$40,000	$44,000

B Note

Bloomberg ID	**NCMS 2018-ALXA**
Deal Type	SASB
Amount ($Thousands)	$114,450

Mezzanine Loan

Bloomberg ID	**NA- Private Placement**
Deal Type	Loan
Amount ($Thousands)	$57,600

Implied Equity	$49,950

Notes: This figure provides the Bloomberg IDs, deal type and loan amounts for all CMBS deals that financed the $316 million loan to fund the Centre 425 Bellevue Property ordered by seniority. Loan to value (LTV) ratios and debt service coverage ratios (DSCRs) are also calculated for each class of loans, with liability split pari passu across the A Notes. SASB = single-asset, single-borrower.
Source: NCMS 2018-ALXA Prospectus, p. A-2-7

A2 Procedure for Calculating Interest Rate Caps on Floating Rate SASB Loans at Extension

We start with the latest reported annual net operating income (NOI) for each Secured Overnight Funding Rate (SOFR)-based loan, which often reported with an as of date of the previous year end. We then relate that to the minimum debt service coverage (DSCR) ratio allowed for each loan under the terms of the Pooling and Service Agreements (PSAs). In most cases, that minimum DSCR is 1.10. We then use this information to compute a Target Debt Service ratio, defined as:

$$\textit{Target Debt Service}_{it} = \frac{NOI_{it}}{1.10} \tag{1}$$

where NOI = the latest annual net interest income for SASB loan i at current time t.

For interest only loans, the Target Rate is then computed as a ratio of the Target Debt Service to the unpaid principal balance (UPB) of the loan:

$$\textit{Target Interest Rate}_{it} = \frac{\textit{Target Debt Service}_{it}}{UPB_{it}} \tag{2}$$

Note that borrowers are only required to hedge the *index value* of their annual interest rate paid, not the full annual interest rate, so we need to subtract off the margin from the Target Rate. Today's floating-rate SASB loan index is one-month SOFR. Since the index used to set the margin for many of the SASB loans was initially LIBOR, we need to adjust the margin for SOFR. The Alternative Reference Rates Committee (ARRC) settled on using the five-year historical difference between LIBOR and SOFR, set on March 5, 2021, recommending a Constant Spread Adjustment (CSA) of 11.448 basis points to the LIBOR-based margin. To get the appropriate Maximum Cap Strike Rate, we adjust the Target Rate to take off the LIBOR margin and the CSA. For 2022, all SASB loans became SOFR-indexed, so no spread adjustment is needed. Thus, the new Max Cap Strike for all pre-2022 issued SASB deals is set at:

$$\textit{Max Cap Strike}_{it} = \textit{Target Interest Rate}_{it} - \sum_{i=1}^{k} Margin_{it} + 0.011448\% \tag{3}$$

subject to:

$$Max\ Cap\ Strike_{it} = Max[MaxCapStrike_{it}, InitialCapStrike_{it}] \tag{4}$$

That is, according to the pooling and servicing agreements, the Max Cap Strike Rate is the greater of the computed maximum capital strike rate and the initial cap strike rate.

Table A1.
Private Label CMBS Issuance before 1998

Notes: The table summarizes counts and balances for all pre-1998 U.S. private label CMBS issuance counts and balances for permanent loan pools, as reported by Green Street. Lease-backed, re-securitizations and purely private placements are excluded. SASB = single-asset, single-borrower.
Source: Green Street

Pre-1998 CMBS Deals

Deal Type	N	Issuance Balance ($ Bil.)	Year First Issued
Seasoned Collateral	235	56.8	1985
SASB	143	18.5	1992
Agency Multifamily	66	9.2	1990
Small Balance Legacy Conduit	58	29.3	1992
Large Loan	11	8.8	1994
Conduit/Fusion	5	7.1	1997
Floating Rate	5	3.4	1994
Totals	523	133.1	

Table A2. Insurance Company and Bank CMBS Holdings for 2021

This table summarizes insurance company and bank private label (PL) CMBS and Agency CMBS security holdings in 2021. Insurance company holdings are from their Schedule D reports. Bank holdings are from 2021 Q4 Bank Holding Company Schedule Y-9C reports. Agency CMBS are securities issued through Ginne Mae, Fannie Mae, and Freddie Mac. P/C = Property and Casuality, LISCC = Large Institution Supervision Coordinating Committee, LFBO = Large and Foreign Banking Organization, RBO = Regional Banking Organization, CBO = Community Banking Organization.
Sources: NAIC, Bank Y-9Cs, Intex

Insurers' CMBS Holdings for 2021 ($ Millions)

Type	Life	P/C	Health	Title	Totals
PL CMBS	158,199	49,083	9,215	14	216,511
Agency CMBS	46,463	28,543	1,909	83	76,998
Total CMBS	204,662	77,626	11,124	97	293,509

Source: NAIC

Bank CMBS Holdings 2021Q4 ($ Millions)

Type	LISCC	LFBO	RBO	CBO	Totals
PL CMBS	20,403	28,087	8,972	4,762	62,224
Agency CMBS	76,834	280,104	78,285	43,900	479,123
Total CMBS	97,237	308,192	87,256	48,662	541,347

Source: Bank Y-9C

CMBS Market Shares of Insurers and Banks 2021 (%)

Insurer Share	Life	P/C	Health	Title	Totals
PL CMBS	25	8	1	0	34
Agency CMBS	5	3	0	0	8

Bank Share	LISCC	LFBO	RBO	CBO	Totals
PL CMBS	3	4	1	1	10
Agency CMBS	8	30	9	5	52

Total Private Label and Agency CMBS at Year-End 2021 ($ Millions)

Total PL CMBS	637,900
Total Agency CMBS	919,850

Table A3. Master and Special Servicer Differences Conduit and SASB Deals 1998-2022

Notes: This table shows counts and deal issuance balances of conduit and SASB deals as to whether the Master and Special Servicers are the same or different, in total and broken out between CMBS 1.0 (1998-2009) and 2.0 (2010-2022). SASB = single-asset, single-borrower. Source: Green Street

Deal Type	Counts		
	Different	Same	% Same
Conduit 1.0	388	86	18
Conduit 2.0	479	24	5
SASB 1.0	38	74	66
SASB 2.0	334	300	47
All Conduit	867	110	11
All SASB	372	374	50

Deal Type	Balances, $ Thousands		
	Different	Same	% Same
Conduit 1.0	720,392	81,713	10
Conduit 2.0	483,821	18,038	4
SASB 1.0	14,739	48,596	77
SASB 2.0	211,549	170,830	45
All Conduit	1,204,213	99,751	8
All SASB	226,288	219,425	49

A3 Correlations Among Commercial Property Price Indices

Two primary sources for commercial property price indices (CPPIs) are Real Capital Analytics (RCA) and CBRE. Both provide national indices for different property types. RCA offers an all commercial property index (All Comm) and splits office into Office Central Business District (CBD) and Office Suburban, which CBRE does not. However, CBRE offers a Hotel index, which RCA does not. RCA gathers data from public records and hand collection from market participants, while CBRE sources its transaction data from internal deal records. We examine correlations in these indices to identify possible differences in the current downturn versus past downturns.

Table A4 provides Pearson correlation coefficients for RCA and CBRE indices, separately, across different property types for two different periods in our sample. We subset indices by the downturn in the PL CMBS market in 2008-2010, following the GFC, and the current downturn. We define the current downturn using the same number of years (three) as the GFC market downturn and end it at the most recent data time, which creates a "current downturn" time frame of Q3 2020-Q2 2023. The current downturn is roughly the start of the pandemic through the latest period, five quarters into the Federal Reserve's rate hiking cycle. As shown, diversification did not provide expected benefits in CMBS 1.0 conduit deals during the GFC market downturn due to the widespread decline in all CRE sectors. However, diversification may provide benefits for conduit 2.0 deals, as industry sectors are not as correlated in the current downturn.

Several things stand out from these tables. During the current downturn, property type correlations range from 47.7% to 99.5% for RCA and -79.9% to 85.3% for CBRE. Office CBD is much less correlated with other property types now than in 2008-2010. This is likely due to the differing impacts of COVID by industry, especially due to work from home (WFH) policies. WFH negatively impacted Office CBD vacancy rates more than other property types (Gupta, Mittal, and Van Nieuwerburgh (2022)), such as industrial properties, which are often warehouses used to store inventory for e-commerce purchases. Warehouses benefited from high demand for e-commerce during COVID. CBRE indexes also show negative correlations between office and retail, as well as office and hotel. Counter to the very high correlations in the 2008-2010 period, several indices are much less correlated with each other in the current downturn.

The lack of correlation in prices between property types may help diversify risks in conduit securitizations. In contrast, SASB deals often are homogeneous in property type and in the same geographic locale, which exposes SASBs to idiosyncratic risks.

Table A4. Cross-Correlations of Property Type Indices from RCA and CBRE

The following panels give cross-correlations for two commercial property price index sources: Real Capital Analytics (RCA) and CBRE. Correlations are calculated over two periods of downturns in the CRE market: the period following the Global Financial Crisis (GFC) in 2008-2010 and the current downturn started during the pandemic in Q3 2020 through the latest reporting period, Q2 2023, five quarters into the Federal Reserve's latest rate hiking cycle. RCA data are monthly, while CBRE data are quarterly.
All Comm=General index including all commercial properties. Office CBD=Central Business District office buildings. Office Sub=Suburban office.

*, **, and *** denote p-values less than 0.10, 0.05, and 0.01, respectively.

Panel A: RCA Correlation Coefficients

Industry	Multifamily	Retail	Industrial	Office CBD	Office Sub	All Comm
GFC (2008-2010)						
Multifamily	1.0000					
Retail	0.9897***	1.0000				
Industrial	0.9883***	0.9993***	1.0000			
Office CBD	0.9972***	0.9895***	0.9878***	1.0000		
Office Sub	0.9853***	0.9928***	0.9942***	0.9890***	1.0000	
All Comm	0.9926***	0.9990***	0.9991***	0.9930***	0.9963***	1.0000
Current Downturn (Q3 2020 - Q2 2023)						
Multifamily	1.0000					
Retail	0.9950***	1.0000				
Industrial	0.9479***	0.9678***	1.0000			
Office CBD	0.5150**	0.4770**	0.2550	1.0000		
Office Sub	0.9633***	0.9592***	0.8943***	0.5662***	1.0000	
All Comm	0.9855***	0.9902***	0.9542***	0.4997**	0.9829***	1.0000

Panel B: CBRE Correlation Coefficients

Industry	Multifamily	Retail	Industrial	Office	Hotel
GFC (2008-2010)					
Multifamily	1.0000				
Retail	0.9948***	1.0000			
Industrial	0.9977***	0.9948***	1.0000		
Office	0.9930***	0.9873***	0.9975***	1.0000	
Hotel	0.9866***	0.9916***	0.9940***	0.9925***	1.0000
Current Downturn (Q3 2020 - Q2 2023)					
Multifamily	1.0000				
Retail	0.1549	1.0000			
Industrial	0.8533***	0.3759	1.0000		
Office	-0.0030	-0.6524*	-0.3389	1.0000	
Hotel	0.5586	0.5587	0.8279***	-0.7993**	1.0000