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Credit risk transfer and de facto GSE reform

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Abstract

We summarize and evaluate Fannie Mae and Freddie Mac's credit risk transfer (CRT) programs, which have been used since 2013 to shift a portion of credit risk on more than \$1.8 trillion of mortgages to private sector investors. We argue that the CRT programs have been successful in reducing the exposure of the federal government to mortgage credit risk without disrupting the liquidity or stability of mortgage secondary markets. In the process, the programs have created a new financial market for pricing and trading mortgage credit risk, which has grown in size and liquidity over time. The CRT programs provide an important building block to help facilitate reform of the U.S. housing finance system.

Key words: mortgage, credit risk transfer, securitization, Fannie Mae, Freddie Mac, GSE

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1. Introduction

Nearly a decade into the conservatorships of Fannie Mae and Freddie Mac, no legislation has yet been passed to reform the housing finance system and resolve the long-term future of these two government-sponsored enterprises (GSEs). The GSEs have, however, implemented significant changes to their operations and practices over this period, even in the absence of legislation.¹ The goal of this paper is to summarize and evaluate one of the most important of these initiatives – the use of credit risk transfer (CRT) instruments to shift mortgage credit risk from the GSEs to the private sector.²

Fannie Mae and Freddie Mac have significant mortgage credit risk exposure, largely because they provide a credit guarantee to investors on the agency mortgage-backed securities (MBS) they issue. Since the CRT programs began in 2013, Fannie Mae and Freddie Mac have transferred to the private sector a portion of the credit risk on approximately \$1.8 trillion in single-family mortgages (as of December 2017; source: Fannie Mae, 2017, Freddie Mac, 2017). The GSEs have experimented with a range of different risk transfer instruments, including reinsurance, senior-subordinate securitizations, and transactions involving explicit lender risk sharing. The bulk of CRT, however, has occurred via the issuance of structured debt securities whose principal payments are tied to the credit performance of a reference pool of securitized mortgages. A period of elevated mortgage defaults and losses will trigger automatic principal write-downs on these CRT bonds, partially offsetting credit losses experienced by the GSEs.

[Figure A: Credit Risk Transfer Volumes by Transaction Type]

Our thesis is that the CRT initiative has improved the stability of the housing finance system and advanced a number of important objectives of GSE reform. In particular the CRT programs have

¹ Aside from credit risk transfer, other reforms implemented over the period of the GSE conservatorships include the development of a common securitization platform for issuing MBS, the single security initiative to issue MBS backed by collateral from both GSEs, changes to the level and structure of guarantee fees, and changes and clarifications to representations and warranty arrangements. These changes have taken place under the stewardship of the GSEs' regulator and conservator, the Federal Housing Financing Agency (FHFA). More detail about these initiatives is available from the FHFA website (fhfa.gov). The GSEs have also wound down the size of their retained mortgage and MBS portfolios over time, in line with the preferred stock purchase agreements reached between the GSEs and U.S. Treasury when the conservatorships began in September 2008.

² Although there is little academic literature on the GSE credit transfer programs, for related discussions of these programs from public policy and practitioner perspectives please see Zandi et al. (2017), Goodman et al. (2016), Davidson et al. (2016), Goodman and Parrott (2016) and FHFA (2015).

meaningfully reduced the exposure of the Federal government to mortgage credit risk without disrupting the liquidity or stability of secondary mortgage markets. In the process, the CRT programs have created a new financial market for pricing and trading mortgage credit risk, which has grown in size and liquidity over time. Given diminished private-label securitization activity in recent years, these CRT securities are one of the primary ways for private-sector capital market investors to gain exposure to residential mortgage credit risk.

An important reason for this success is that the credit risk transfer programs do not disrupt the operation of the agency MBS market or affect the risks facing agency MBS investors. Because agency MBS carry a GSE credit guarantee, agency MBS investors assume that they are exposed to interest rate risk and prepayment risk, but not credit risk. This reduces the set of parameters on which pass-through MBS pools differ from one another, improving the standardization of the securities underlying the liquid to-be-announced (TBA) market where agency MBS mainly trade³. Even though the GSEs now use CRT structures to transfer credit risk to a variety of private sector investors, these arrangements do not affect agency MBS investors, since the agency MBS credit guarantee is still being provided *only* by the GSE. In other words, the GSE stands in between the agency MBS investors and private-sector CRT investors, acting in a role akin to a central counterparty.

Ensuring that Fannie Mae and Freddie Mac's credit risk sharing efforts occur independently of the agency MBS market is important for both market functioning and financial stability. The agency MBS market, which remains one of the most liquid fixed income markets in the world, proved to be quite resilient during the 2007-2009 financial crisis, helping to support the supply of mortgage credit during that period. The agency market financed \$2.89 trillion of mortgage originations during 2008 and 2009, experiencing little drop in secondary market trading volume during that period (Vickery and Wright, 2013). In contrast, the non-agency MBS market, where MBS investors are exposed directly to credit risk, proved to be much less stable; Issuance in this market essentially froze in the second half of 2007, and has remained at low levels since that time.⁴

³ The to-be-announced (TBA) market is a forward market for agency pass-through MBS. In a TBA trade, the buyer and seller agree on a set of characteristics of the pool (issuer, term, coupon, settlement month), but do not stipulate the exact security which will be delivered at settlement. This thereby concentrates trading into a small number of liquid contracts, enhancing the liquidity of typically highly heterogeneous individual mortgages. See Vickery and Wright (2013) for more details.

⁴ This freeze in non-agency MBS liquidity reduced mortgage credit availability for loans which could no longer be securitized; for example, interest rates for jumbo mortgages rose sharply relative to rates on conforming

The remainder of this paper is structured into four sections. Section 2 provides background on the risks faced by Fannie Mae and Freddie Mac and different mechanisms used by the GSEs to mitigate their exposure to mortgage credit risk. Section 3 explains the mechanics of how CRT instruments work, and provides descriptive statistics about the growth and composition of this market. Section 4 considers some potential improvements to the market and its ancillary structures. Section 5 concludes.

2. Background and history of GSE credit risk sharing

Residential mortgages are exposed to three key types of risk: interest rate risk, prepayment risk, and credit risk. In an agency mortgage securitization, Fannie Mae and Freddie Mac effectively transfer interest rate and prepayment risk to agency MBS investors.⁵ Credit risk is however retained by the GSEs, who provide a credit guarantee of timely payment of principal and interest on the MBS, even if there are defaults on the mortgages in the MBS pool. This credit risk exposure of Fannie Mae and Freddie Mac is substantial, given that the GSEs own or guarantee \$5.1 trillion of residential mortgages (FHFA, 2017a).

Fannie Mae and Freddie Mac manage this credit risk in a number of ways:

- 1. Guarantee fees.** The GSE issuer receives up front and ongoing guarantee fees from the pool to compensate them for their MBS credit guarantee. Historically these guarantee fees have not varied significantly based on mortgage loan credit characteristics (Hurst et al., 2016), although since 2008, up-front fees have been sensitive to loan-to-value ratios and borrower credit scores (see FHFA, 2016a, for more details).
- 2. Private mortgage insurance.** Under their charters, the GSEs cannot purchase mortgages with loan-to-value ratios exceeding 80 percent unless those loans have additional credit enhancement. This requirement is generally met by requiring mortgage borrowers to obtain private mortgage insurance (PMI). PMI reduces the GSEs' credit risk exposure although it

mortgages which could be funded through the still-liquid agency MBS market (Vickery and Wright, 2013). Kung (2015) finds evidence that the liquidity freeze had broader macroeconomic effects, in particular that it reduced home prices. Kung identifies this result using microeconomic data on home sales and listings and changes in the conforming loan limit in 2008.

⁵ Fannie Mae and Freddie Mac are also exposed to interest rate risk and prepayment risk associated with mortgage assets which are retained in portfolio rather than sold. Historically this risk was substantial (Jaffee, 2003), although the GSEs have significantly reduced the size of their retained mortgage portfolios over the past decade.

exposes them to counterparty risk if the PMI provider is unable to perform on the insurance contract, as may be the case during a severe housing downturn.⁶

- 3. Underwriting standards.** The GSEs set minimum standards governing which mortgages they will guarantee, including maximum debt-to-income and minimum credit score requirements, property inspection and appraisal requirements, and required documentation of borrower income and assets.
- 4. Representations and warranties.** Fannie Mae and Freddie Mac require loan sellers to agree to a set of representations and warranties setting out terms under which the seller must repurchase the loan at par (e.g., in the case of mortgage fraud or significant misrepresentation of loan terms).⁷
- 5. Equity capital.** Equity capital provides an additional buffer against insolvency if credit losses exceed guarantee fee income and other revenue. Historically, the GSEs faced minimum capital requirements, which would need to be evaluated under more comprehensive GSE reform. Today, the two firms essentially have no equity capital, because retained earnings are remitted to the U.S. Treasury under the revised terms of the firms' conservatorship (see Frame et al., 2015, for more information on the conservatorships).

Despite the use of these credit risk management tools, Fannie Mae and Freddie Mac experienced high mortgage credit losses during the 2007-2009 financial crisis period, leading to the conservatorship of the two GSEs in September 2008. This experience highlighted the need to find ways to more effectively mitigate credit risk. This mitigation has in part been achieved by significantly increasing and redesigning guarantee fees, strengthening fraud detection, and winding down the size of the GSEs' retained mortgage portfolios.

To supplement these steps, in 2012, Fannie Mae and Freddie Mac's regulator, the Federal Home Financing Agency (FHFA), established its intent to develop "loss sharing agreements" under which

⁶ Bhutta and Keys (2017) document the financial distress experienced by the private mortgage insurance industry during the 2007-09 financial crisis, including the failure of several large PMI providers.

⁷ The GSEs have revised their representations and warranty framework in recent years to provide additional clarity to lenders about the conditions under which mortgages may be repurchased (e.g., see Goodman, Parrot and Zhu, 2015; Housing Wire, 2014). These changes have been motivated by concerns that uncertainty around repurchase risk may be reducing mortgage credit supply, particularly for riskier types of loans.

private investors would bear credit risk on mortgage loans underlying agency MBS (see FHFA, 2012).⁸ The first credit risk transfer pilot transaction was a Structured Agency Credit Risk (STACR) offering brought to market by Freddie Mac in mid-2013.⁹ The first Connecticut Avenue Securities (CAS) bond offering from Fannie Mae followed shortly thereafter. In addition to issuing STACR/CAS securities on a fairly regular basis, the GSEs have also tested a range of other instruments such as lender risk-sharing and reinsurance.

The FHFA has established several principles which are used in evaluating and fine-tuning the design of the CRT programs. Among these are: (i) reducing taxpayer risk, (ii) engaging in transactions which are economically viable (where the cost of transferring the credit risk does not meaningfully exceed the cost of the GSEs retaining that risk), (iii) not interfering with the continuation of the GSEs' core business of acquiring and securitizing mortgages and guaranteeing mortgage-backed securities and (iv) designing transaction structures that will be robust and retain CRT investor interest throughout different phases of economic and housing cycles (see FHFA, 2016b, for a complete list).

2.1 Private versus public sector assumption of mortgage credit risk

Should the GSEs aim to transfer *all* mortgage credit risk to private investors? Asset pricing theory would suggest that the “price” of credit risk is the same regardless of which party owns that risk, and therefore that the GSEs (backed up by the Federal government) have no particular comparative advantage in bearing that risk. From this perspective, it may be appropriate, or at least benign, to sell off all credit risk to the private sector.¹⁰

⁸ Related to this paper, see Frame (2003) for a discussion of mortgage risk-sharing transactions undertaken in an earlier program by the Federal Home Loan Banks.

⁹ In this inaugural transaction, Freddie Mac retained the risk of the first 0.3 percent of credit losses on the reference pool, transferred a substantial portion of the next 2.7 percent of credit losses across two tranches (mezzanine tranches M1 and M2), and retained top 97 percent of loss risk. For the purposes of measuring credit losses, a credit event was defined as the event of a loan becoming 180-day delinquent, and loss severity was defined to be 15 percent for the initial 1 percent of defaults, with defaults exceeding this initial level being assigned a progressively higher severity rate. These features simplified loss modeling, because it meant that investors did not need to worry about foreclosure and property liquidation timelines, which impact both cash flow timing and ultimate realized loss severity. This structure introduces basis risk for the issuer, however, because realized credit losses will differ from the calculated loss rate based on these stylized assumptions.

¹⁰ One reason to minimize the government guarantees and other contingent liabilities is that such liabilities are not properly fair valued for budgetary purposes. Thus, the presence of such guarantees may yield a misleading position of the government's fiscal position (Lucas and McDonald, 2010).

There are likely to be some limits to this “full risk transfer” argument, however. First, in a financial crisis, specialized mortgage investors may be financially distressed or face high costs of external finance, leading to high risk premia for mortgage credit risk (as in the model of Shleifer and Vishny, 1992; see Stanton and Wallace, 2011, for evidence). In such cases, it may be appropriate and stabilizing for government to bear more risk, at least temporarily, particularly considering the central role of housing in the business cycle and in propagating financial crises (Leamer, 2015; Reinhart and Rogoff, 2009). The FHFA’s credit risk transfer principles note this consideration explicitly, stating that “*In some market downturns, the Enterprises could retain credit risk for a period of time and then subsequently transfer it to private investors when more normal market conditions return*” (FHFA, 2016b). For example, the GSEs would likely retain the credit risk on a mortgage pool if the cost of risk transfer significantly exceeded the guarantee fee income on the underlying mortgages.

By the same logic, it may be costly to reinsure extreme mortgage tail risks which would be realized only in a crisis or severe recession. In an insurance context, Froot (2001) documents the lack of supply of private capital for tail risk catastrophe reinsurance.

Second, the GSEs play an important ex ante screening role in setting standards for which mortgages they will purchase and securitize into agency MBS. They also conduct ongoing monitoring of loan performance and compliance with representations and warranties. It may be useful for the GSEs to retain at least some risk for incentive reasons, analogous to a deductible on a standard insurance policy.

How do these considerations match up to the portions of credit risk transferred to date using the CRT programs? Using the taxonomy of FHFA (2015), the GSEs’ credit risk exposure can be segmented into: (i) *expected losses* likely to occur in a typical time period, (ii) *unexpected losses* occurring in a period of heightened defaults such as a recession or housing market downturn, and (iii) *catastrophic losses*, which occur during a severe and unlikely tail event. The GSEs currently generally retain the first loss exposure (e.g., for the first 50 basis points of credit losses), as well as extreme tail risk (e.g., losses in excess of roughly 400 basis points) and have focused on transferring risk associated with unexpected credit losses. The benefits and drawbacks of the current extent of risk sharing has been widely debated, as we discuss further in section 4.

3. Mechanics, structure, and trading of STACR/CAS synthetic notes

Although the GSEs have experimented with a number of different risk transfer instruments, the STACR and CAS debt securities have been the most widely used, accounting for 77% of the risk in force shed from the GSEs' balance sheets (FHFA 2017b).¹¹ While other risk sharing models, such as front-end risk transfers and reinsurance transactions, have their own merits, the broad investor base in STACR/CAS transactions, combined with the independence of the structure from other parts of the agency MBS market has helped the securities gain a wide acceptance and a broad investor support in the marketplace.

3.1 Basic structure

Figure B represents an illustrative STACR/CAS structure in which the Enterprises transfer credit risks on a reference pool of 30 year fixed rate GSE-guaranteed mortgages.¹² The STACR/CAS securities are floating rate fixed income securities that pay the investor an interest rate tied to the 1-month London Interbank Offer Rate (LIBOR) plus a spread determined by market demand at the time of the primary market issuance of the bond, discussed in more detail below. Recently issued securities have a 12 1/2 year final maturity, with a call option for the GSE after 10 years.¹³

[Figure B: Illustrative Enterprise Debt Issuance Structure]

The key feature of these STACR/CAS bonds is that the required principal payments are linked to the credit performance of a mortgage reference pool. In the representative example shown in Figure B, the securities are divided, or tranching, into four risk slices.¹⁴ Starting with the most junior securities, the bottom 0.5 percent of the structure represents the "first loss" piece covering the *expected credit losses*. The GSEs retained all of the first loss tranche in early CRT transactions, but have also sold portions of this risk in a subset of more recent transactions. Immediately senior to this first loss tranche are three

¹¹ The term "risk in force" refers to the maximum credit loss which could be incurred by the investor in the credit risk transfer instrument. For example, if a STACR bond assumed the first 3% of credit losses on a \$10bn mortgage reference pool, the risk in force would be \$300m.

¹² To date, all STACR/CAS deals have referenced 30-year fixed rate mortgages (FRMs), which represent the majority of the mortgage collateral securitized into agency MBS. Shorter-term FRMs (e.g., 15 year FRMs) also bear less credit risk than 30 year FRMs, reducing the need to transfer credit risk on these loans. Even so, it seems possible that CRT programs could be expanded to other loan types in the future.

¹³ This means that the GSE can prepay the bond at par after 10 years. In practice, it is expected that the GSEs would exercise this call option under nearly all scenarios, given that after 10 years the remaining mortgages will generally have little remaining credit risk, making the bond an expensive source of funding relative to the amount of credit protection provided. Earlier CRT deals had 10 year final maturities with no call option.

¹⁴ In practice, the number of tranches differs by CRT transaction. More complex transactions generally involve the same basic structure as shown here, but include a larger number of mezzanine tranches.

mezzanine tranches that cover credit losses between 0.5 and 1.0 percent (typically referred to as B1), 1.0 and approximately 3.0 percent (typically referred to as M2), and 3.0 to approximately 4.0 percent (typically referred to as M1).¹⁵ Credit risk for both mezzanine tranches, covering elevated *unexpected losses*, is sold to private investors, with the GSEs typically retaining only a small 5 percent vertical slice of each mezzanine tranche. Finally, the top roughly 96 percent of the structure, the “senior tranche”, is entirely retained by the GSEs to cover *catastrophic losses*.

After issuance, when the GSE receives the proceeds from the debt sale, the GSEs begin forwarding principal and interest payments to the investors. The lower STACR/CAS tranches, which bear more credit risk, receive higher coupon payments relative to more senior tranches. Scheduled principal payments and prepayments result in a corresponding pro rata paydown of principal between the GSE-retained senior tranche (the top 96% of the structure in recent transactions) and the mezzanine classes of STACR/CAS notes sold to investors. But initially this is not the case; instead, prepayments are solely directed towards the senior tranche, resulting in an increase in the credit enhancement of the senior class over time. Typically, this occurs until credit enhancement has increased by 25-50bps relative to the initial credit enhancement, thereby affording the GSEs incremental protection against credit losses relative to initial credit enhancement available at transaction inception.¹⁶

Within the set of mezzanine tranches, principal payments are allocated in order of seniority; thus, payments will first be made to the M1 tranche, leading the outstanding balance of the M1 tranche to decline towards zero over time.¹⁷ Figure C illustrates how the unpaid balance of the different tranches for a typical CRT deal evolves over time under a baseline scenario.

[Figure C: Anticipated CAS Deal Balance and Cash Flows]

¹⁵ Some of the earlier STACR bonds have a three tranche structure. For example, in STACR-2016-DNA2 M1 covers credit losses ranging from 4.0 to 5.0 percent of the reference pool, M2 covers losses between 3.05 to 4.0 percent, and M3 covers losses between 1.0 to 3.05 percent.

¹⁶ In addition, there are delinquency and cumulative net loss tests in the deal that are designed to provide incremental structural protection to the GSE-retained senior tranche, should performance deteriorate beyond initial expectations. These tests are designed to shut off mezzanine tranches from principal cash flow should delinquencies and losses increase above pre-determined thresholds.

¹⁷ After prepayments and scheduled amortization have extinguished the M1 tranche, further principal payments are allocated to the M2 tranche, and so on. Meanwhile, losses are being allocated to the most junior tranche outstanding, initially the B2 tranche. Mortgage delinquencies can result in one of three outcomes: 1) they can be cured in which case no loss occurs, 2) they can be modified, in which case the difference between the original loan and the modified loan is passed as a loss on a monthly basis, 3) the underlying loan property might be disposed in which case the loss is passed as a onetime reduction in principal at the time of the disposition of property. The loss would be the difference between the loan amount and the net proceeds from the disposition (essentially the property sale amount less transaction costs).

The GSEs assume no counterparty risk through the STACR/CAS structure. CRT investors pay for the notes in full at purchase and absorb credit losses through reduction in the principal value of the bonds. After the sale of the securities, the GSEs manage the proceeds to generate a return close to 1-month LIBOR to ultimately service the floating leg of the STACR/CAS coupon paid to the investors. As the mortgage loans in the reference pool prepay, the GSEs pay down the bonds accordingly. However, if mortgage loans in the reference pool default, the GSEs will use a portion of cash, equivalent to the loss incurred, to reimburse themselves for the cost of making full payment of principal and interest to the investors in the MBS pool. In this situation, the face value of the STACR/CAS bond will be written down, and the investor will lose a corresponding portion of the principal payment and associated interest.

It should be noted that high-LTV mortgages in GSE securitizations have credit enhancement in the form of private mortgage insurance. Credit losses on the reference pool are measured net of payouts on the private mortgage insurance. However, it is the GSE, not the STACR/CAS investor, which bears the counterparty risk associated with contractual failure to pay by the PMI provider.¹⁸ This simplifies credit analysis from the perspective of the STACR/CAS investor.

Early STACR/CAS deals involved a concept of scheduled severity, whereby loss severity assigned to defaulted loans for purposes of determining losses to be allocated to CRT investors were pre-defined up front at deal issuance.¹⁹ Although this approach helped attract investors to this developing sector in the early stages of its life cycle, the use of this formulaic approach led to an imprecise hedge against losses for the GSEs, given that actual defaults and loss severities realized in practice may differ from the scheduled severity assumptions. With that in mind, starting in 2016, both Fannie and Freddie made adjustments to the structures, transitioning to a configuration where losses would accumulate to the bondholders upon actual property liquidation (or a similar event) and would reflect actual realized loss severity.

3.2. Primary market issuance

¹⁸ For instance, the GSE would cover any counterparty losses due to the bankruptcy of a PMI provider. However, if for example, if a borrower walks away from a hurricane-damaged property, the GSEs would not cover the mortgage insurers' failure to pay, because the mortgage insurer would not be contractually obligated to cover the damage in this case.

¹⁹ In this formulaic approach, a loan default was defined as 180 day delinquency, in addition to certain other events, such as foreclosure sale or deed-in-lieu. A pre-specified loss severity schedule is then applied to every defaulted loan. Loss severity increases with the level of defaults.

CRT transactions are issued in a fairly predictable, regularly-scheduled fashion roughly every four weeks alternating between Fannie Mae and Freddie Mac. Since the initiation of the program in 2013, Fannie Mae has issued 23 CAS deals, while Freddie Mac has issued 31 STACR deals (as of late 2017).²⁰

[Figure D: CRT Issuance Volumes and Spreads at Issuance]

Deals are generally announced and marketed one week before pricing. STACR/CAS securities are issued through a syndication process in which participating broker-dealers take customer orders and adjust pricing to most effectively match customer demand with the supply of bonds from the GSEs. Since bonds are issued at par, pricing is adjusted via a fixed spread over Libor payable by each bond, which represents the effective cost of CRT financing for the GSE. Broker-dealers and the GSEs strive to avoid situations in which overly aggressive pricing leads to poor performance in the secondary market shortly after transaction pricing. Similarly, they also attempt to avoid situations whereby pricing is overly conservative such that GSEs end up overpaying investors for the protection they buy. Every attempt is made to price each deal so that secondary trading post transaction pricing is orderly and does not cause undue volatility for a given issue or the sector at large.

Once pricing is set, the GSEs ultimately allocate the bonds to the individual investors according to their internal methodology. While that methodology is not disclosed to investors, the GSEs appear to favor investors that place orders earlier in the syndication process over ones that place later orders. Given that earlier investors face greater price risk, this allocation method rewards investors taking on greater risk.

The STACR/CAS market has grown in size and investor popularity over time, reflecting continued investor demand for residential mortgage credit risk amid a shrinking volume of available credit-sensitive mortgage securities. As a whole, the residential credit sector is now less than one third of its pre-crisis peak size, reflecting low issuance of non-agency MBS since 2007. Although CRT securities represent only 5.1 percent of this smaller market's total outstanding size, STACR/CAS issuance represented 21 percent and 18 percent of aggregate residential credit gross issuance in 2016 and 2017, respectively (SIFMA 2017).

The growth in investor interest in the STACR/CAS market has also benefited from:

²⁰ These statistics are through the end of 2017, excluding the STACR SPI and HARP deals issued in Q4 2017. The most recent CAS and STACR securities considered at time of writing were issued on November 21 and October 18, 2017, respectively.

- The regularity of and transparency around primary market issuance,
- Granular loan-level historical performance data which has been made available by the GSEs, helping investors to model credit performance across various market environments and macroeconomic scenarios (see also Canter 2017),
- A sound economy and housing market²¹, and
- The availability of credit ratings from a number of credit rating agencies (e.g., Fitch). Ratings for some CRT bonds have been frequently upgraded since issuance (see figure E below).

[Figure E: Bond Rating Upgrades]

3.3. Secondary market trading and liquidity

Secondary market trading of STACR/CAS has more than doubled from an average of \$47.7 million per day in 2014 to \$117.1 million per day in 2017, roughly proportional to the expansion in the volume of outstanding securities. As shown in figure F, CRT trading volume fluctuates significantly over time. For example, volume increased in early 2016, corresponding to a period of elevated market volatility and widening in credit spreads. Trading volume for STACR and CAS bonds tends to move closely together, reflecting the high degree of substitutability between the two types of securities. Trades are typically conducted in \$2-10 million block sizes, smaller than commonly seen in agency MBS, particularly in the much larger and more liquid TBA market, yet comparable with other sectors of the fixed income market such as corporate bonds and non-agency MBS. Figure G reports some summary statistics about trading volume drawn from FINRA TRACE data. Trade size for STACR/CAS securities averages \$2-3 million, and is roughly similar across securities of different seniorities.

[Figure F: Average Daily Trading Volumes]

[Figure G: FINRA TRACE Trading Volumes Table]

Figure H plots on-the-run yield spreads to Libor on STACR/CAS bonds as well as for high-yield corporate bonds. After rising in the second half of 2015, STACR/CAS yield spreads have declined significantly since early 2016, broadly tracking high yield corporate credit spreads over the same period. On net, spreads

²¹ National home prices measured by the Case-Shiller index have grown in excess of 5% at a seasonally adjusted annual rate over the life of the CRT programs (2013-17). Meanwhile, mortgage lending standards remain tight by most measures, while mortgage delinquencies remain at levels similar to those seen during the prior housing market peak in 2003-06.

on M2 tranches have tightened from around 400 basis points (bps) in mid-2015 to 250 bps by the third quarter of 2017.

[Figure H: On The Run CRT Spreads vs High-Yield Bonds]

Two periods of spread widening are worth noting. First, STACR/CAS spreads spiked by about 200 bps in early 2016, reflecting a general widening in credit spreads due to macroeconomic concerns around the stability of the Chinese economy and the declining price of oil weighing on the spectrum of credit products. STACR/CAS spreads mirrored the general trend in high yield spreads during this episode, despite no evidence of deterioration in underlying housing and mortgage market fundamentals. Second, STACR/CAS spreads widened by about 100 bps during August and September of 2017, as the anticipation of extensive hurricane damage to Texas and Florida raised investor concerns about heightened mortgage default risk. The spread widening ultimately reversed in both cases, reflecting a sound housing market and strong demand for credit, but the temporary widening provides a “real-time” measure of market expectations about the anticipated effect of these events on credit loss rates for agency-eligible residential mortgages.

3.4. Investors

The CRT investor base has broadened over time and Freddie Mac has publically indicated that they have seen more than 200 distinct investors in their credit-risk transfer transactions.²² The largest CRT investor group is money managers which invest across the mezzanine stack of securities offered by the GSEs. These money managers are interested in replacing maturing non-agency mortgage holdings and have been consistent CRT investors. Real Estate Investment Trusts (REITs) have similar intentions to money managers but generally invest in the lower mezzanine tranche (M2), which offers a more desirable risk/return tradeoff than more senior tranches for this investor group. Hedge funds also actively invest in the sector, either to take advantage of short-term fluctuations in spreads, or because CRT investments have become an attractive way to speculate on broader housing market performance.²³ Sovereign wealth funds and a limited number of insurance companies round out the investor base. Of note, banks currently do not invest in STACR/CAS securities, primarily due to their high regulatory capital risk weights, which make it difficult for STACR/CAS investments to meet bank return on equity targets.

²² Fannie Mae and Freddie Mac provide regularly updated information on the size and composition of their CRT investor bases on their websites.

²³ The ample availability of repo financing to lever positions and achieve attractive returns has generally made the STACR/CAS securities attractive for the hedge fund community.

The different investment objectives and investment horizons of STACR/CAS investors (in which some investors are motivated by yields over the medium run, while others are focused on short-term directional trading) have supported the growth in sector liquidity since inception. Moreover, the presence of many smaller investors and low-leverage investors, such as asset managers, is a positive feature of the market from the perspective of diversifying mortgage credit risk exposure and reducing overall systemic risk. One caveat, however, is that the increasing depth of the CRT investor base has occurred during a period of quiescence in the housing market and broader macroeconomy. The market has not yet been tested by a significant period of falling home prices and elevated mortgage defaults.

3.5 Other risk transfer instruments

Although STACR/CAS has been the core of the GSE credit risk transfer initiative, the two enterprises also make use of several other structures. Largest among these, the GSEs purchase credit reinsurance from a set of highly-rated diversified reinsurers through the Freddie Mac Agency Credit Insurance Structure (ACIS) and Fannie Mae Credit Insurance Risk Transfer (CIRT) programs. These reinsurance transactions are structured the same way as STACR/CAS, and are used either to reinsure the retained vertical slice of mezzanine risk on a STACR transaction (in the case of ACIS), or a standalone reference pool. These transactions are partially collateralized, reducing but not completely eliminating counterparty risk.

In addition, the GSEs have also experimented with senior-subordinated transactions, in which a pool of mortgage collateral is effectively securitized into several tranches of MBS, and the junior bonds do not carry a credit guarantee. The current active program of this type is the STACR Securitized Participation Interests (SPI) offering introduced by Freddie Mac in late 2017.²⁴ STACR SPI bonds have a fixed coupon rate, rather than the floating rate offered by STACR/CAS bonds.

The GSEs also engage in some “front-end” risk sharing, in which a portion of mortgage credit risk is transferred to a third party prior to securitization. Some front end risk sharing involves a portion of credit risk being retained by the loan seller. The GSEs have also recently made use of “deep cover” private mortgage insurance, in which additional credit risk is insured by specialist mortgage insurers, beyond the required credit enhancement for mortgages with LTV exceeding 80 percent.

²⁴ In a STACR SPI transaction, participation interests in a pool of mortgages are deposited into a trust which issues Freddie Mac gold pass-through MBS. Any loans repurchased due to nonperformance are then deposited in the STACR SPI trust, which thereby assumes any credit losses. STACR SPI replaces the Freddie Mac Whole Loan Securities program. STACR SPI is designed to be a residential MBS transaction, unlike regular STACR bonds which are unsecured debt of the GSEs. See Freddie Mac 2017b for more details.

Maintaining a range of CRT tools helps satisfy the needs of different investors. For example, the fixed coupon rate offered by STACR SPI certificates may appeal particularly to life insurers who generally prefer long-duration investments. It also gives the GSEs flexibility to adjust the mix of CRT instruments over the cycle as demand by different investors fluctuates. This is important for stabilizing overall demand for agency mortgage credit risk, and ensuring the program remains viable in a range of different market environments.²⁵ Experimentation is also valuable in itself, given that the CRT programs are still relatively new.

That said, our assessment is that STACR/CAS should remain at the core of credit risk transfer programs. STACR/CAS has proven successful in attracting a wide range of investors and diversifying exposure to mortgage credit risk, and has created a secondary market for trading and pricing risk. The liquidity of this market will be greater if CRT issuance is concentrated in STACR/CAS rather than being fragmented across a large number of different programs. We also note that front end risk sharing provides less diversification of mortgage credit risk than the various back end programs used to date, since it involves credit risk being retained by loan sellers or specialized private mortgage insurers, which like the GSEs already have a concentrated exposure to mortgage credit risk.

4. Outstanding Issues in CRT Design

The GSE STACR/CAS programs have been a success both for the GSEs and for participating investors. These programs significantly diversified the GSEs' concentrated exposure to mortgage credit risk among a wider number of participants. For investors, the programs provided exposure to a significant part of the residential credit sector. In this section, however, we consider a number of open issues regarding the design of STACR/CAS securities and the GSE CRT programs more broadly.

4.1. Should the GSEs transfer first loss and catastrophic risk?

As discussed in section 2.1, the GSE credit risk exposure can be segmented into expected, unexpected, and catastrophic losses, reflecting progressively higher losses which are correspondingly less likely to

²⁵ Anecdotally we have heard from the GSEs that ACIS/CIRT reinsurers are generally considered to be stable buy-and-hold investors, and include a significant number of foreign investors, helping to diversify mortgage credit risk exposure.

occur.²⁶ Current STACR/CAS security design focuses on transferring the unexpected losses borne by the mezzanine bonds. As discussed below, we deem this to be an appropriate strategy, weighing the costs and benefits of transferring different slices of mortgage credit risk.

Starting at the bottom of the capital structure, although the GSEs have embedded some sharing of the most junior “first loss” tranche of credit losses into recent CRT transactions, they primarily retain this exposure, for several reasons. First, losses sustained on this risk slice (usually around the first 50bp of credit losses) are unlikely to lead to overall net losses for the GSEs after taking into consideration the stream of guarantee fee income earned on the reference mortgage pool.²⁷ Second, given that some credit losses are expected to be incurred even during normal periods, selling the most junior slice of credit losses is of limited benefit from a risk-sharing point of view. Third, by retaining the first loss piece, the GSEs retain “skin in the game” exposure to the deal structure, which may help attract investors and mitigate moral hazard given the important screening and ongoing monitoring role played by the GSEs. Fourth, some private investors may face high capital costs from holding first-loss tranches (e.g., because of minimum capital requirements or other regulations). Given these factors, as well as transaction costs, selling the first loss tranche would be likely to increase the STACR/CAS implied guarantee fee relative to current GSE execution. For example, we estimate that a 50 percent increase in the spreads for the first loss piece would increase the STACR/CAS security implied guarantee fee from 18 bps to 23 bps.²⁸

On the other side, should future risk-sharing transactions attempt to sell catastrophic risk, which to date has been retained by the GSEs? Currently, the GSEs retain exposure to credit losses in excess of roughly four percent of the principal value of the reference pool. Credit losses are only estimated to reach this range under an extremely adverse macroeconomic environment.

²⁶ Expected losses are, as their name suggests, a common part of residential credit. These losses are thought to be independent of the state of the economy or the housing market, but are thought to occur as a result of borrower specific circumstances. Catastrophic losses, meanwhile, are only seen during a significant downturn in the economy or housing market that typically exceeds that of a more frequent business cycle downturn. A business cycle recession or a regional national disaster that witnesses localized or modest national home price declines is expected to impact unexpected losses.

²⁷ The FHFA estimates that the GSEs charged an average annual guarantee fee of 61 bps for 30-year fixed rate mortgages in 2016. 10bp of this fee is distributed to the U.S. Department of Treasury and 7bp is estimated to cover general and administrative expenses. The remainder of the fees covers credit risks included in the insured mortgages, including risk of catastrophic losses.

²⁸ Calculations based on the Fannie Mae issued deal CAS 2017-C06 in which we assume that spreads for B2 tranches from 12% to 18% in a scenario in which Fannie Mae transfers the first loss credit risk to the private market.

As an illustration of this point, the left panel of Figure I presents the projected cumulative credit loss rates for the reference pool in a recent Fannie Mae CAS deal²⁹ assuming that the evolution of macroeconomic conditions matches the experience from different historical vintages. As the figure illustrates, net credit losses are projected to reach 3.0 percent if the mortgage reference pool experienced the same home price and macroeconomic environment as the 2006 vintage, originated just prior to the housing market collapse and 2007-09 recession. Even this scenario would therefore not be likely to lead to full extinguishment of the principal of the mezzanine CRT bonds, given that the senior mezzanine security (M1) for this transaction covers cumulative credit losses up to 4.25 percent.

[Figure I: Projected CRT Net Loss Rates Relative to Historical Experience]

For comparison, the left panel of figure H also shows the actual realized credit loss rate for these different vintages. Note that the conditional expected loss rate of 3.0 percent projected for the CRT reference pool under post-2006 macroeconomic conditions is below the historical actual loss rate of 3.5 percent realized by Fannie Mae on their 2006 mortgage vintage.³⁰ The difference between the two reflects the improvement in credit quality and underwriting standards of agency mortgages post-crisis. However, even under a more conservative assumption where losses match the historical performance of Fannie Mae 2006 vintage mortgages one for one, net credit losses would not exceed the detachment point of the M1 CRT tranche for this deal.

The right panel of Figure I presents results for the same exercise looking across CAS deals issued thus far. Fannie Mae loan level disclosures and modelling show that total credit losses for performance comparable to that experienced by 2006 collateral would not breach the catastrophic loss portion of CAS deals issued to date.

Note that the attachment and detachment points reported in Figure I reflect the *initial* level of credit enhancement at the point in time when the CAS/STACR deal is issued. Even though CRT deals do not

²⁹ CAS 2017-C07, in this case collateral group 1 which represents low LTV pools. The average LTV of the collateral is 75.3%, compared to CAS 2017-C07 collateral group 2, which represents high LTV pools and has an average LTV of 92.5% at issuance. Recall, however that all mortgages with LTV exceeding 80 percent have additional credit enhancement in the form of private mortgage insurance.

³⁰ Represents the credit net loss rate on 2006 issued original unpaid principal balance of Fannie guaranteed residential credit loans. Based on 2006 issuance of \$172.4 billion, net losses totaled \$6.6 billion. The figures exclude losses from expenses related to modification of loans or losses that occurred from loans that remain in the pipeline.

have an explicit cash flow lock out feature³¹, the deals do contain structural features which result in an increase in credit enhancement for the senior tranche and mezzanine class over time, as we discussed in section 3.1. Thus, if a period of housing stress occurred relatively early in a transaction's life, losses would reach further up the capital stack than would be the case in a more seasoned structure which has already delevered somewhat.

This evidence suggests that the senior credit risk tranche currently retained by the GSEs would suffer losses only in a very adverse macroeconomic environment, mirroring or exceeding the 2007-09 financial crisis in magnitude and pervasiveness. We do note that the credit rating agencies project loss rates for a "triple-A" level stress event of the order of 8-9 percent for recent CRT deals, significantly above the detachment point for the M1 CRT bonds. These stress projections are based on very conservative assumptions, however.

This logic suggests that the risk management benefits of transferring the senior tranches of credit risk from the GSEs to the private sector would be relatively small. Furthermore, as we argue in section 2, it also seems appropriate from a fiscal and financial stability perspective for the public sector to retain exposure to mortgage tail risk, given the systemic risk of the housing sector. Against this limited upside, the GSEs would incur some nontrivial costs if they were to transfer this risk. Aside from transaction costs, this asset would be expensive to hold on bank or insurance company balance sheets given constraints around regulatory capital. This asset will also likely command a sizeable liquidity premium.³²

For these reasons, our reading of the evidence is that it is appropriate for the GSEs to retain this catastrophe risk and first loss piece, while continuing to focus on transferring the mezzanine credit risk associated with their guarantee portfolio.

4.2. The tradeoff in the timing of the GSE risk transfer

³¹ A cash flow lock out feature, used in certain types of insurance contracts and other securities containing credit risk, would delay principal and interest payments to investors until further credit enhancement has been built up in the structure. Although it would be possible to incorporate such a feature in the design of STACR/CAS deals, such a mechanism would extend the average lives of the mezzanine notes, in turn increasing the cost of the risk transfer as investors require higher returns to hold a similar credit risk over a longer period.

³² A hypothetical example around the expansion of the mezzanine structure might illustrate this point. Assume that the GSEs issued an additional senior mezzanine tranche covering credit losses between 4 percent and 7 percent of the reference pool. The additional tranche would bear little credit risk, suggesting it should trade at a very modest spread to the underlying floating rate. Hypothetically, the security could trade at Libor + 10 bps. However, given the high capital cost for the private investor and the unattractive return of such a security, demand would be rather weak, resulting in wider spreads for the additional now most senior mezzanine tranche.

Under the current approach to credit risk transfer, there is a time lag between when the GSE purchases and securitizes agency mortgages and when the CRT securities are sold to investors. This lag arises because it takes time to assemble a large enough reference pool of mortgages for inclusion in the CRT transaction. The GSE remains exposed to mortgage credit risk during this intervening period when the CRT deal is being assembled.

The FHFA has sought feedback regarding how to reduce the time lag between MBS issuance and the transfer of credit risk. In this vein, Fannie Mae and Freddie Mac have completed several transactions involving front-end risk sharing, in which mortgage sellers retain part of the credit risk in return for a reduced guarantee fee or a premium payment from the GSEs. The transactions eliminate the aforementioned time-lag between MBS securitization and risk transfer for the GSEs.³³

Although front-end risk transfer appears appealing given the effective elimination of the aforementioned time lag, this comes at the cost of a smaller investor universe. These front-end risk transfers can only be conducted by mortgage originators delivering loans to the GSEs, therefore significantly limiting the universe of possible holders of mortgage credit risk. This more limited investor universe should make for less efficient execution, in turn raising the premium for the credit risk. From a broader financial stability perspective, this approach also implies less system-wide diversification of mortgage credit risk, given that mortgage originators, like the GSEs, are significantly exposed to the housing market and are also often highly leveraged. Some earlier front-end risk transfer deals were then securitized by the originators (e.g. JP Morgan Madison Avenue Securities), in turn helping the GSEs to transfer the credit risk through an intermediary. However, these deals were one-off issuances that required a significant liquidity premium, making them less appealing from an economic perspective for the GSEs.

As the CRT market has ramped up in size, the GSEs have also shortened the time lag between mortgage issuance and credit-risk transfer (see figure J). For recent CRT reference pools, loan age at the time of the CRT transaction averages only about 4-6 months, a relatively small fraction of the 5-7 year average life of a mortgage. Further reducing the pipeline risk, newly originated mortgages tend to have more limited prepayment and credit risk in the early part of their life, because the borrower's financial

³³ In front-end or lender-facing upfront risk transfer transactions, the GSEs utilize collateralized recourse structures to sell credit risk on loans the GSEs counterparties originated and/or service at the time of loan acquisition from the GSEs.

position and the state of the economy likely have not evolved significantly from the point in time when the mortgage was underwritten.

[Figure J: Weighted Average Reference Pool Loan Age by Quarter of STACR/ CAS Issuance]

4.3. Improving dealer market making capabilities

One of the major challenges to the STACR/CAS market has been dealers' market making ability, which has been primarily curbed by difficulties in warehousing securities to facilitate trading. Higher post-crisis capital requirements and other regulations affecting securities trading portfolios, combined with the limited turnover for CRT bonds, make it difficult for dealers to meet return on equity targets as CRT market makers. Current STACR/CAS bid-ask spreads are estimated to be roughly 10 basis points,³⁴ a level which, on a standalone basis, does not support an attractive return on equity for dealers given current CRT transaction volumes.

Despite these considerations, secondary market trading volumes in this sector have risen primarily because dealers are incentivized to act as market makers in the secondary market through the allocation of lucrative underwriting fees from the syndication process. The GSEs have chosen to allocate issuance share according to dealers' support for the secondary market, allocating more syndication volume to dealers that support secondary market trading. The practice allows dealers to subsidize lower returns generated from providing secondary market liquidity with lucrative underwriting. Whether such cross-subsidies represent the most opportune way to support liquidity in the CRT sector is one aspect of the market that regulators and policy makers may wish to consider in the future.

4.4. Further broadening the investor base

In addition to dealers' limited market making ability, the STACR/CAS sector faces a number of regulatory uncertainties, which once removed could further expand and deepen the investor base.

- The CAS and STACR deals are classified as derivative contracts for which the US Commodities Futures Trading Commission requires investors to register as "commodity pool operators" or otherwise have an exemption from registration. Although Fannie Mae and Freddie Mac received exemptions from registering from the Commission, certain investors in the structures are unsure

³⁴ Dealers generally do not take directional positions in markets. They rather profit from the bid-ask spread, which allows them to sell securities at prices (ask prices) slightly above the price at which they purchased the same security (bid price) shortly before.

whether the exemption extends to them as well. The overhang from regulatory uncertainty for investors remains and therefore somewhat curbs attractiveness of the sector to a broader set of investors (Goodman 2016).

- CRTs represent unsecured debt of the GSEs, while the underlying mortgage bonds are only indexed in the structure. Given that STACR/CAS investors do not have recourse against the underlying real estate assets, CRTs do not qualify as “good” assets for the purpose of the REIT tax rules, precluding a significant residential mortgage investor class from investing in the sector beyond their current more limited holdings.³⁵ Recognizing this issue, the GSEs are currently considering proposals to switch CRT bonds to a real estate mortgage investment conduit (REMIC) structure, with the first transaction expected to be issued in mid-2018. A REMIC is a pass-through trust which offers investors recourse to the underlying real estate assets.³⁶
- STACR/CAS primary market issuance has seen more limited insurance company participation given a lack of National Association of Insurance Commissioners (NAIC) ratings on the deals. Obtaining such ratings at issuance would potentially help to attract more insurance companies to participate as investors.

5. Conclusion

Like many observers, we believe that the Fannie Mae and Freddie Mac credit risk transfer programs have to date been a notable success. The programs have reduced the exposure of the GSEs and the Federal government to mortgage credit risk without disrupting the liquidity or stability of mortgage secondary markets. In the process, the CRT programs have created a new financial market for pricing

³⁵ Applicable REIT tax qualification rules require that 75% of gross income is derived from assets tied to real estate. In addition, at least 95% of the REIT’s gross income must be derived from real estate income that meets the 75% test plus passive income such as dividends and interest income. The monthly GSE interest payments on CRT securities would qualify as passive income and therefore count as “good income” with respect to the 95% test. Generally, REITs must also satisfy an exemption from registration to the Investment Company Act of 1940 in order to operate their businesses. This exemption requires a company to invest at least 55% of its assets in “mortgages and other liens on and interest in real estate” (qualifying interests) and at least 80% of its assets in qualifying interests plus “real estate-type interests” (real estate-type interests). On October 16, 2017, the Division of Investment Management of the SEC issued a no-action letter which specified that certain CRT securities may be treated as real estate-type interests under the Investment Company Act.

³⁶ As long as a REMIC holds at least 95% in real estate assets, interests in the REMIC would be considered good REIT assets; the tax treatment would switch to a proportional allocation should the REMIC hold less than 95% of its assets in qualifying real estate.

and trading mortgage credit risk, which has grown in size and liquidity over time and attracted a broad base of investors. A key benefit of the structured CRT bonds used to date by the GSEs, compared to other possible types of mortgage risk transfer such as reinsurance, is that the market prices of these bonds provide real-time market information about the price of credit risk in the mortgage market.

We note that the CRT programs have not yet been tested by an adverse macroeconomic environment, and we cannot be certain how CRT investor demand and pricing will evolve under such conditions (see Wachter, 2018, for a more detailed discussion of how CRT pricing may evolve over the housing cycle). Careful management of the programs will likely be needed during such an episode. As we discuss, there are also a several outstanding questions about the design of CRT instruments, and how to maximize secondary market liquidity and enhance the breadth of the investor base. The credit risk transfer programs will continue to grow and evolve in response to these considerations.

Even in the absence of legislation, the CRT program represents a valuable step forward towards GSE reform, as well as a basis for future reform. Many proposals have been put forward for long-term reform of mortgage market since the GSE conservatorships began in 2008.³⁷ Although the details of these proposals vary, they generally share in common the goals of (1) ensuring that mortgage credit risk is borne by the private sector (probably with some form of government backstop and/or tail insurance to insure catastrophic risk and stabilize the market during periods of stress), while (2) maintaining the current securitization infrastructure as well as the standardization and liquidity of agency MBS markets. The credit risk transfer program, now into its fifth year, represents an effective mechanism for achieving these twin goals.

³⁷ Reform proposals include Cantrill et al. (2018), Bright and DeMarco (2016), Ranieri et al. (2016), Mortgage Bankers Association (2017), Mosser, Tracy and Wright (2016), Scharfstein and Sunderam (2011). See Scharfstein and Swagel (2016) for a review and discussion of the Corker-Warner bill and other post-crisis legislative efforts to reform the housing finance system.

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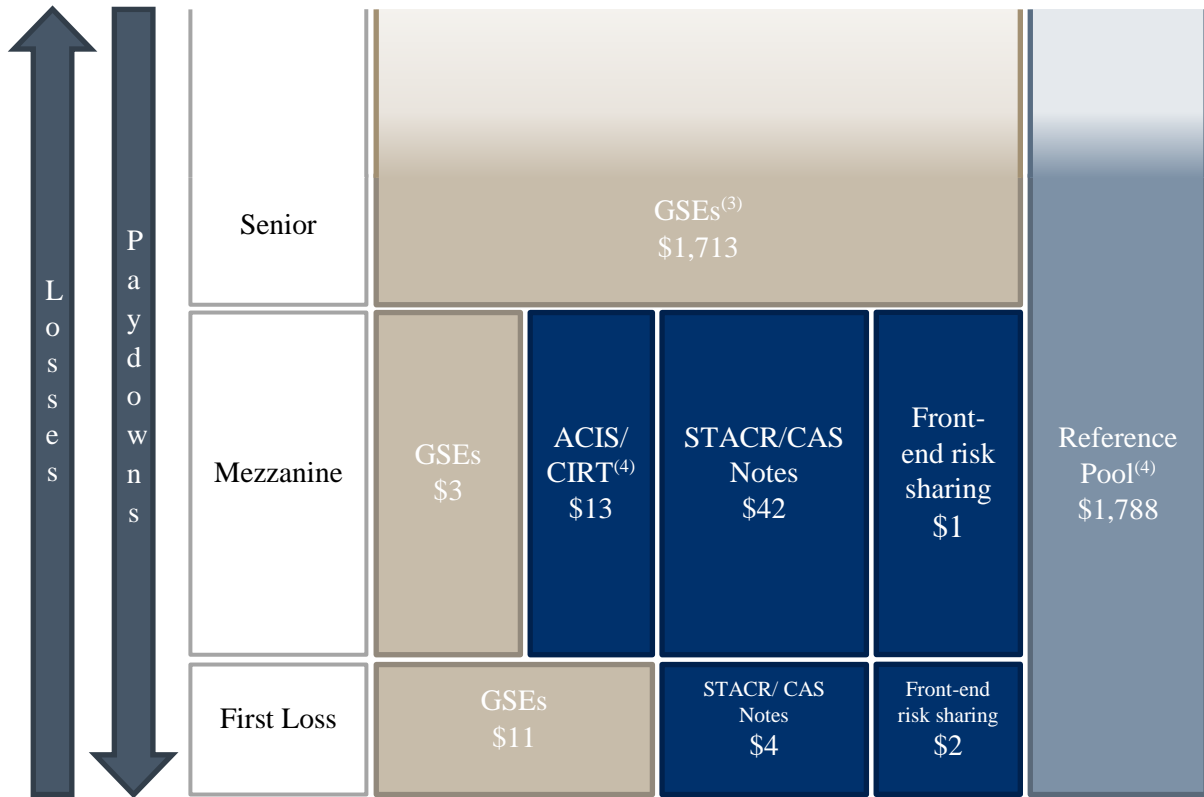
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Figures

Figure A: Cumulative Single Family Credit Risk Transfer Transactions^(1,2)



⁽¹⁾ Represents the issuance amount across Fannie Mae and Freddie Mac since inception of the credit risk transfer program in 2013; current amount outstanding is smaller than the numbers quotes. All figures are quoted in USD billions as of December 31, 2017

⁽²⁾ Actual tranche sizes vary across programs.

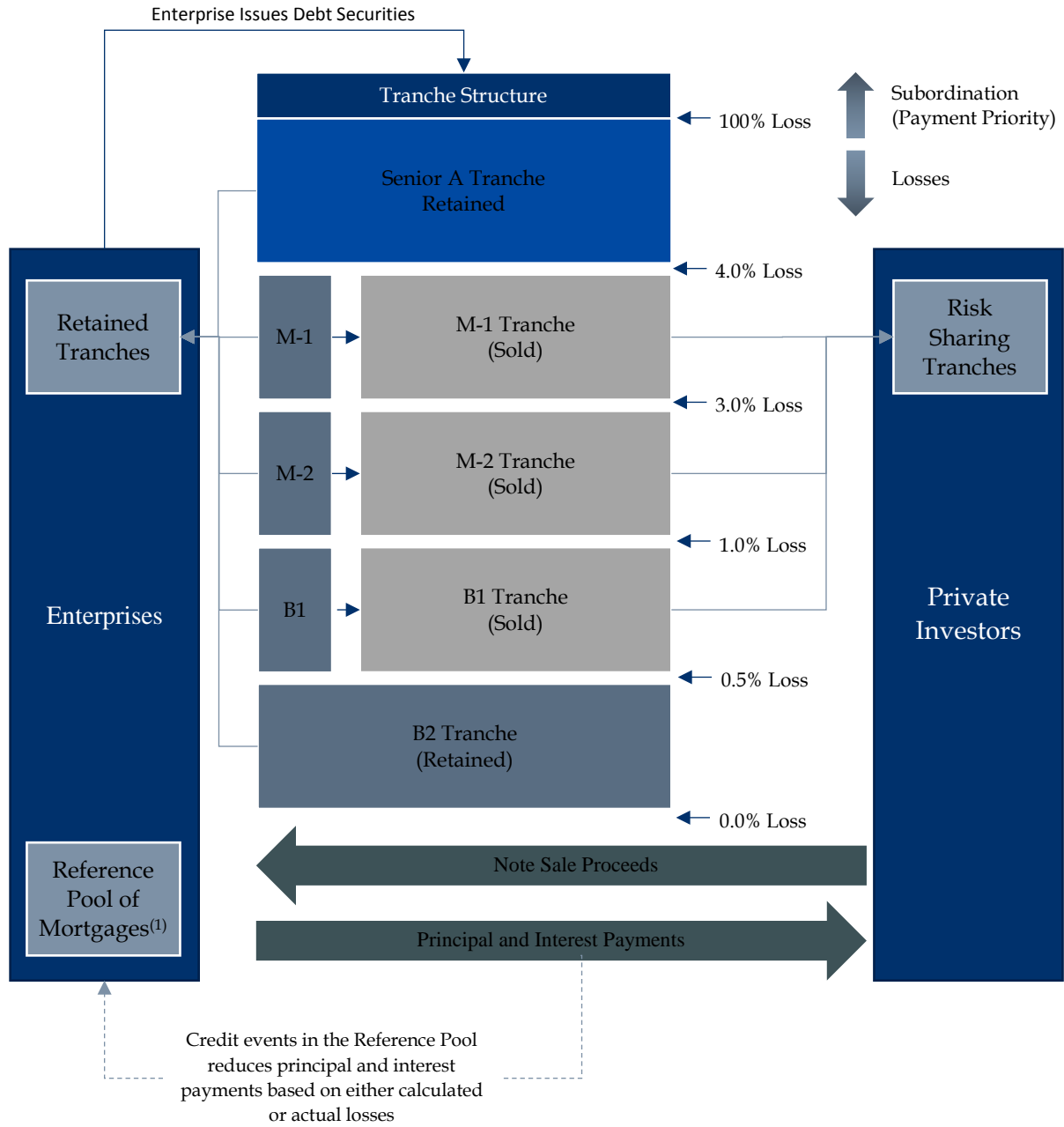
⁽³⁾ Orange boxes represent risk amounts retained by the GSEs, blue boxes represent risk sold to the private sector.

⁽⁴⁾ ACIS refers to the Freddie Mac Agency Credit Insurance Structure program, and CIRT is the Fannie Mae Credit Insurance Risk Transfer (CIRT) program. See section 3.5 for details.

⁽⁵⁾ For CIRT and some front-end risk sharing transactions, “reference pool” reflects the pool of covered loans

Source: Fannie Mae 2017 10K, Freddie Max 2017 10K.

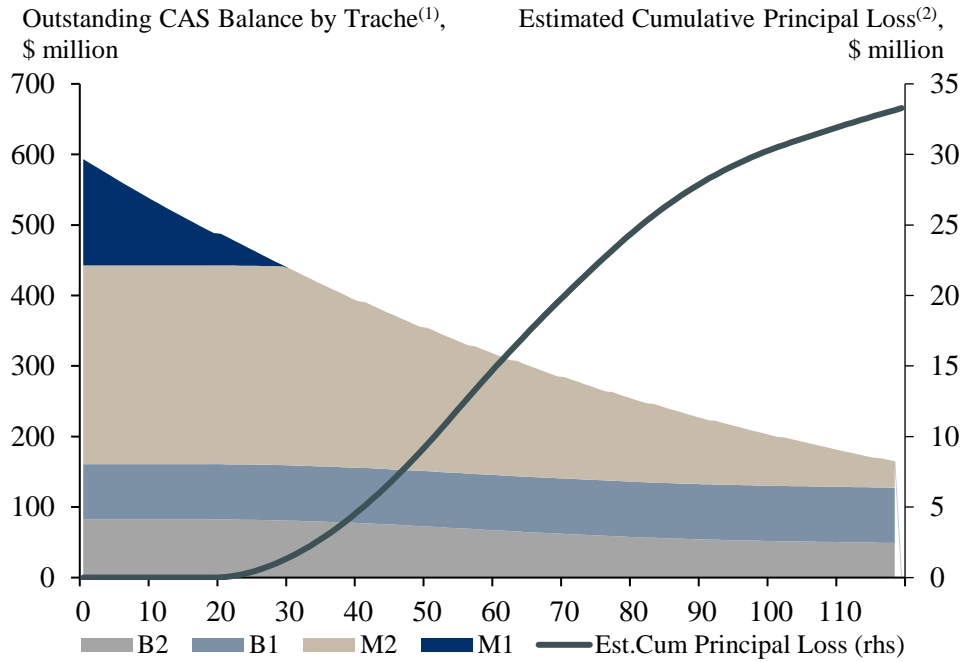
Figure B: Illustrative Enterprise Debt Issuance Structure



Source: Fannie Mae

⁽¹⁾ STACR/ CAS reference pools have averaged \$18.8 billion per STACR deal and \$31.1 billion per CAS deal.

Figure C: Anticipated CAS Deal Balance and Cash Flows



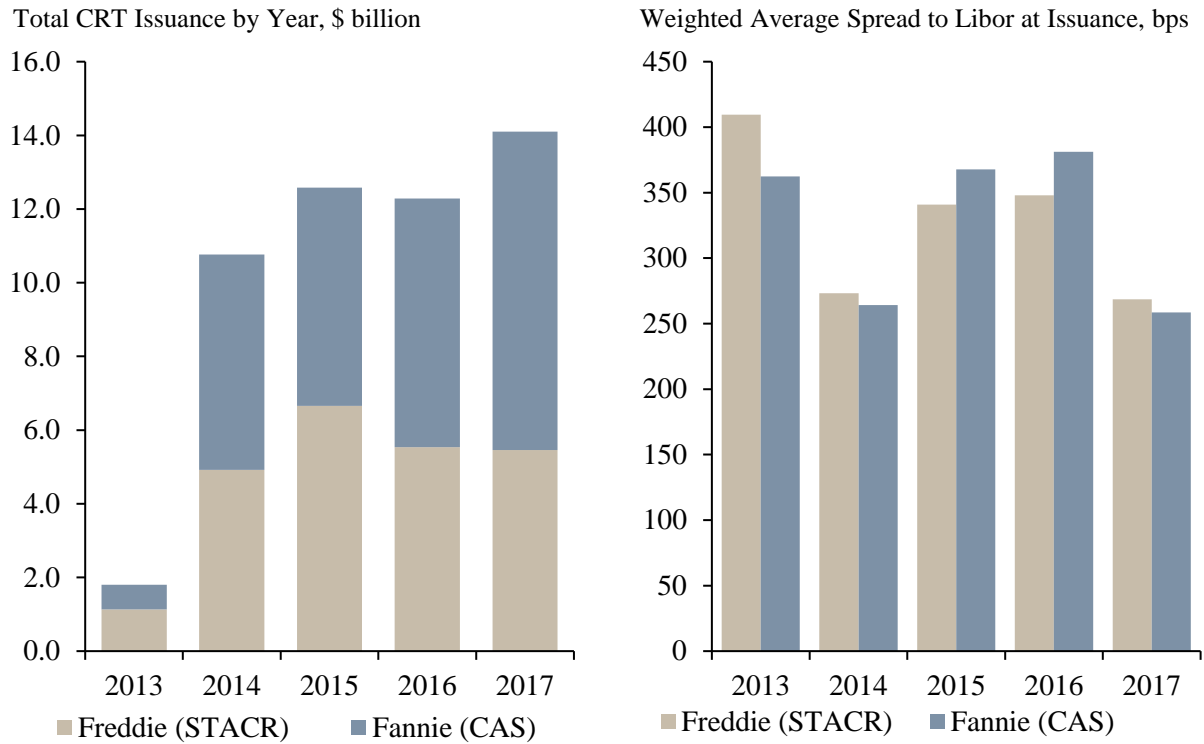
Source: Intex, Authors' Calculations

Note: The structure shown represents CAS 2017-C06 under a baseline scenario of credit losses.

⁽¹⁾ The graph is based on a constant prepayment rate of 10 CPR, representing a 10% decline in the outstanding reference pool balance per year as a result of mortgage prepayments.

⁽²⁾ Principal losses are modelled as serious delinquencies (borrowers are 120+ days delinquent) rising to 30 bps of the outstanding mortgage reference pool over the initial 36 months of the deal outstanding, thereafter staying constant for 24 months at 30 bps, before declining linearly to 15 bps. Losses are assumed to reach a 20% severity with an 18 month delay (time necessary to foreclose of delinquent borrowers).

Figure D: CRT Issuance Volumes and Spreads at Issuance⁽¹⁾

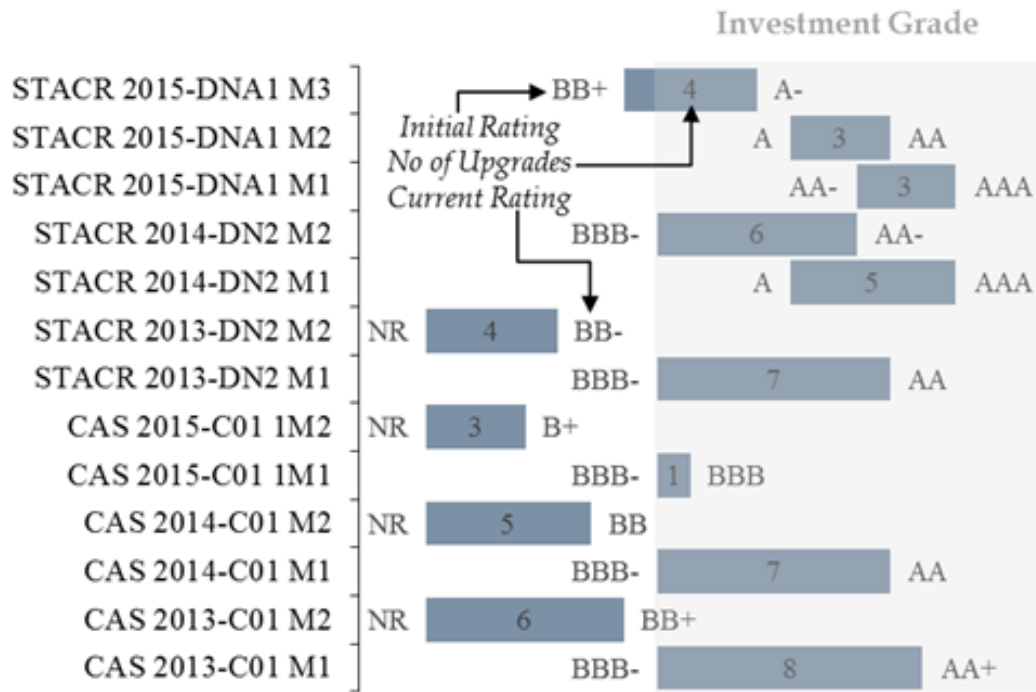


Source: Bloomberg, Authors' Calculations

⁽¹⁾ Includes only standard STACR/CAS deals and excludes recent STACR deals with special collateral such as STACR 2017-HRP1, a deal which utilized collateral that went through the Home Affordable Refinance Program (HARP), or the STACR 2017-SPI1, a credit risk transfer transaction that utilizes a REMIC election on the underlying mortgages.

Figure E: Bond Rating Upgrades

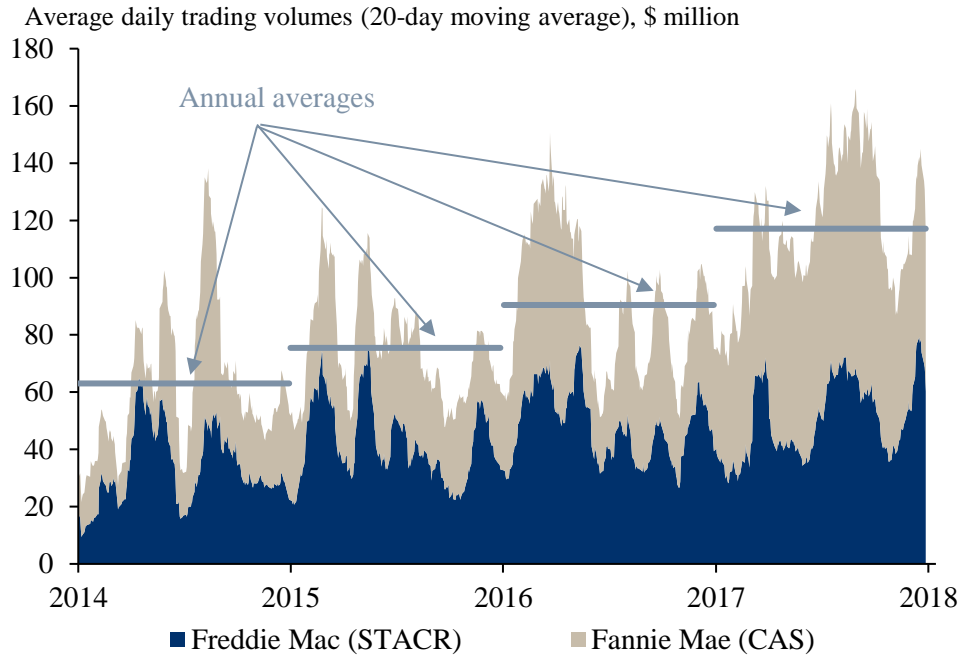
Initial and current credit ratings on STACR/CAS bonds. NR = not rated.



Source: Morgan Stanley, Fitch, author calculations.

Note: STACR/CAS deals shown represent Fitch-rated securities. The sample includes the first deal issued by either GSE for the years 2013 through 2015 that was rated. STACR 2014-DN1 did not receive any ratings.

Figure F: Credit Risk Transfer Average Daily Trading Volumes



Source: Finra TRACE, JP Morgan Chase

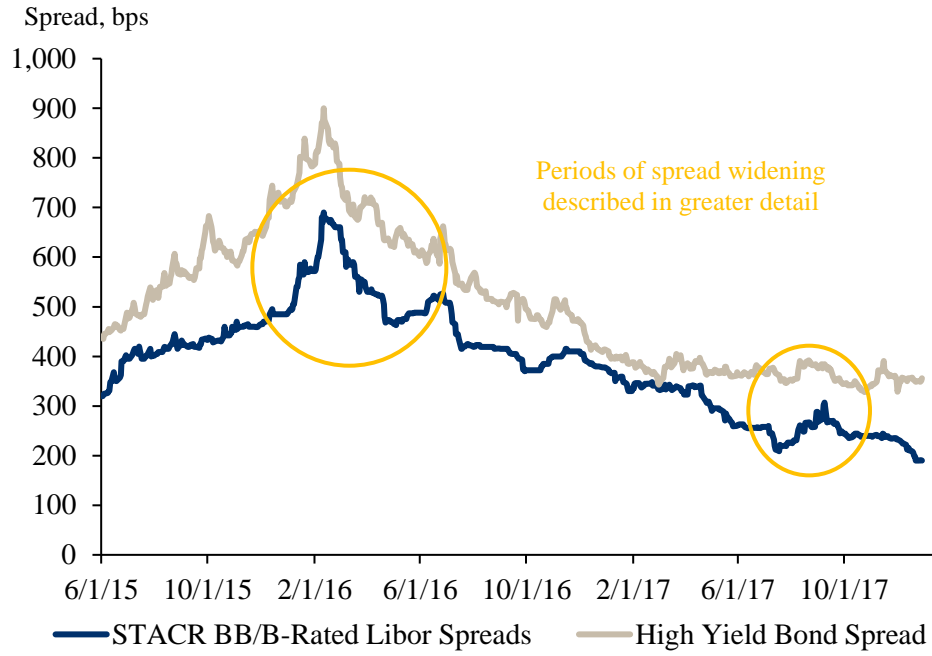
Figure G: Comparative Trading Volumes

Trading volume and number of trades for STACR/CAS credit risk transfer securities. Of the four tranche types listed, M1 is the most senior, followed by M2, M3 and B (which corresponds to first loss tranches).

	STACR/ CAS				Corp. Bonds	Non-agency MBS
	M1	M2	M3	B		
Traded Volume by Year (\$, million)						
2015	3,357	9,653	4,768	474	4,442,003	336,043
2016	2,439	12,067	6,440	769	4,805,017	297,699
2017	3,184	17,476	4,513	4,166	4,859,517	225,216
Number of Trades ('000)						
2015	1.0	2.7	1.3	0.2	11,266.7	166.1
2016	1.1	3.7	1.9	0.3	13,372.5	144.8
2017	1.6	5.7	1.4	1.5	14,338.2	136.0
Average Size (Traded Volume/ Number of Trades, \$ million)						
2015	3.3	3.6	3.7	2.2	0.4	2.0
2016	2.2	3.2	3.4	2.3	0.4	2.1
2017	1.9	3.1	3.3	2.8	0.3	1.7

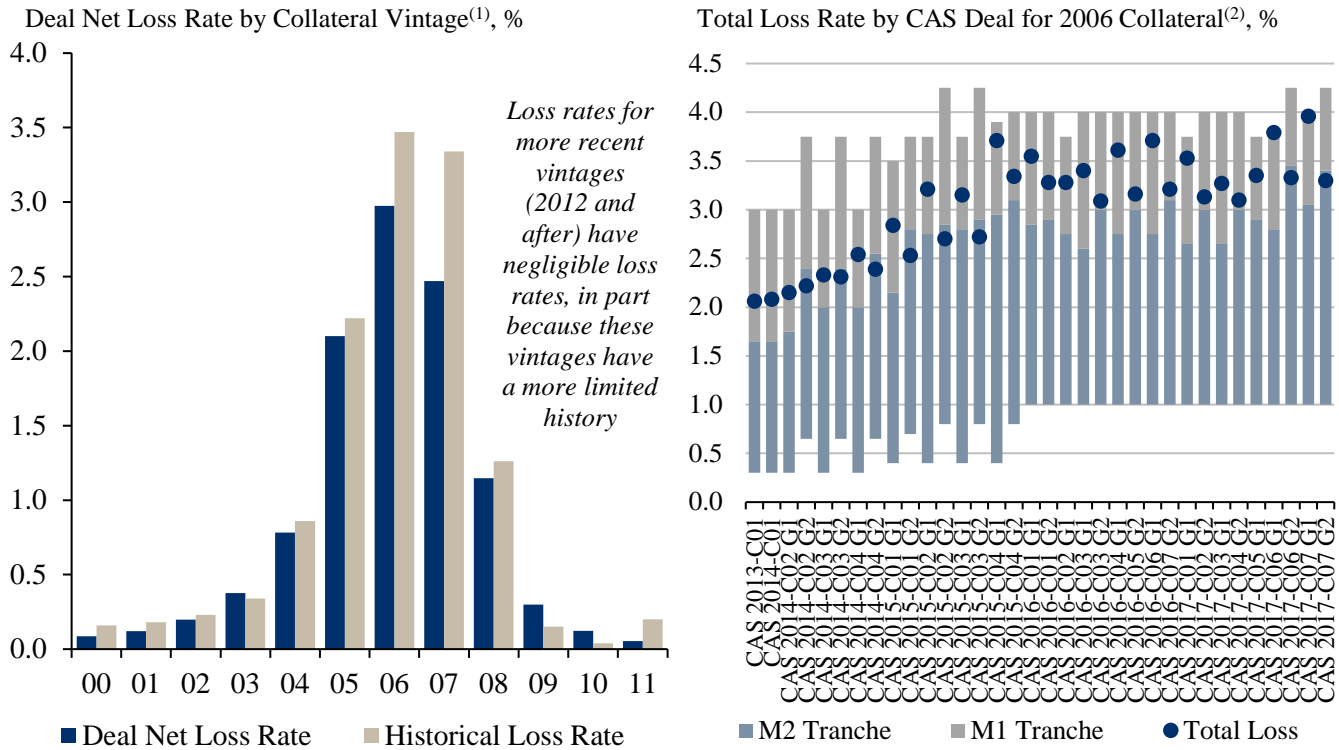
Source: FINRA, MarketAxess, JP Morgan

Figure H: On the Run Spreads vs High-Yield Bonds



Source: Bank of America

Figure I: CRT Net Loss Rates Relative to Historical Experience



⁽¹⁾ “Deal Net Loss Rate” shows the anticipated loss rates for a particular deal, in this case CAS 2017 C07, should the underlying collateral undergo a similar housing market environment as the vintages shown. For example, should the collateral in the shown CAS securities face the same development in home prices and credit conditions as collateral issued in 2006, losses on the deal are expected to reach 3.0% as modelled by Fannie Mae.

In comparison, the “historical loss rate” for the 2006 vintage collateral was 3.47%, nearly 0.50 percentage points higher than what would be expected for the current deal. The lower net loss rate is emblematic of the more stringent underwriting standards today than ahead of the Global Financial Crisis.

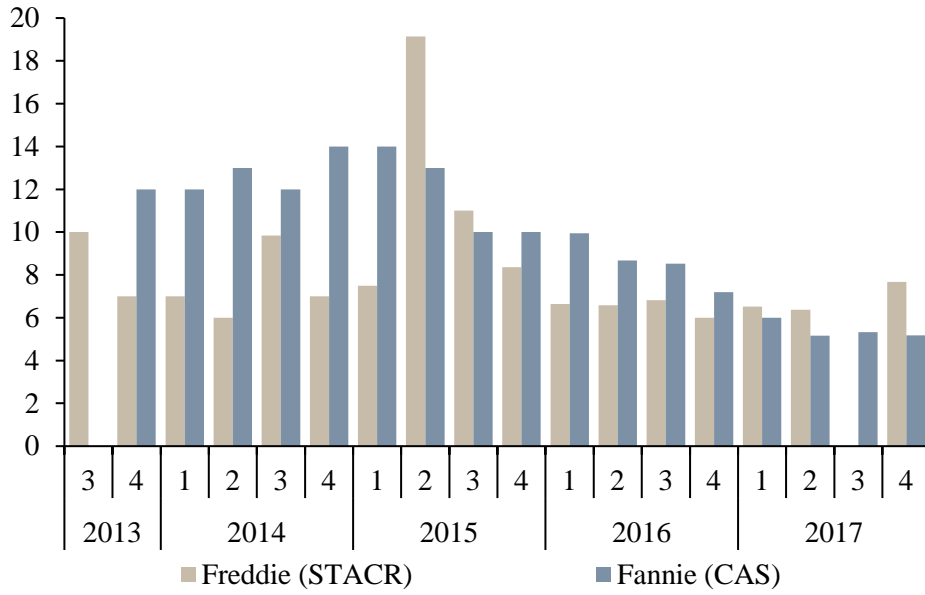
The graph only shows net losses for both deal and historical experiences, which represents the loss on loans that are no longer active due to short sales, third-party sale, mortgage release, or foreclosure sales net of any proceeds. The net loss rate excludes potential or actual losses from loan modifications or potential pipeline losses from loans in foreclosure.

⁽²⁾ Total loss rates includes fixed severity rate for all CAS deals up to and include CAS 2015 C03. Thereafter, total loss rates includes pipeline, modification and net losses, expressed as a share of issuance balance of the underlying reference pool of mortgages.

Source: Fannie Mae Data Analytics

Figure J: Weighted Average Reference Pool Loan Age by Quarter of STACR/ CAS Issuance

STACR/ CAS Reference Pool Weighted Average Loan Age at Origination by Quarter, months



Source: Bloomberg, Authors' Calculations