
CREDIT RISK TRANSFER AND DE FACTO GSE REFORM

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OVERVIEW

- Fannie Mae and Freddie Mac—which operate as government-sponsored enterprises (GSEs)—have substantial credit risk exposure owing largely to a credit guarantee on mortgage-backed securities (MBS) they issue.
- Since 2013, the GSEs have experimented with instruments to sell off a portion of the credit risk to the private market, notably using structured debt securities tied to the credit performance of an underlying pool of mortgages.
- This study evaluates the GSE credit risk transfer programs, finding that they have meaningfully reduced the GSEs' credit risk exposure without disrupting the agency MBS market or affecting the risks facing agency MBS investors.
- 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.

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). However, the GSEs have implemented significant changes in 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

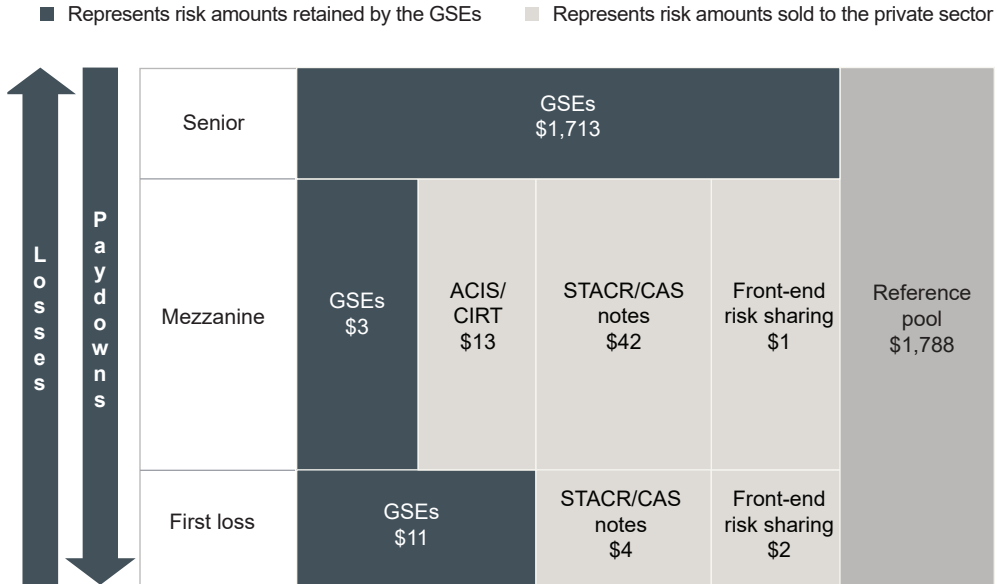
Fannie Mae and Freddie Mac have significant mortgage credit risk exposure, largely because they provide a credit guarantee to investors on the agency mortgage-backed securities (MBS) they issue. Since the CRT programs began in 2013 through December 2017, Fannie Mae and Freddie Mac transferred to the private sector a portion of the credit risk on approximately \$1.8 trillion in single-family mortgages (Fannie Mae 2017; Freddie Mac 2017a). The GSEs have experimented with a range of risk transfer instruments, including reinsurance, senior-subordinate securitizations,

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EXHIBIT 1

Cumulative Single-Family Credit Risk Transfer Transactions



Sources: Fannie Mae 2017 Form 10-K; Freddie Mac 2017 Form 10-K.

Notes: Totals represent the issuance amount across Fannie Mae and Freddie Mac since the inception of the credit risk transfer program in 2013; the current amount outstanding is smaller than the numbers quoted. All values are reported in billions of U.S. dollars and are as of December 31, 2017. Actual tranche sizes vary across programs. Dark gray boxes (not to scale) represent the risk amounts retained by the government-sponsored enterprises (GSEs) and beige boxes represent risk sold to the private sector. ACIS refers to the Freddie Mac Agency Credit Insurance Structure program and CIRT to the Fannie Mae Credit Insurance Risk Transfer (CIRT) program. STACR refers to the Freddie Mac Structured Agency Credit Risk securities and CAS to Fannie Mae Connecticut Avenue Securities. See Sections 1 and 2.5 for details. For CIRT and some front-end risk sharing transactions, “reference pool” reflects the pool of covered loans.

and transactions involving explicit lender risk sharing. However, as shown in Exhibit 1, the bulk of CRT has occurred through 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 would trigger automatic principal write-downs on these CRT bonds, partially offsetting GSE credit losses.

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 meaningfully reduced the federal government’s exposure 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 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 investors in agency MBS. Because agency MBS carry a GSE credit guarantee, agency MBS investors assume that they are exposed to interest rate and prepayment risk, but not credit risk. This feature reduces the set of parameters on which pass-through MBS pools differ from one another, thereby improving the standardization of the securities underlying the liquid to-be-announced (TBA) market where agency MBS mainly trade.³ 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 agency MBS credit guarantees are still being provided only by the GSEs. In other words, the GSEs stand between agency MBS investors and private sector CRT investors, acting in a role akin to a central counterparty.

Ensuring that the GSEs' efforts to share credit risk 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 resilient during the 2007-09 financial crisis, helping support the supply of mortgage credit during that period. The agency market financed \$2.89 trillion in mortgage originations during 2008 and 2009, experiencing little drop in secondary market trading volume (Vickery and Wright 2013). In contrast, the non-agency MBS market, in which MBS investors are exposed directly to credit risk, proved to be much less stable. Issuance in that market essentially froze in the second half of 2007 and has remained at low levels since.⁴

The remainder of this article is structured in four sections. Section 1 provides background on the mortgage credit risks faced by Fannie Mae and Freddie Mac, and different mechanisms used by the GSEs to mitigate their exposure to risk. Section 2 explains the mechanics of how CRT instruments work and provides descriptive statistics about the growth and composition of this market. Section 3 considers potential improvements to the market and its ancillary structures. Section 4 concludes.

1. 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 However, credit risk is retained by the GSEs, which provide a guarantee of timely payment of principal and interest on the MBS even if mortgages in the MBS pool default. This credit risk exposure of Fannie Mae and Freddie Mac is substantial, given that the GSEs own or guarantee \$5.1 trillion in residential mortgages (Federal Housing Finance Agency 2017).

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

- *Guarantee fees.* The GSE issuer receives up front and ongoing guarantee fees from the pool to compensate them for the MBS credit guarantee. Historically, these guarantee fees have not varied significantly based on mortgage loan credit characteristics (Hurst et al. 2016), although, since 2008, upfront fees have been sensitive to loan-to-value ratios and borrower credit scores (see FHFA [2016a] for more details).
- *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 provision is generally met by requiring mortgage borrowers to obtain private mortgage insurance (PMI). PMI reduces the GSEs' credit risk exposure, although it exposes them to counterparty risk if the PMI provider is unable to perform on the insurance contract—a possibility during a severe housing downturn.⁶
- *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.
- *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, for example, in the case of mortgage fraud or significant misrepresentation of loan terms.⁷
- *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, Fannie Mae and Freddie Mac essentially have no equity capital because retained earnings are remitted to the U.S. Treasury under the revised terms of their conservatorships (see Frame et al. [2015] for more information).

Despite the use of these credit risk management tools, Fannie Mae and Freddie Mac experienced high mortgage credit losses during the 2007-09 financial crisis, and were placed in conservatorship in September 2008. These events highlighted the need for the GSEs to find ways to mitigate their credit risk more effectively. Mitigation has in part been achieved by significantly increasing and redesigning guarantee fees, strengthening fraud detection, and trimming the size of GSE-retained mortgage portfolios.

To supplement these steps, the Federal Housing Finance Agency (FHFA), the regulator of Fannie Mae and Freddie Mac, established in 2012 its intent to develop “loss-sharing agreements” under which private investors would bear credit risk on mortgage loans underlying agency MBS (see FHFA [2012]).⁸ The first pilot credit risk transfer transaction was a Structured Agency Credit Risk (STACR) offering, which Freddie Mac brought to market 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 to evaluate and fine-tune the design of the CRT programs. Among these are: reducing taxpayer risk, engaging in transactions that are economically viable (where the cost of transferring the credit risk does not meaningfully exceed the GSEs' cost of retaining that risk), not interfering with the continuation of the GSEs' core business of acquiring and securitizing mortgages and guaranteeing mortgage-backed securities, and 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).

1.1 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 suggests that the “price” of credit risk is the same regardless of which party owns that risk, and therefore that the GSEs (backed 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

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 (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 probably 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 that would be realized only in a crisis or severe recession. In an insurance context, Froot (2001) documents the lack of private capital for tail risk catastrophe reinsurance.

Second, the GSEs play an important 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 with the portions of credit risk transferred to date using the CRT programs? Using the taxonomy of the FHFA (2015), the GSEs' credit risk exposure can be segmented into: *expected losses* likely to occur in a typical time period; *unexpected losses* occurring in a period of heightened defaults, such as a recession or housing market downturn; and *catastrophic losses*, which occur during a severe and unlikely tail event. The GSEs currently generally retain the first loss exposure (for example, for the first 50 basis points of credit losses), as

well as extreme tail risk (for example, 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 have been widely debated, as we discuss in Section 3.

2. MECHANICS, STRUCTURE, AND TRADING OF STACR/CAS SYNTHETIC NOTES

Although the GSEs have experimented with a number of risk transfer instruments, the STACR and CAS debt securities have been the most widely used, accounting for 77 percent of the risk in force shed from the GSEs' balance sheets (FHFA 2017).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 these securities gain wide acceptance and broad investor support.

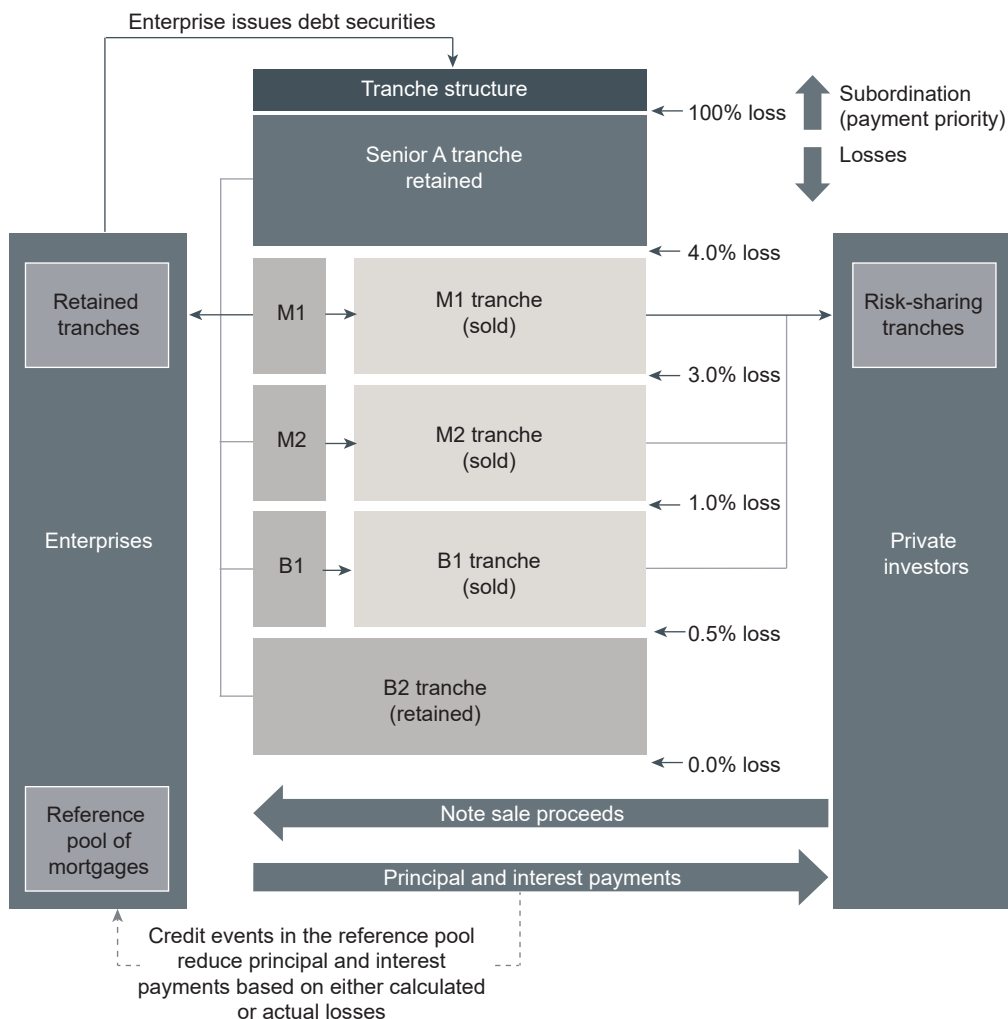
2.1 Basic Structure

Exhibit 2 represents an illustrative STACR/CAS structure in which the GSEs transfer credit risk on a reference pool of thirty-year fixed-rate mortgages that they guarantee.¹² STACR/CAS are floating-rate fixed-income securities that pay investors an interest rate tied to the one-month London interbank offered rate (Libor) plus a spread determined by market demand at the time of the bonds' primary market issuance, discussed in more detail below. Recently issued securities have a 12½-year final maturity with a call option for the GSE after ten years.¹³

The key feature of STACR/CAS bonds is linkage of the required principal payments to the credit performance of a mortgage reference pool. In the representative example shown in Exhibit 2, the securities are divided, or tranced, 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 expected credit losses. The GSEs retained all the first-loss tranches in early CRT transactions, but have sold portions of this risk in some more recent transactions. Immediately senior to the first-loss tranche are three 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 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 proceeds from the debt sale, it begins forwarding principal and interest payments to investors. The lower STACR/CAS tranches, which bear more credit risk, receive higher coupon payments than 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 percent of the structure in recent

EXHIBIT 2
Illustrative Enterprise Debt Issuance Structure



Source: Fannie Mae.

Note: STACR/CAS reference pools have averaged \$18.8 billion per STACR deal and \$31.1 billion per CAS deal.

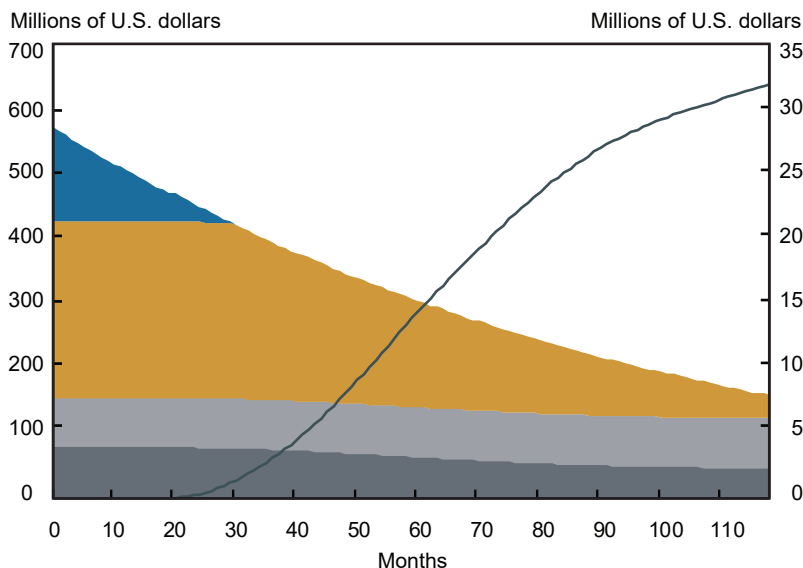
transactions) and the mezzanine classes of STACR/CAS notes sold to investors. But this is not the case initially. Instead, prepayments are directed solely toward the senior tranche, increasing the credit enhancement of the senior class over time. Typically this occurs until credit enhancement increases by 25-50 basis points relative to the initial enhancement, thereby affording the GSEs incremental protection against credit losses compared with the initial credit enhancement at transaction inception.¹⁶

Within the set of mezzanine tranches, principal payments are allocated in order of seniority. Thus, payments are first made to the M1 tranche, leading the outstanding balance of the M1 tranche

CHART 1

Projected CAS Deal Balance and Cash Flows

Outstanding CAS balance by tranche (left scale) ■ B2 ■ B1 ■ M2 ■ M1
 Estimated cumulative principal loss (right scale) —



Sources: Intex; authors' calculations.

Notes: The structure shown represents CAS 2017-C06 under a baseline scenario of credit losses. The chart is based on a constant prepayment rate of 10 CPR, representing a 10 percent decline in the outstanding reference pool balance per year as a result of mortgage prepayments. Principal losses are modeled as serious delinquencies (for borrowers who are 120+ days delinquent) rising to 30 basis points of the outstanding mortgage reference pool over the initial thirty-six months of the deal outstanding, thereafter staying constant for twenty-four months at 30 basis points before declining linearly to 15 basis points. Losses are assumed to reach 20 percent severity with an eighteen-month delay necessary to foreclose on delinquent borrowers.

to decline toward zero over time.¹⁷ Chart 1 illustrates how the unpaid balances of the different tranches for a typical CRT deal evolve over time under a baseline scenario.

The GSEs assume no counterparty risk in the STACR/CAS structure. CRT investors pay in full when they purchase the notes and absorb credit losses through reduction in the principal value of the bonds. After sale of the securities, the GSEs manage the proceeds to generate a return close to one-month Libor, which goes to 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 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 investors in the MBS pool. In this situation, the face value of STACR/CAS bonds are written down and investors lose a corresponding portion of principal payments and associated interest.

In GSE securitizations, high loan-to-value (LTV) mortgages have credit enhancement in the form of private mortgage insurance. Credit losses on the reference pool are measured net of PMI payouts. However, the GSEs, not STACR/CAS investors, bear the counterparty risk when PMI providers fail to pay, simplifying credit analysis from the investor's perspective.¹⁸

Early STACR/CAS transactions involved a concept of scheduled severity in which losses allocated to CRT investors when loans defaulted were predefined at deal issuance.¹⁹ This approach helped attract investors to this developing sector in its early stages. However, use of this formulaic approach led to imprecise hedges against losses for the GSEs, since actual defaults and loss severities realized in practice differed from the scheduled severity assumptions. With that in mind, starting in 2016, both Fannie Mae and Freddie Mac adopted a configuration in which losses accumulate to bondholders on property liquidation or a similar event, reflecting actual realized loss severity.

2.2 Primary Market Issuance

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 through late 2017, Fannie Mae issued twenty-three CAS deals, while Freddie Mac issued thirty-one STACR deals.²⁰ Chart 2 plots the evolution of issuance volume and average spreads at issuance for STACR/CAS securities over this period.

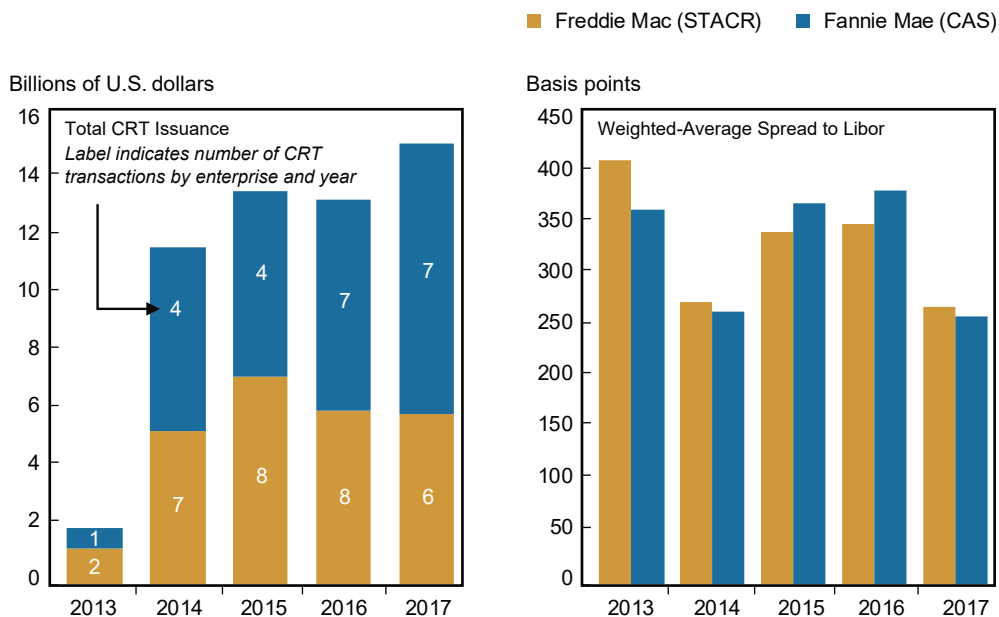
Deals are generally announced and marketed one week before pricing. STACR/CAS securities are issued through a syndication process in which participating broker-dealers take customer orders and adjust pricing to most effectively match demand with bond supply. Since bonds are issued at par, pricing is adjusted by setting a fixed spread over Libor for each bond, which represents the GSE's effective cost of CRT financing. Broker-dealers and the GSEs strive to avoid situations in which overly aggressive pricing leads to poor secondary market performance. They also try to avoid overly conservative pricing in which the GSEs end up overpaying investors for protection. Every effort is made to price each deal so that secondary trading is orderly, avoiding undue volatility for a given issue or the overall sector.

Once pricing is set, the GSEs use an internal methodology to allocate bonds to investors. While the GSEs do not disclose that methodology, they appear to favor investors that place orders earlier in the syndication process over those 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 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 a 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 size, STACR/CAS issuance respectively represented 21 percent and 18 percent of aggregate residential credit gross issuance in 2016 and 2017 (Securities Industry and Financial Markets Association 2017).

CHART 2

Credit Risk Transfer Issuance Volumes and Spreads at Issuance



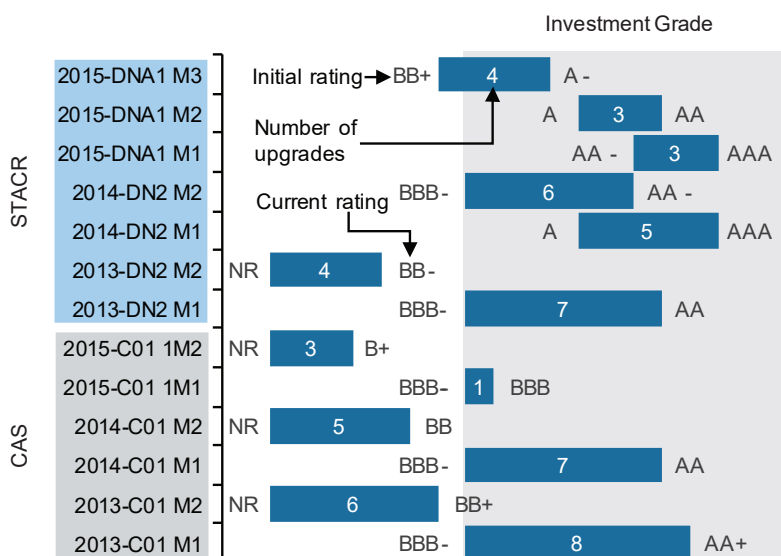
Sources: Bloomberg L.P.; authors' calculations.

Notes: Data include only standard STACR/CAS deals, except recent STACR deals with special collateral such as the STACR 2017-HRP1, a deal utilizing collateral that had gone through the Home Affordable Refinance Program, and the STACR 2017-SPI1, a credit risk transfer transaction utilizing a REMIC election on the underlying mortgages.

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

- the regularity and transparency of primary market issuance,
- granular loan-level historical performance data made available by the GSEs, helping investors model credit performance across various market environments and macroeconomic scenarios (see Canter [2017]),
- a sound economy and housing market,²¹ and
- the availability of credit ratings from a number of credit rating agencies (for example, Fitch), which have frequently upgraded some CRT bonds since issuance (see Exhibit 3).

EXHIBIT 3
Bond Rating Upgrades



Sources: Morgan Stanley; Fitch; authors' calculations.

Notes: 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. We note the initial and current bond ratings. NR means not rated. STACR 2014-DN1 did not receive any ratings.

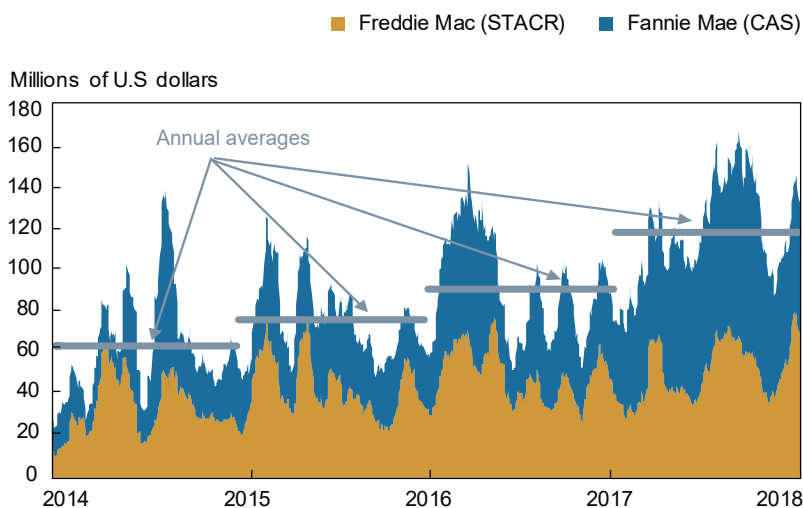
2.3 Secondary Market Trading and Liquidity

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 Chart 3 shows, CRT trading volume fluctuates significantly over time. For example, volume increased in early 2016, corresponding with a period of elevated market volatility and widening credit spreads. Trading volumes for STACR and CAS bonds tend 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. These are smaller than usual for agency MBS, particularly in the much larger and more liquid TBA market, but are comparable with other sectors of the fixed-income market, such as corporate bonds and non-agency MBS. Table 1 reports some summary statistics about trading volume drawn from Financial Industry Regulatory Authority (FINRA) Trade Reporting and Compliance Engine (TRACE) data. Trade size for STACR/CAS securities averages \$2-3 million and is roughly similar across securities of different seniorities.

We plot on-the-run yield spreads to Libor for STACR/CAS and high-yield corporate bonds in Chart 4. 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

CHART 3

Credit Risk Transfer Average Daily Trading Volume



Sources: FINRA TRACE; J.P. Morgan.

Note: The chart plots twenty-day moving averages.

TABLE 1

Comparative Trading Volumes

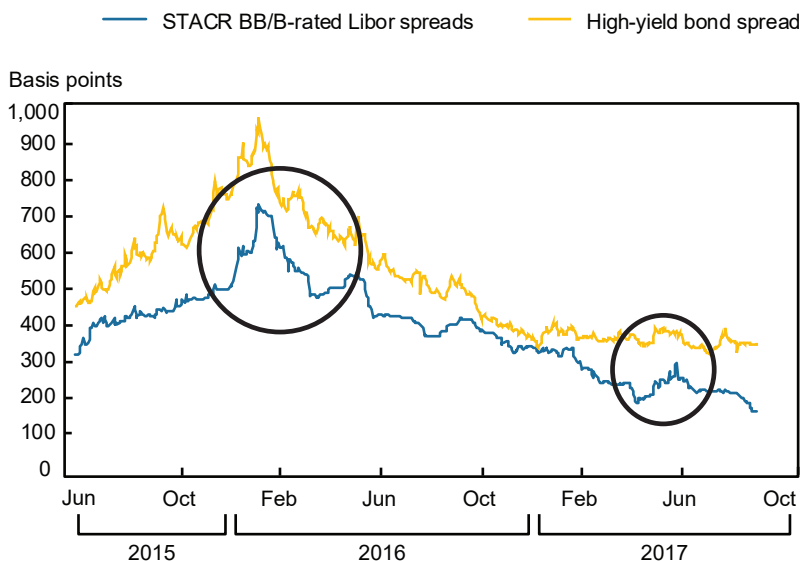
	STACR/CAS				Corporate Bonds	Non-Agency MBS
	M1	M2	M3	B		
Traded Volume by Year (in Millions of U.S. Dollars)						
2015	3,357	9,653	4,768	474	4,442,003	336,043
2016	2,439	12,067	6,440	769	4,805,017	297,699
2017	3,184	17,476	4,513	4,166	4,859,517	225,216
Number of Trades (in Thousands)						
2015	1.0	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, in Millions of U.S. Dollars)						
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

Sources: FINRA TRACE; MarketAxess; J.P. Morgan.

Note: Of the four tranche types listed, M1 is the most senior, followed by M2, M3, and B (designations correspond to first-loss tranches).

CHART 4

On-the-Run CRT versus High-Yield Bond Spreads



Source: Bank of America.

Note: Section 2.3 examines periods of spread widening (circled) in greater detail.

same period. On net, spreads on M2 tranches tightened from around 400 basis points in mid-2015 to 250 basis points by the third quarter of 2017.

Two periods of widening spreads are worth noting. First, STACR/CAS spreads spiked by about 200 basis points in early 2016, reflecting a general widening in credit spreads amid concerns about the stability of the Chinese economy and the declining price of oil. STACR/CAS spreads mirrored the general high-yield spread trend during this episode, although there was no evidence of deteriorating housing or mortgage-market fundamentals. Second, STACR/CAS spreads widened by about 100 basis points during August and September 2017 when fears of extensive hurricane damage in Texas and Florida raised investor concerns about heightened mortgage default risk. In both cases, the widening spreads ultimately reversed, reflecting a sound housing market and strong demand for credit. Still, the temporary widening provided a real-time measure of market expectations about the anticipated effect of these events on credit loss rates for agency-eligible residential mortgages.

2.4 Investors

The CRT investor base has broadened over time. In particular, Freddie Mac indicates it has seen more than 200 investors in its credit risk transfer transactions.²² The largest CRT investor group consists of money management firms that 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 become consistent CRT investors. Real estate investment trusts (REITs) have similar intentions to money managers, but generally invest in the lower mezzanine tranche (M2), which from their perspective offers a more desirable risk-return trade-off than more senior tranches. Hedge funds are also active investors, either to take advantage of short-term spread fluctuations or to speculate on broader housing market performance.²³ Sovereign wealth funds and a small number of insurance companies round out the investor base. Of note, banks currently do not invest in STACR/CAS securities, primarily because their high regulatory capital risk weights make it difficult for STACR/CAS investments to meet bank return-on-equity targets.

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

2.5 Other Risk Transfer Instruments

Although STACR/CAS has been the core of the GSE credit risk transfer initiative, the two enterprises also use several other structures. In the largest of 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 to reinsure a stand-alone reference pool or, in the case of ACIS, the retained vertical slice of mezzanine risk in a STACR transaction. These transactions are partially collateralized, reducing, but not completely eliminating, counterparty risk.

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

The GSEs also engage in “front-end” risk sharing in which a portion of mortgage credit risk is transferred to a third party before securitization. In some front-end risk sharing, the loan seller retains a portion of the credit risk. The GSEs have also recently used “deep cover” PMI in which additional credit risk, beyond the required credit enhancement for mortgages with an LTV exceeding 80 percent, is insured by specialist mortgage insurers.

Maintaining a range of CRT tools helps satisfy the needs of different kinds of investors. For example, the fixed coupon rate on STACR SPI certificates may particularly appeal to life insurers, which generally prefer long-duration investments. A variety of instruments also gives the GSEs flexibility to adjust the mix over the credit cycle as demand from different investors

fluctuates. Importantly, this stabilizes overall demand for agency mortgage credit risk, ensuring the program remains viable throughout a range of market environments.²⁵ Experimentation is also valuable in itself given that the CRT programs are relatively new.

Nonetheless, we believe that STACR/CAS should remain at the core of the credit risk transfer initiative. STACR/CAS has proven successful in attracting a wide range of investors and diversifying exposure to mortgage credit risk. Moreover, it has created a secondary market for trading and pricing risk. The liquidity of this market is greater when CRT issuance is concentrated in STACR/CAS rather than being fragmented across a number of programs. Also, front-end risk sharing provides less mortgage credit risk diversification than the various back-end programs used to date because loan sellers or specialized private mortgage insurers retain credit risk. Like the GSEs, these parties already have concentrated exposure to mortgage credit risk.²⁶

3. OUTSTANDING ISSUES IN CRT DESIGN

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

3.1 Should the GSEs Transfer First-Loss and Catastrophe Risk?

As discussed in Section 1.1, GSE credit risk exposure can be segmented into expected, unexpected, and catastrophic losses, reflecting progressively higher losses correspondingly less likely to occur.²⁷ Current STACR/CAS security design focuses on transferring the unexpected losses borne by the mezzanine bonds. As discussed below, we consider this an appropriate strategy given the relative costs and benefits of transferring different slices of mortgage credit risk.

We start at the bottom of the capital structure. Although, in recent CRT transactions, the GSEs have distributed some of the most junior first-loss tranche of credit losses, they primarily retain this exposure, for several reasons. First, losses sustained on this risk slice, usually around the first 50 basis points of credit losses, are unlikely to lead to overall net losses for the GSEs because of the stream of guarantee-fee income earned on the reference mortgage pool.²⁸ Second, because some credit losses are expected to occur 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 keeping the first-loss piece, the GSEs retain "skin in the game," which may help attract investors and mitigate moral hazard given the GSEs' important screening and monitoring role. Fourth, some private investors may face high capital costs from holding first-loss tranches because of minimum capital requirements or other regulations. When transaction costs are also taken into account, selling the first-loss tranche would probably 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 to 23 basis points.²⁹

On the other side, should future risk-sharing transactions attempt to sell catastrophe risk, which to date has been retained by the GSEs? Currently, the GSEs retain exposure to credit losses above roughly 4 percent of the principal value of the reference pool. Credit losses are only estimated to reach this range in extremely adverse macroeconomic environments.

Illustrating this point, the top panel of Chart 5 presents the projected cumulative credit loss rates for the reference pool in a recent Fannie Mae CAS deal, assuming the evolution of macroeconomic conditions matches the experiences from different historical vintages.³⁰ As the chart shows, net credit losses are projected to reach 3.0 percent if the mortgage reference pool were to experience the same home price trends and macroeconomic environment as the 2006 vintage, originated just before the housing market collapse and 2007-09 recession. Therefore, even this scenario may not lead to full extinguishment of the mezzanine CRT bonds' principal, given that the senior mezzanine security (M1) in this transaction covers cumulative credit losses up to 4.25 percent.

For comparison, the top panel of Chart 5 also shows the actual realized credit loss rate for different vintages. The conditional expected 3.0 percent loss rate projected for the CRT reference pool under post-2006 macroeconomic conditions is below the actual 3.5 percent loss rate realized by Fannie Mae on its 2006 mortgage vintage.³¹ The difference reflects post-crisis improvement in credit quality and underwriting standards of agency mortgages. However, even under a more conservative assumption, in which losses match the performance of Fannie Mae 2006 vintage mortgages, net credit losses would not exceed the detachment point of the M1 CRT tranche for this deal.³²

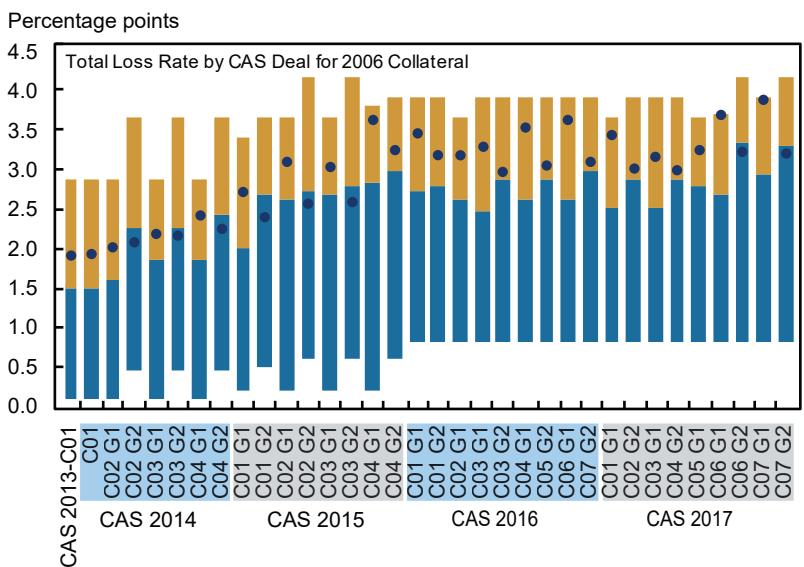
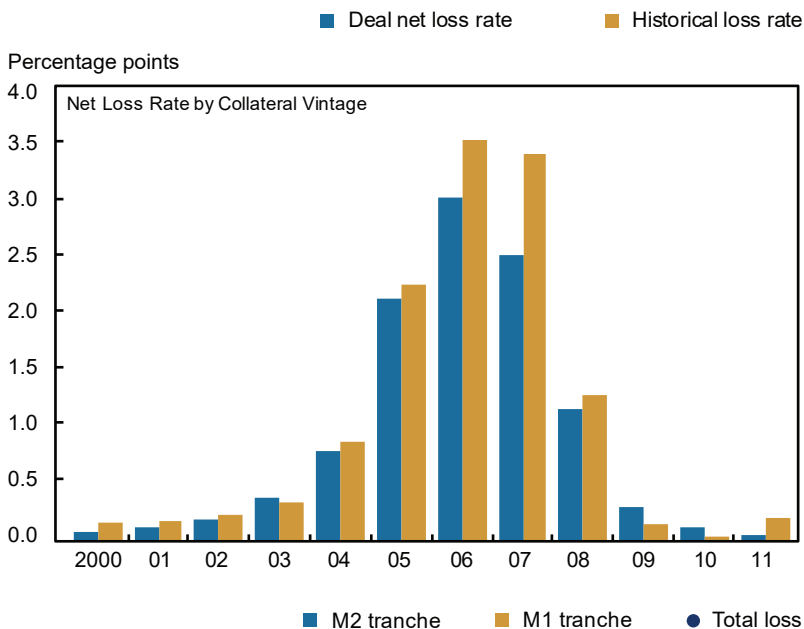
The bottom panel of Chart 5 presents results for the same exercise looking across CAS deals issued thus far. Fannie Mae loan-level disclosures and modeling show that total credit losses comparable with those of 2006 collateral would not breach the catastrophic loss portion of CAS deals issued to date.

Note that the attachment and detachment points reported in Chart 5 reflect the *initial* level of credit enhancement when CAS/STACR deals were issued. As discussed in detail in Zandi et al. (2017), the timing of prepayments and losses matters—in a scenario where there is significant early prepayment, followed by a later surge in defaults, the GSEs will bear a higher percentage of the cumulative credit losses, because some principal will have already been returned to CRT investors. Limiting these effects, however, CRT deals contain structural features that increase credit enhancement for the senior tranche and mezzanine class over time, particularly in a stress environment, as discussed in Section 2.1.³³ Zandi et al. estimate that in a scenario mimicking the 2008 financial crisis, 60-70 percent of the total credit losses on a typical STACR/CAS reference pool would be transferred to CRT investors, taking into account retention of first loss and a portion of the mezzanine bonds by the GSEs.

The risk management benefits of transferring the senior tranches of credit risk to the private sector seem to be relatively small, given that the senior credit risk tranche currently retained by the GSEs would experience losses only in a very adverse macroeconomic environment, mirroring or exceeding the 2007-09 financial crisis in magnitude and pervasiveness. Furthermore, as we argue in Section 1, it also seems appropriate from a fiscal and financial stability perspective for the public sector to retain exposure to mortgage tail risk, given the housing

CHART 5

CRT Net Loss Rates Relative to Historical Experience



Source: Fannie Mae Data Analytics.

Notes: “Deal net loss rate” shows the projected loss rates for a particular deal, CAS 2017-C07, assuming the underlying mortgage collateral experiences a similar housing market environment as the vintages shown. For example, if the collateral faced the same evolution of home prices and credit conditions as collateral issued in 2006, losses are projected to reach 3.0 percent. By comparison, the realized “historical loss rate” for the 2006 vintage collateral is 3.47 percent, nearly 50 basis points higher. The difference reflects the more stringent underwriting standards today compared to the period prior to the Global Financial Crisis. See endnote 31 for more details about how the loss rate is measured. Recent vintages (2012 onwards) have negligible loss rates, in part because these vintages have a more limited history.

sector's importance for the macroeconomy. Measured against this limited upside, the GSEs' transaction costs of transferring this senior tranche of risk would be nontrivial, and investors would likely demand a sizable liquidity premium.³⁴

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

3.2 The Trade-Off in the Timing of the GSE Risk Transfer

Under the current credit risk transfer approach, there is a lag between GSE purchase and securitization of agency mortgages and sale of CRT securities to investors. This lag reflects the time it takes to assemble a large enough reference pool of mortgages for the CRT transaction. The GSE remains exposed to mortgage credit risk during this intervening period.

The FHFA has examined how to reduce the time between MBS issuance and 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 reduced guarantee fees or premium payments from the GSEs. These transactions eliminate the lag between MBS securitization and GSE risk transfer.

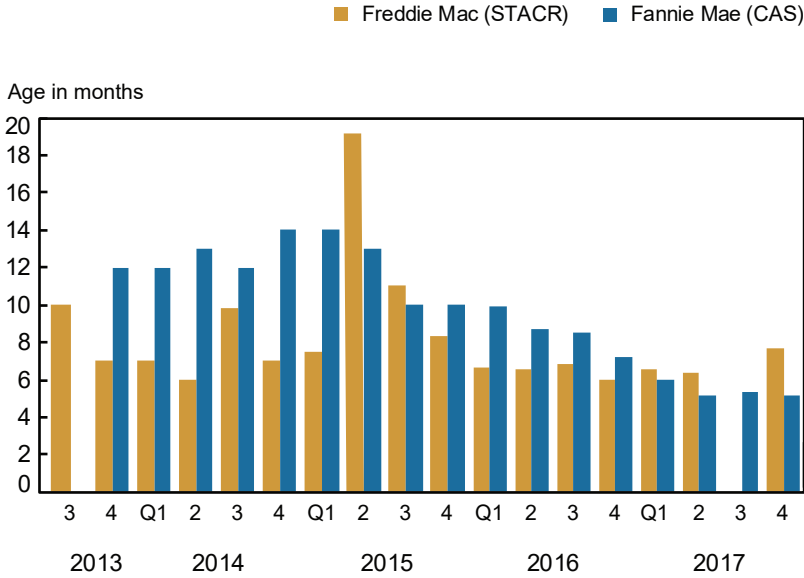
Although front-end risk transfer seems appealing given that it eliminates the time lag, it comes at the cost of a smaller investor universe. These front-end risk transfers can only be conducted by mortgage originators delivering loans to the GSEs, which significantly limits the number of possible mortgage credit risk holders. This more limited investor universe makes execution less efficient, which in turn raises 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 often highly leveraged. Some earlier front-end risk transfer deals were then securitized by the originators (for example, J.P. Morgan Madison Avenue Securities LLC), in turn helping the GSEs transfer the credit risk through an intermediary. However, those deals were one-off issuances that required a significant liquidity premium, making them less appealing economically to the GSEs.

As the CRT market has ramped up, the GSEs have shortened the time between mortgage issuance and credit risk transfer (see Chart 6). For recent CRT reference pools, loan age at the time of CRT transactions has averaged only about four-to-six months, a relatively small fraction of the five-to-seven year average mortgage life. Further reducing pipeline risk, newly originated mortgages tend to have more limited prepayment and credit risk early on because borrowers' financial positions and the state of the economy are not likely to have changed significantly from when the mortgage was underwritten.

3.3 Improving Dealer Market-Making Capabilities

One of the major challenges in the STACR/CAS market has been dealers' market-making ability, which primarily has been curbed by difficulties in warehousing securities to facilitate trading. Higher post-crisis capital requirements and other regulations affecting securities

CHART 6
 Weighted-Average Reference Pool Loan Age by Quarter of STACR/CAS Issuance



Sources: Bloomberg L.P.; authors' calculations.

trading portfolios, combined with limited turnover of CRT bonds, make it difficult for CRT market makers to meet return-on-equity targets. Current STACR/CAS bid-ask spreads are estimated to be roughly 10 basis points, a level that on a stand-alone basis does not provide dealers an attractive return given current CRT transaction volumes.³⁵

Despite these considerations, the sector’s secondary market trading volumes have risen primarily because lucrative syndication underwriting fees give dealers incentive to act as market makers. The GSEs have chosen to allocate more syndication volume to dealers that support secondary market trading. This practice allows dealers to use underwriting to subsidize lower returns from market making. Whether such cross-subsidies represent the optimal way to support CRT market liquidity is something regulators and policymakers may wish to consider in the future.

3.4 Further Broadening the Investor Base

The STACR/CAS sector faces a number of regulatory uncertainties. Removing them could further expand and deepen the investor base.

- CAS and STACR deals are classified as derivative contracts for which the U.S. Commodities Futures Trading Commission (CFTC) requires investors to register as “commodity pool operators” or otherwise have an exemption from registration. Although Fannie Mae and Freddie Mac have received CFTC exemptions, some investors in the structures are unsure whether the exemption extends to them as well. This overhang from regulatory uncertainty curbs the sector’s attractiveness to a broader set of investors (Goodman et al. 2016).
- CRTs represent unsecured GSE debt, 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. This precludes a significant residential mortgage investor class from investing in the sector beyond its current limited holdings.³⁶ Recognizing this issue, the GSEs have begun an initiative to switch CRT bonds to a real estate mortgage investment conduit (REMIC) structure. The first transaction launched in October 2018. A REMIC is a pass-through trust which offers investors recourse to the underlying real estate assets.³⁷
- A lack of National Association of Insurance Commissioners ratings on STACR/CAS deals at issuance has limited insurance company participation in primary market issuance. Obtaining such ratings at issuance could help attract more insurance companies to participate as investors.

4. CONCLUSION

Like many observers, we believe that the Fannie Mae and Freddie Mac credit risk transfer programs have been notable successes to date. The programs have reduced GSE and federal government exposure 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 and trading mortgage credit risk. This market has grown in size and liquidity, and attracted a broad investor base. A key benefit of the structured CRT bonds the GSEs have used to date compared with other possible types of mortgage risk transfer, such as reinsurance, is that trading of the bonds provides real-time information about the price of credit risk in the mortgage market.

Importantly, the CRT programs have not yet been tested by an adverse macroeconomic environment. We cannot be certain how CRT investor demand and pricing will react under such conditions.³⁸ Careful program management will be needed during such an episode. As noted, several questions remain outstanding regarding how to design CRT instruments,

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 programs represent a valuable step forward and a basis for GSE reform. Many proposals have been advanced for long-term mortgage-market reform since the GSE conservatorships began in 2008.³⁹ Although details vary, these proposals generally share common goals of ensuring that mortgage credit risk is borne by the private sector, probably with some form of government backstop and/or tail insurance to protect against catastrophe risk and stabilize the market during periods of stress, while 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.

NOTES

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¹ Aside from credit risk transfer, other reforms implemented during 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 Finance Agency (FHFA). Details about these initiatives are 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 the 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, see Goodman (2018), Congressional Budget Office (2017); Zandi et al. (2017), Goodman et al. (2016), Davidson et al. (2016), Goodman and Parrott (2016), and FHFA (2015). In addition, see Timothy Howard, "Risk Transfer and Reform," *Howard on Mortgage Finance* (blog), September 27, 2017, <https://howardonmortgagefinance.com/2017/09/27/risk-transfer-and-reform/>.

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, and settlement month), but do not stipulate the exact security to be delivered at settlement. This 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 that could no longer be securitized. For example, interest rates on jumbo mortgages rose sharply relative to rates on conforming 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, reducing home prices in particular. 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 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.

⁶ Bhutta and Keys (2017) document the financial distress experienced by the private mortgage insurance (PMI) 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 (Goodman, Parrot, and Zhu [2015]). For details, see "GSEs Officially Update Representation and Warranty Policies," HousingWire, November 20, 2014, <https://www.housingwire.com/articles/32130-gses-officially-update-representation-and-warranty-policies>. These changes were motivated by concerns that uncertainty about repurchase risk may be reducing mortgage credit supply, particularly for riskier types of loans.

⁸ See Frame (2003) for a discussion of mortgage risk-sharing transactions undertaken in an earlier program by the Federal Home Loan Banks.

NOTES (CONTINUED)

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 the top 97 percent of loss risk. To measure credit losses, a credit event was defined as a loan becoming 180-day delinquent. Loss severity was defined to be 15 percent for the initial 1 percent of defaults, with defaults exceeding this level assigned a progressively higher severity rate. These features simplified loss modeling because investors did not need to worry about foreclosure and property liquidation timelines, which affect both cash flow timing and ultimate realized loss severity. However, this structure introduced basis risk for the issuer because realized credit losses differ from the calculated loss rate based on these stylized assumptions.

¹⁰ One reason to minimize government guarantees and other contingent liabilities is that such liabilities are not always properly assessed at fair value for budgetary purposes. Thus, such guarantees may lead to misstatement of the government's fiscal position (Lucas and McDonald 2010).

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

¹² To date, all STACR/CAS deals have referenced thirty-year fixed-rate mortgages (FRMs), which represent the majority of the mortgage collateral securitized into agency MBS. Shorter-term FRMs (for example, fifteen-year mortgages) also bear less credit risk than thirty-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.

¹³ This means the GSE can prepay bonds at par after ten years. In practice, it is expected that the GSEs will exercise this call option under nearly all scenarios, given that, after ten years, the remaining mortgages generally have little credit risk, making the bonds an expensive source of funding relative to the amount of credit protection provided. Earlier CRT deals had ten-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 described here, but include additional mezzanine tranches.

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 from 3.05 to 4.0 percent, and M3 covers losses from 1.0 to 3.05 percent.

¹⁶ In addition, the deal includes delinquency and cumulative net loss performance tests designed to provide incremental structural protection to the GSE-retained senior tranche if performance deteriorates more than initially expected. These tests are designed to shut off principal cash flow from mezzanine tranches if delinquencies and losses increase above predetermined 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 allocated to the most junior tranche outstanding, initially the B2 tranche. Mortgage delinquencies can result in one of three outcomes: they can be cured with no loss occurring; they can be modified, in which case the difference between the original loan and the modified loan is passed on as a monthly loss; or the underlying property can be disposed of, passing on the loss as a one-time reduction in principal.

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

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

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

NOTES (CONTINUED)

²¹ National home prices measured by the Case-Shiller index have grown in excess of 5 percent 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 delinquencies on recent mortgage vintages are extremely low relative to historical averages.

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 to hedge funds.

²⁴ In a STACR SPI transaction, participation interests in a pool of mortgages are deposited in a trust which issues Freddie Mac gold pass-through MBS. Any loans repurchased because of nonperformance are deposited in the STACR SPI trust, which 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 details.)

²⁵ Anecdotally, the GSEs have told us that ACIS/CIRT reinsurers are generally considered to be stable buy-and-hold investors. This group includes a significant number of foreign investors, helping to diversify mortgage credit risk exposure.

²⁶ Although private mortgage insurers may have expertise in modeling mortgage credit risk due to their concentrated exposure, Bhutta and Keys (2017) find no evidence that these firms used this knowledge in practice to reduce their exposure to mortgage risk ahead of the 2007-08 financial crisis. In fact, if anything these firms *increased* their market share and risk exposure just prior to the crisis.

²⁷ 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 to occur because of specific borrower circumstances. A typical business-cycle recession, or a regional or national disaster that causes localized or modest national home price declines, would generate unexpected losses. Catastrophic losses only take place during significant downturns in the economy or housing market exceeding those occurring during more typical business-cycle downturns.

²⁸ The FHFA estimates that the GSEs charged an average annual guarantee fee of 61 basis points for thirty-year fixed-rate mortgages in 2016. Ten basis points are distributed to the U.S. Department of Treasury and 7 basis points are estimated to cover general and administrative expenses. The remainder of the fee covers credit risks in the insured mortgages, including risk of catastrophic losses.

²⁹ Calculations are based on the Fannie Mae issue CAS 2017-C06. We assume that spreads for B2 tranches are from 12 to 18 percent under a scenario in which Fannie Mae transfers the first-loss credit risk to the private market.

³⁰ CAS 2017-C07, in this case collateral group 1, represents low LTV pools. The collateral's average LTV is 75.3 percent, compared with CAS 2017-C07 collateral group 2, which represents high LTV pools with an average LTV of 92.5 percent at issuance. However, as noted, all mortgages with LTVs exceeding 80 percent have additional credit enhancement through private mortgage insurance.

³¹ The historical loss rate represents losses on loans that are no longer active because of short sales, third-party sale, mortgage release, or foreclosure sales net of proceeds. The net loss rate excludes potential or actual losses from loan modifications or potential pipeline losses from loans in foreclosure. The total loss rate includes a fixed severity rate for all CAS deals up to and including CAS 2015-C03. Thereafter, total loss rates includes pipeline, modification, and net losses expressed as a share of issuance balance of the underlying mortgage reference pool.

³² We note that the credit rating agencies project loss rates for a "triple-A" level stress event of around 8 to 9 percent for recent CRT deals, significantly above the detachment point for the M1 CRT bonds. However, these projections are based on very conservative assumptions.

³³ Note that CRT deals do not have an explicit cash flow lockout provision, as used in certain types of insurance contracts and other securities containing credit risk. Such a feature 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. This could increase the cost of risk transfer because investors would require higher returns to hold a similar credit risk over a longer period.

NOTES (CONTINUED)

³⁴ A hypothetical example concerning expansion of the mezzanine structure illustrates this point. Assume that the GSEs issued an additional senior mezzanine tranche covering credit losses between 4 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 plus 10 basis points. However, given private investors' high capital costs and such a security's unattractive return, demand would be weak, resulting in wider spreads for the additional now-most-senior mezzanine tranche.

³⁵ Dealers generally do not take directional positions in markets. Instead, they profit from the bid-ask spread, which allows them to sell securities at ask prices slightly above the bid prices they paid to purchase them.

³⁶ Applicable REIT tax qualification rules require that 75 percent of gross income be derived from assets tied to real estate. In addition, at least 95 percent of the REIT's gross income must come from real estate income that meets the 75 percent 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 percent test. Generally, to operate their businesses, REITs must also satisfy requirements for exemption from registration under the Investment Company Act of 1940. This exemption requires a company to invest at least 55 percent of its assets in "mortgages and other liens on and interest in real estate" (qualifying interests) and at least 80 percent of its assets in qualifying interests plus "real estate-type interests." On October 16, 2017, the Securities and Exchange Commission's Division of Investment Management issued a no-action letter which specified that certain CRT securities may be treated as real estate-type interests under the Investment Company Act.

³⁷ As long as a REMIC's holdings are at least 95 percent in real estate assets, interests in it are considered to be good REIT assets. If the REMIC holds less than 95 percent of its assets in qualifying real estate, the tax treatment switches to proportional allocation.

³⁸ See Wachter (2018) for a detailed discussion of how CRT pricing may evolve over the housing cycle.

³⁹ Reform proposals include Cantrill et al. (2018); Bright and DeMarco (2016); Parrott et al. (2017); Mortgage Bankers Association (2017); Mosser, Tracy, and Wright (2016); and Scharfstein and Sunderam (2011). See Scharfstein and Swagel (2016) for a discussion of the Corker-Warner bill and other post-crisis legislative efforts to reform the housing finance system.

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