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Introduction to GSE Credit Risk Transfer

- Fannie Mae and Freddie Mac are programmatically issuing about twice a quarter. The deals provide mortgage credit exposure to the GSEs' wrap business
- Bonds are unsecured obligations of the GSEs with a 12.5-year final maturity and cash flows linked to payments of a reference pool of mortgages
- Scheduled principal is paid pro-rata between the senior and subordinate bonds but sequentially within the subs
- Lockout can occur if various triggers are hit. Both STACR and CAS deals accelerate unscheduled principal to seniors if subordination falls below a target, but the Freddie deals contain an additional trigger based on credit events or losses that can cause extension
- On older deals, defaults are replaced with credit events, which are generally given by 180-day delinquency. A fixed schedule based on cumulative credit events defines severities. However, recent issues pass through losses from liquidation through to investors
- Although collateral quality and credit guidelines have remained fairly consistent, both GSEs have added loans from their affordability programs: HomeReady and Home Possible. We examine them in more detail
- Our CRT model consolidates loan-level loss modeling with our traditional pool level agency prepayment model
- We track CRT performance in multiple regularly-published reports, including the MBS Credit Monthly. We stratify historical performance along various attributes, including GSE, LTV type, loan vintage, deal vintage, and severity type (fixed schedule or actual loss)
- We identify various frameworks to determine relative value of CRT bonds

MBS Strategy
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See page 17 for analyst certification and important disclosures.

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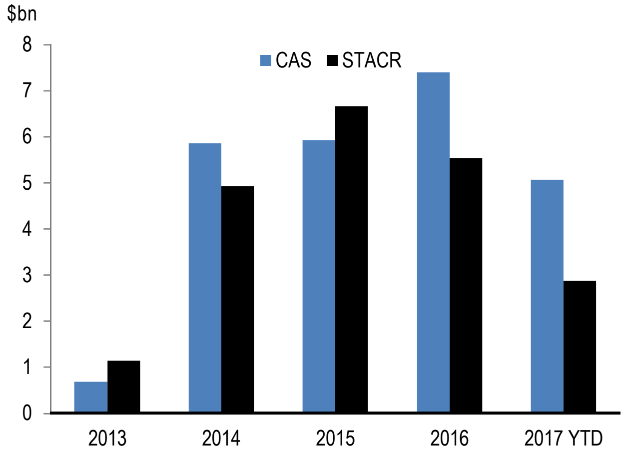
Issuance and Investor Base Trends

As part of FHFA's initiative to bring private capital back to the mortgage market, Fannie and Freddie have issued over $46bn of risk-sharing deals over the past four years. In these deals the credit risk on the GSE's wrap business is transferred to private investors. Freddie Mac debuted its first risk-sharing security (STACR 2013-DN1) in July 2013. Fannie Mae followed up with their version (CAS 2013-C01) in October. Since then the GSEs have been issuing typically twice per quarter or 7 to 8 times a year. Aggregate CRT issuance in 2016 totaled $13bn (Exhibit 1). This asset class has received wide attention by investors as it presented opportunities for investors to access US residential mortgage credit, especially given the weak issuance in prime jumbo 2.0 non-agencies.

Exhibit 1: Annual GSE CRT Issuance as of June 1, 2017



Source: J.P. Morgan, Freddie Mac, Fannie Mae

Asset managers are the largest investors in this space (Exhibit 2). They made up 55% and 68% of the investor base in the most recent CAS and STACR transactions. Other investors, such as insurance companies, REITS, sovereign funds, banks and credit unions are comparatively smaller. Hedge funds comprised 33% and 21% of the most recent CAS and STACR deals but are most active in the bonds at the bottom of the cashflow waterfall, such as STACR B1s/B2s and CAS M2s/B1s, while asset managers are active across the capital structure. In addition, new investors are looking at CRT. These new investors come from insurance companies and asset managers who were involved in legacy RMBS, but have largely been on the side-lines post-crisis. There also appears to be a small amount of cross-over from high-yield corporate credit into the CRT space.

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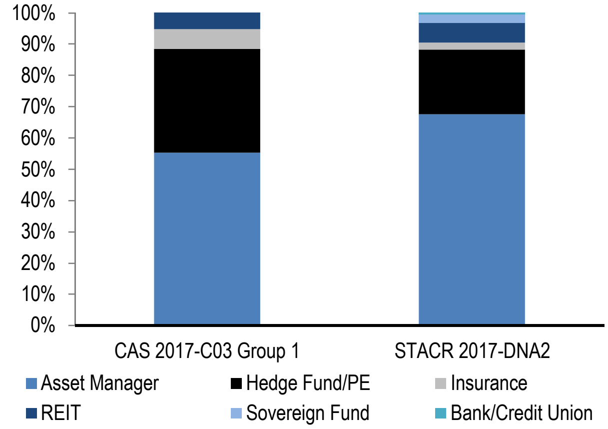
Exhibit 2: Investor breakdown in the two recent STACR and CAS transactions weighted by dollar balance



Source: J.P. Morgan, Freddie Mac, Fannie Mae

REIT participation is limited by the fact that none of the tranches are REIT eligible in that they don't have equity tax status. However, both Fannie Mae[1] and Freddie Mac[2] have announced potential changes to the CRT program that would make the tranches REIT-eligible. The proposal is to structure future CRT offerings as notes issued by REMIC trusts.

Deal structure iterations to present day

Basic overview

STACR and CAS transactions have been through several iterations to arrive at the current structure (Exhibit 3). However some aspects are consistent. CRT securities are floaters that are unguaranteed and unsecured obligations of the GSEs with a 10 or 12.5-year maturity and callable at 10% pool factor (or 10 years for 12.5 year maturity transactions). Notes are issued at par, and pay a margin above 1-month LIBOR. Although cash flows are linked to prepayments and defaults of the reference mortgage loans, the securities are debentures, not mortgage-backed securities. We review the historical changes in structure over time. Investors may find our "MBS Credit Monthly" report's deal comparison pages helpful to compare structure, pricing, collateral, ratings, and other attributes.

Exhibit 3: CRT transactions have seen several iterations over time

Source: J.P. Morgan

Nomenclature: STACR transactions are issued as "DN" or "HQ" deals, where "DN" designates low-LTV (60-80%) pools and "HQ" refers to high-LTV (80-97%) pools. CAS deals are one- or two-pool transactions. Group 1 pools are low-LTV and have "1" as the first character of the tranche name, such as 1M1. Group 2 pools are high-LTV pools, identified by a "2" in the beginning of the tranche name, like 2M1.

Fixed Severity Transactions

The inaugural STACR and CAS deals both contain one low-LTV reference pool and two mezzanine classes with 10-year maturities. In addition to the two mezzanine classes, the structure contains a senior and a residual tranche, which were not sold to investors (Exhibit 4). The senior and residual tranches are used for the purposes of calculating cashflows distributed to M1 and M2 tranches and can be thought of as effectively retained by the GSEs.

[1] www.fanniemae.com/portal/funding-the-market/mbs/news/2017/connecticut-avenue-securities-mbs-prospectus-050817.html
[2] www.freddiemac.com/creditriskofferings/docs/STACR_REMIC_announcement.pdf

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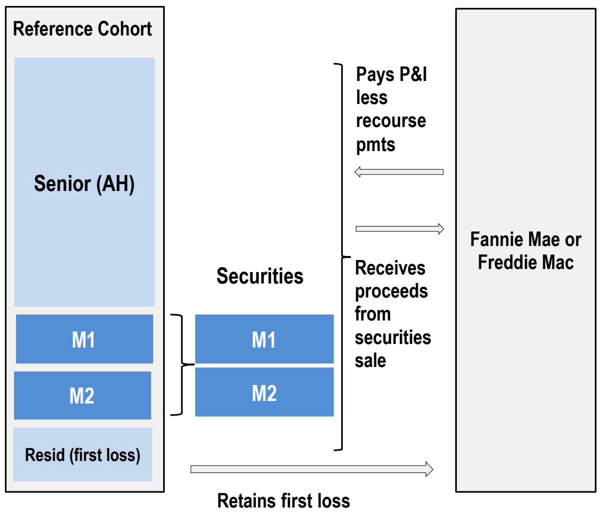
Exhibit 4: Earlier vintage GSE Credit Risk Transfer deal structure do not offer the first loss residual B class



Only the M1 and M2 are certificates receiving cash flows

Source: J.P. Morgan, deal documents

Cashflows depend primarily on prepayments and credit events in the reference pool. Principal is not locked out from mezzanine bonds entirely. Instead, scheduled principal is paid pro-rata between the senior (retained) tranche and the mezzanine/residual tranches. Within the mezzanine tranches, principal flows sequentially with the M1 receiving principal before the M2, and so on. Unscheduled principal is paid pro-rate between the senior and mezzanine/residual tranches if specific tests are met as described below.

Defaults and losses are based on credit events and a fixed severity schedule: Instead of traditional defaults, which are thought of as REO liquidations, short sales or foreclosure sales, writedowns are allocated based on credit events. These credit events are defined roughly as 180 day delinquency or short sale/REO. The initial transactions have fixed severity schedules dependent on cumulative credit event levels. In practice, this means that once a credit event occurs it will drop out of the pool and create an immediate loss. The severity rate applied to the credit event is dependent on the cumulative credit events. For example, in the inaugural STACR deal, the first 100bp of credit events is assigned a 15% loss severity. The next 100bp of losses has a 25% loss severity; any additional losses have a 40% loss severity. CAS deals have a different severity schedule than STACR deals.

Triggers: CAS and STACR deals with fixed severity schedules include minimum credit enhancement triggers, which go into effect if senior credit enhancement rates drop below a pre-specified level that, depending on the deal, ranges between 3% and 7%. The credit enhancement trigger is breached as losses come in and erode the balance of the subordinate bonds. Once the trigger is breached, unscheduled principal is redirected to the senior tranche until the senior enhancement returns above the minimum threshold. The minimum credit enhancement trigger will not be hit if defaults are small, but can be hit in a rapidly deteriorating housing market. The STACR deals have an additional trigger which is hit if cumulative credit events increase beyond a pre-determined schedule. This trigger will also not be hit if defaults are small, but can be hit in a rapidly deteriorating housing market.

Subsequent modifications: In 2014, STACR added a M3 tranche while CAS deals continued with the two mezzanine tranche structure. Later CAS and STACR added deals that referred to high-LTV loans. CAS deals included 2 collateral groups segmented by low LTV (group 1) and high LTV (group 2). STACR high-LTV deals have "HQ" in the series name. Both high-LTV STACR and CAS transactions further breakdown loss severities at higher cumulative credit events thresholds than their respective low-LTV deals/groups (Exhibit 5). In 2015, STACR included an additional twist with a class B mezzanine bond that had 0% credit enhancement (CAS follows suit in 2016).

Exhibit 5: CAS deals have been modified to include high LTV loans

	Inaugural CAS 2013-C01	Two collateral groups CAS 2014-C02 Group 1	Group 2
Size ($MM)	$675	$1,200	$400
Ref Pool	Fannie 3Q12	Fannie 1Q13	
Maturity	10 years	10 years	
Class / Thickness	M1:135bp, M2:135bp	1M1:125bp 1M2:145bp	2M1:135bp 2M2:175bp
Ratings	M1: BBB- (Fitch) M2: NR	1M1: BBB- (Fitch/S&P) 1M2: NR	2M1: BBB+/BB (Fitch/S&P) 2M2: NR
Severity	Fixed schedule		
<1% CE	10%	10%	10%
1-2% CE	20%	20%	20% (1-3%CE)
2+% CE	40%	40%	25% (>3%CE)
Triggers			
Min Credit Enhancement	3%	3%	3.75%
Cum. Net CE	None	None	None
Cum. Net Loss	None	None	None
Delinquency	None	None	None

Source: J.P. Morgan, Fannie Mae

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Actual Loss Deals

The biggest change in the CRT structures occurred with the introduction of actual loss deals for both STACR and CAS, the first being STACR 2015-DNA1 in April 2015 followed by others (Exhibit 6). CAS issued their first actual loss deal in October 2015 (CAS 2015-C04). While older deals use a fixed severity schedule and credit events, actual loss deals use actual losses resulting from property disposition or modification to calculate cumulative losses.

Exhibit 6: STACR deal structures have evolved over time to include M3 and B tranches, high LTV deals, and those that reference actual losses

	STACR 2013-DN1	STACR 2015-HQA1
Size ($MM)	$500	$872
Ref Pool	Freddie 3Q12	Freddie Aug '14 - Nov '14
Maturity	10 years	12.5 years
Class / Thickness	M1:135bp, M2:135bp	M1 : 100bp, M2 : 225bp, M3 : 170bp, B : 100bp
Ratings	M1/M2 NR	M1: A-/A-, M2: BBB-/BBB-, M3:B+/B+, B:NR (Fitch, Kroll)
Severity	Fixed schedule	
<1% CE	15%	Based on actual loss
1-2% CE	25%	
2+% CE	40%	
Triggers		
Min Credit Enhancement	3%	6.45%
Cum. Net CE	0.25% year 1, increasing 25bp /year to 2.5%	None
Cum. Net Loss	None	0.1% year 1, increasing 10bp / year to 1.3%
Delinquency	None	6m avg distressed bal < 0.5*($subordinate - $current loss)

Source: J.P. Morgan, Freddie Mac

Actual losses are the following. At property disposition:

- Collateral deficiency
- Delinquent interest
- Expenses (legal fees, taxes, maintenance)
- Principal forgiveness

At modification:

- Interest shortfall
- Bankruptcy cramdown

The actual loss bonds also have a longer maturity at 12.5 years instead of 10 years on earlier deals. Freddie and Fannie have the option to terminate the deal at the earlier of 10% pool factor or 10 years.

Triggers: The actual loss deals include a couple of modifications to the existing triggers. The minimum credit enhancement trigger still exists. The cumulative credit event trigger from the fixed severity deals is modified and now refers to cumulative losses. The deals also include a new delinquency test. Here, subordinate bonds are locked out from receiving principal if the 6-month average distressed balance is more than a certain percentage of the subordinate balance (including reference tranches and subtracting any losses). That limit is 40% for CAS deals and 50% for STACR deals. In this way, lockout happens far in advance of the actual losses ramping up if delinquencies build up substantially. In 2016, CAS for the first time sold the class B first-lost piece with 0% credit enhancement. CAS also moved away from two collateral pool deals and towards just one collateral type (low or high LTV) per transaction.

Changes in 2017: In 2017, both CAS and STACR deals have continued to evolve. STACR deals that had three mezzanine tranches and one B tranche now consist of two mezzanine bonds (M1 and M2) and two B tranches (B1 and B2). The former B tranche is broken up in a 0-50bp credit support B2 tranche and a 50-100bp credit support B1 bond. CAS has the same structure. STACR has sold down to the B2 tranche but CAS deals have thus far retained their B2 bond (Exhibit 7 and 8).

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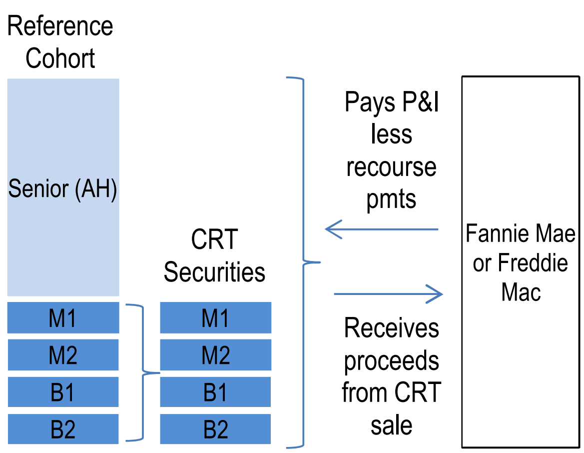
Exhibit 7: Current deal structure consists of M1, M2, B1, and B2



Source: J.P. Morgan, deal documents

Exhibit 8: 2017 deal structures have now converged between STACR and CAS

	STACR 2017-DNA2	CAS 2017-C03 Group 1
Size ($MM)	$1,220	$1,371
Ref Pool	Freddie Jul - Oct'16	Fannie Jul - Oct '16
Maturity	12.5 years	12.5 years
Class / Thickness	M-1:120bp, M-2:130bp, B-1:50bp, B-2:50bp	1M-1:145bp, 1M-2:155bp, 1B-1:50bp
Ratings	M-1: BBB-/BBB, M-2: B+/BB+, B-1: NR/NR, B-2:NR/NR (Fitch/MSTR)	1M-1: Baa3/BBB, 1M-2: B2/B H, 1B1: NR/NR (Moody's/DBRS)
Severity		
	Based on actual loss	Based on actual loss
Triggers		
Min Credit Enhancement	4.00%	4.00%
Cum. Net CE	None	None
Cum. Net Loss	0.1% year 1, increasing 10bp / year to 1.3%	None
Delinquency	6m avg distressed bal < 0.5*($subordinate - $current loss)	6m avg distressed bal < 0.4*($subordinate - $current loss)

Source: J.P. Morgan, Freddie Mac, Fannie Mae

2018: potentially first CRT from REMIC trusts

As discussed earlier, the GSEs announced potential changes to make CRT more attractive for REIT investors by issuing from a REMIC. The GSEs would have to make a REMIC tax election on a majority of acquired single-family mortgage loans that the GSEs acquire and guarantee. The GSEs each released Fact Sheets and FAQs. The highlights include their commitment to avoid disruption to the TBA MBS market, and potential impact on ERISA-eligibility of CRT class B bonds. M1 and M2 are anticipated to remain ERISA-eligible. Some investors who hold MBS directly and use the cash method of accounting to report taxable income would have to report using the accrual method of accounting. This affects timing of reported income by one month. We believe few investors use the cash method.

Going forward, the anticipated changes are expected to occur after the feedback period. Then over an aggregation period of about two quarters, the GSEs anticipate that they will acquire single-family loans to a sufficient amount with a REMIC election to bring CRT REMIC transactions to market in early 2018.

Collateral characteristics

The underlying reference pools consist of mostly 30-year fixed-rate mortgages wrapped by the GSEs, with particular credit constraints that have stayed mostly consistent, apart from new affordability programs. Using STACR 2017-DNA2 as an example, the underlying loans have to meet the following key criteria, among others:

- 20-30 year fixed-rate with full documentation (note that 99% of collateral is still 30-year)
- No underwriting or servicing defects found in Freddie’s internal quality control process
- Never delinquent (since acquired by GSE)
- No mortgage insurance
- LTV between 60 and 80, inclusive of 80
- Combined LTV less than or equal to 97
- Not subject to recourse
- No HARP loans
- Original principal balance of at least $5,000

We note that CAS deals' group 2 and STACR HQ deals have LTVs between 80 and 97. These loans have higher defaults but, because of mortgage insurance, have lower severities. Within these constraints, individual reference pools can have different collateral characteristics.

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Thus far, across both CAS and STACR, WALA at origination has ranged between 5 to 28 months. Weighted average FICOs have been above 740 reflecting the high quality of the borrower base. DTIs have been in the low to mid-30s. A summary of each deal's structure and collateral can be found in our MBS Credit Monthly.

New affordability programs in CRT

By 2017, both Fannie and Freddie had started including loans from HomeReady and Home Possible, which are their respective affordability programs. Both programs make loans more affordable by allowing borrowers to go up to 97% LTV and reducing their MI coverage requirements with the possibility of no LLPAs.

Fannie Mae has enhanced the data tape file to include a HomeReady Program Indicator. In the most recent deal, CAS 2017-C04 had 6.73% HomeReady loans. Prior CAS deals have had some My Community loans, which was the older version of the HomeReady program. However, given the increasing prevalence of affordability program loans in GSE CRT deals, investors need to get comfortable with the incremental risk. To learn more about these programs, please see our report on the topic.[3]

Modeling

Our CRT models have gone through a few iterations since 2013. First, we had a 180-day charge-off model, which we then followed up by modeling the full pipeline until liquidation as the products evolved. Present in each iteration was our use of a loan-level approach to modeling agency prepayments. This, while more granular, was also greatly simplified relative to our long standing agency pool-level model.

Our most recent model consolidates the two approaches. Our CRT model will use the same, loan-level loss modeling (based on GSE loan level disclosure data) combined with our traditional pool-level agency prepayment model. This will eliminate any discrepancies between the two prepayment approaches. The same model that drives OAS will also contribute to our loss forecasting. Our daily analytics reports use this framework. As the agency prepayment model evolves and becomes more loan-aware, both the OAS and credit frameworks will improve simultaneously.

Default projections

Using the loan level credit model, we project credit events and writedowns on the entire universe of CRT bonds under various housing scenarios. In the base case home price scenario, we project between 21bp and 2.24% cumulative credit events/defaults across the deals, with losses ranging between 1bp and 21bp (Exhibit 9). In our base case, across all CRT bonds outstanding, only the class B tranches take writedowns.

Exhibit 9: Model base case credit event/default and loss projections for recent transactions (% of current balance)

Deal	Group	% C.E.	% Loss
CAS 2016-C06	1	1.17	0.13
CAS 2016-C07	2	2.00	0.16
CAS 2017-C01	1	1.23	0.14
CAS 2017-C02	2	2.19	0.19
CAS 2017-C03	1	1.34	0.15
STACR 2016-DNA4		1.22	0.15
STACR 2016-HQA4		1.90	0.17
STACR 2017-DNA1		1.18	0.12
STACR 2017-DNA2		1.21	0.13
STACR 2017-HQA1		2.23	0.21

As of June 5, 2017

Source: J.P. Morgan

Our repeated crisis scenario, which repeats the downturn in 2007-2010, is the most severe home price stress scenario in our model. Under these scenarios only the B classes take larger writedowns. This points to the strong structures backing these deals and to the broader improvement in underwriting standards since 2007.

Our full set of default projections for each bond is available for our base and stress case scenarios in several reports and online: the daily Non-agency RMBS, CRT and SFR Analytics Package, MBS Credit Monthly, or on DataQuery on JPMorgan Markets. Our monthly report also includes a set of default attribution reports that break out defaults by FICO, LTV, and delinquency status. This is useful for comparing deals and peeling back any layered risks.

Prepayment projections

Prepayments are another source of risk for CRT bonds. They are a bigger concern for the earlier deals that, as of when this report was published, trade at larger premiums than new issue. Additionally, M1s are far less sensitive to prepayment rates. M2s are lower down in the waterfall and therefore, have some prepay protection due to the lockout period.

[3] Affordability loans in CRT report: https://jpmm.com/research/content/GPS-2292466-0

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One feature of these bonds is that unscheduled principal prepayments to the reference pool are distributed pro-rata to the senior (class A) and subs (CRT bonds) in order to maintain the credit enhancement at a constant level.

We have two ways to analyze prepayment rates. First, our CRT model produces deal level prepayment projections. We broadly expect lifetime CPRs to range between 5 CPR to 11 CPR across both CAS and STACR transactions (Exhibit 10). The wide range of our projections is in line with the difference in WAC profiles of the pools.

Exhibit 10: Model base case forward prepayment projections for recent transactions

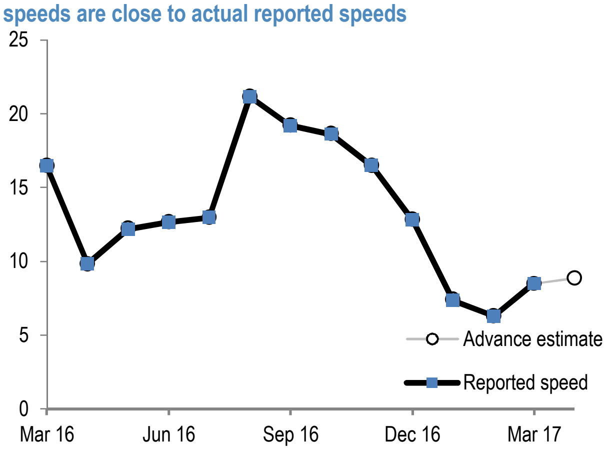
Deal	Group	3M	CPR 1Y	Life
CAS 2016-C06	1	9.87	10.11	7.61
CAS 2016-C07	2	5.99	6.62	6.76
CAS 2017-C01	1	7.06	7.55	6.73
CAS 2017-C02	2	3.40	4.12	5.71
CAS 2017-C03	1	4.85	5.59	6.06
STACR 2016-DNA4		8.28	9.08	7.40
STACR 2016-HQA4		6.21	6.98	6.98
STACR 2017-DNA1		6.15	6.85	6.50
STACR 2017-DNA2		4.41	5.23	6.07
STACR 2017-HQA1		3.72	4.45	5.92

As of June 5, 2017
Source: J.P. Morgan

Secondly, we look at the agency universe for more short term forecasts. CRT deals reference the same mortgage loans that collateralize agency MBS. Prepayments experienced on these loans directly affect both agency MBS and the associated GSE CRT deals. Speeds on CRT deals are reported later than agency MBS pools.

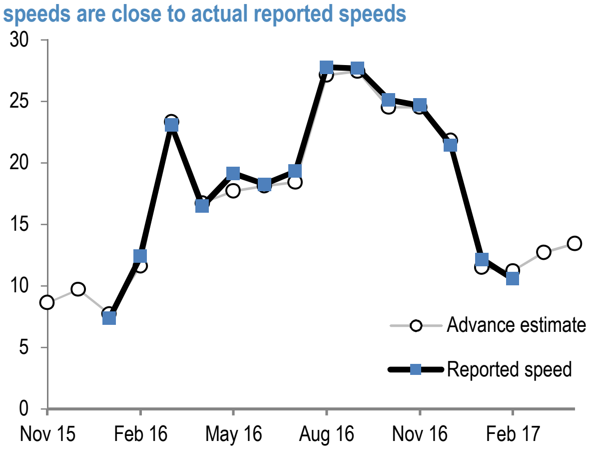
Given these timing differences, we can estimate the speeds for STACR and CAS deals one to two months in advance of the GSEs' official paydown announcement. We map the prospectus information provided on CRT reference pools to agency MBS collateral to find pools that are broadly representative of specific CAS/STACR transactions. These estimates are published a few days after GSE prepayment data is released by the agencies in our report entitled STACR-CAS Prepayment Estimates and Projections. The advance estimate and reported CRT speeds are very close for both STACR and CAS deals (Exhibit 11 and 12).

Exhibit 11: STACR 2016-HQA1 advance estimate prepayment speeds are close to actual reported speeds



Source: J.P. Morgan

Exhibit 12: CAS 2016-C02 Group 2 advance estimate prepayment speeds are close to actual reported speeds



Source: J.P. Morgan

Historical performance

We track CRT performance regularly outside of ad-hoc reports. This performance is available in the following:

- DataQuery on JPMorgan Markets
- Non-agency RMBS, CRT and SFR Analytics Package daily report
- Non-agency MBS and CRT Remit Report monthly report
- STACR-CAS Prepayment Estimates and Projections monthly report
- MBS Credit Monthly report

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In our MBS Credit Monthly report, besides performance projections, we summarize historical performance by various attributes, including LTV type, loan vintage, deal vintage, and severity type (fixed severity schedule or actual loss).

The GSE historical collateral performance pages report performance by GSE and LTV type for each loan vintage of 30 year fixed rate collateral using Fannie Mae and Freddie Mac disclosure data. Cumulative defaults, losses and severities to date help highlight credit performance of each vintage. In addition to those fields, we also show origination statistics such as FICO, DTI and original LTVs. The current LTVs are calculated using realized HPA (i.e. our Case-Shiller indices) since loan origination (Appendix 1 to 4).

The CRT reference pool performance pages report CPR, CDR, severities and 60+ delinquencies of loans that were included in CRT reference pools. The charts show performance metrics broken down by deal vintage. The table below the charts shows cumulative losses, severities and defaults by deal vintage and severity type. Origination statistics such as WALA, FICO, DTI and LTV are also reported for each of the groupings. Current LTV and CLTV are again calculated by adjusting original LTV by the realized HPA. There are four pages in all, with a page for each program by LTV type (Appendix 5 to 24).

Lastly, we added a separate page to report performance of fixed severity deals. Due to their seasoning, many of these deals have 3+ years of performance history. To help compare performance of the respective deals, we show credit events by WALA for each of the deals broken out by LTV type and GSE (Appendix 25 to 28).

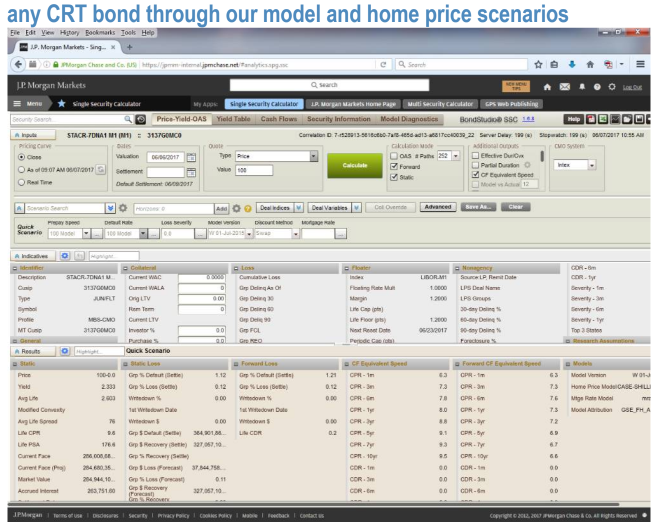
Relative value

We have several tools for investors to compare CRT to other sectors and find relative value within the space.

We run each bond daily through four home price scenarios (base, depression, repeated crisis, and positive) using our CRT model to calculate yield, DM, average life, and cash flow spread. We also report our projected defaults, losses, and prepayments using a forward and static rate curve. These results are also available on JP Morgan Markets through the DataQuery application.

If needed, investors can also run individual CRT bonds through our GSE model themselves using JP Morgan Markets' single security calculator and multi-security calculator tools. In short, investors select which bond to run, and input price, model, home price scenario, and other assumptions to stress test and to conduct sensitivity analysis on various parts of the capital structure (Exhibit 13).

Exhibit 13: Single security calculator on JP Morgan Markets runs any CRT bond through our model and home price scenarios



Source: J.P. Morgan

We also bucket CRT bonds by vintage, collateral, and rating to create various indices. We have 2014, 2015, and 2016 vintage CRT indices and on-the-run indices, that are based on the three most recently issued bonds of each rating (AA/A, BB/B, BBB, or NR). We calculate returns, yields, WAL, etc. for each of these indices. These metrics are available on DataQuery, the daily analytics package or in our MBS Credit Monthly.

Lastly, we have constructed a credit OAS framework that brings together our home price scenarios to evaluate CRT bonds. Putting the base case, upside and downside HPA scenarios together in a single framework is critical to understanding the relative value of CRT bonds.

We run CRT bonds through various HPA scenarios and assign a probability to each of these scenarios occurring. Weighting the DMs in each of these scenarios by their respective probabilities gives us a "credit OAS." The credit OAS can help compare how sensitive different CRT bonds are to changes in home prices. At this point, the credit OAS is a custom run that cannot be done using our online calculators. However, we hope to implement it in our CRT modeling system in the near future. For more information on the framework, please see our introduction report.[4]

[4] Credit OAS report: https://jpmm.com/research/content/GPS-2286891-0

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Appendix: CRT performance reporting in the Credit Monthly

Appendix 1: Freddie Mac High LTV

Vintage	UPB $bn	Factor	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Cur LTV	Cur CLTV	Cum Dflt	Cum Loss	Cum Sev
2000	0.2	0.01	669	36.0	92.0	92.0	47.5	47.5	1.7%	0.3%	11.6%
2001	0.9	0.02	675	35.4	91.3	91.3	48.9	49.0	2.2%	0.5%	16.0%
2002	1.7	0.03	679	36.3	91.2	91.2	51.9	51.9	2.8%	0.8%	20.2%
2003	3.9	0.07	695	35.9	90.7	90.7	54.5	54.6	3.7%	1.2%	26.2%
2004	3.1	0.10	689	37.5	91.1	91.1	62.4	62.4	5.6%	1.9%	29.1%
2005	3.5	0.12	692	39.3	90.8	90.9	73.1	73.2	10.0%	3.7%	33.0%
2006	2.7	0.11	686	41.1	90.6	90.7	82.1	82.2	12.5%	5.1%	35.3%
2007	4.2	0.13	687	41.4	90.6	90.6	83.0	83.1	13.2%	5.5%	34.5%
2008	4.4	0.11	708	42.2	90.6	90.6	76.5	76.5	8.8%	3.2%	29.4%
2009	4.5	0.16	752	33.6	89.8	89.8	66.4	66.4	1.6%	0.3%	15.9%
2010	4.1	0.26	756	32.6	90.6	90.6	66.2	66.2	0.6%	0.1%	13.1%
2011	5.7	0.33	756	33.2	91.2	91.3	65.8	65.8	0.3%	0.0%	10.2%
2012	18.5	0.61	759	32.8	91.4	91.5	67.9	67.9	0.1%	0.0%	9.5%
2013	30.4	0.65	756	33.4	91.7	91.7	73.6	73.6	0.1%	0.0%	6.0%
2014	36.2	0.66	747	34.8	92.4	92.4	80.4	80.4	0.0%	0.0%	6.1%
2015	60.3	0.87	748	35.0	91.8	91.8	84.5	84.5	0.0%	0.0%	0.1%
2016	19.4	0.95	747	35.5	91.7	91.7	87.8	87.8	0.0%	0.0%	0.0%

Source: Freddie Mac, Loan Performance

Appendix 2: Freddie Mac Low LTV

Vintage	UPB $bn	Factor	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Cur LTV	Cur CLTV	Cum Dflt	Cum Loss	Cum Sev
2000	0.2	0.00	683	34.1	76.2	76.5	37.3	37.5	0.5%	0.2%	17.9%
2001	1.3	0.01	694	33.2	75.7	76.3	38.4	38.6	0.6%	0.2%	26.4%
2002	3.0	0.02	700	33.8	75.4	76.1	41.2	41.6	0.8%	0.4%	31.2%
2003	10.4	0.05	712	33.6	74.6	75.7	43.7	44.4	1.3%	0.5%	26.9%
2004	8.2	0.07	702	36.2	75.4	76.8	51.4	52.3	2.5%	1.1%	35.6%
2005	14.0	0.09	702	38.2	75.3	76.8	62.7	63.9	5.9%	2.9%	45.4%
2006	10.7	0.08	695	39.8	75.4	77.2	70.8	72.5	8.2%	4.6%	51.7%
2007	11.5	0.10	695	40.0	75.3	77.3	69.3	71.2	8.3%	4.7%	51.6%
2008	10.2	0.08	709	40.9	75.0	76.2	62.2	63.2	4.7%	2.5%	47.8%
2009	31.5	0.15	754	35.0	74.8	75.8	54.2	54.9	0.7%	0.3%	35.1%
2010	28.9	0.24	756	34.3	75.4	76.1	53.8	54.4	0.3%	0.1%	31.3%
2011	26.9	0.31	759	33.7	75.3	76.1	52.7	53.2	0.1%	0.0%	31.1%
2012	70.2	0.61	766	32.3	74.7	75.6	53.7	54.4	0.0%	0.0%	28.0%
2013	84.5	0.68	761	32.9	74.9	75.8	58.8	59.5	0.0%	0.0%	26.6%
2014	60.5	0.62	752	34.6	76.0	76.8	65.4	66.1	0.0%	0.0%	22.6%
2015	109.0	0.84	752	34.8	75.3	76.2	69.0	69.8	0.0%	0.0%	30.5%
2016	35.4	0.93	748	35.2	75.2	75.9	72.1	72.8	0.0%	0.0%	0.0%

Source: Freddie Mac, Loan Performance

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Appendix 3: Fannie Mae High LTV

Vintage	UPB $bn	Factor	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Cur LTV	Cur CLTV	Cum Dflt	Cum Loss	Cum Sev
2000	0.3	0.01	682	35.7	92.1	92.2	46.4	46.7	1.4%	0.2%	12.7%
2001	1.2	0.01	689	34.8	91.2	91.3	47.7	47.7	1.8%	0.3%	17.6%
2002	2.2	0.03	694	35.9	91.2	91.2	50.7	50.7	2.2%	0.5%	23.1%
2003	5.2	0.07	699	36.0	90.9	90.9	53.8	53.8	3.4%	0.9%	26.7%
2004	2.9	0.09	695	38.6	91.3	91.3	62.9	62.9	5.5%	1.7%	30.9%
2005	3.1	0.12	697	40.5	90.7	90.7	73.1	73.1	9.9%	3.4%	34.9%
2006	2.5	0.11	691	42.4	90.5	90.5	82.4	82.4	12.2%	4.6%	37.8%
2007	5.3	0.13	688	43.2	90.4	90.5	83.3	83.3	13.1%	4.7%	36.1%
2008	5.5	0.10	717	43.3	90.8	90.8	75.8	75.8	6.9%	1.9%	27.9%
2009	5.5	0.16	755	33.8	89.8	89.8	65.7	65.7	1.4%	0.3%	18.3%
2010	7.0	0.26	762	32.7	90.3	90.4	65.3	65.4	0.5%	0.1%	11.0%
2011	11.7	0.33	762	33.4	91.4	91.4	64.9	65.0	0.2%	0.0%	8.4%
2012	42.0	0.57	764	32.8	91.4	91.5	66.5	66.5	0.1%	0.0%	7.6%
2013	55.0	0.59	757	34.0	92.1	92.1	73.1	73.2	0.1%	0.0%	6.5%
2014	53.3	0.63	748	35.0	92.2	92.2	79.6	79.6	0.0%	0.0%	8.4%
2015	90.2	0.84	750	34.7	92.1	92.1	84.1	84.2	0.0%	0.0%	7.1%
2016	12.3	0.92	749	35.0	92.1	92.1	86.7	86.8	0.0%	0.0%	0.0%

Source: Fannie Mae, Loan Performance

Appendix 4: Fannie Mae Low LTV

Vintage	UPB $bn	Factor	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Cur LTV	Cur CLTV	Cum Dflt	Cum Loss	Cum Sev
2000	0.3	0.00	683	34.9	75.6	75.8	36.8	37.2	0.5%	0.2%	33.4%
2001	1.9	0.01	696	34.1	75.0	75.2	37.4	37.6	0.5%	0.2%	39.1%
2002	4.6	0.02	704	34.5	74.6	74.9	40.2	40.3	0.7%	0.3%	42.7%
2003	16.3	0.05	710	34.4	74.1	74.8	42.6	43.0	1.3%	0.5%	38.5%
2004	9.2	0.07	703	37.7	74.7	76.2	51.1	52.1	2.6%	1.1%	43.5%
2005	12.9	0.09	702	39.9	74.5	76.5	62.1	63.7	5.9%	2.9%	49.0%
2006	9.9	0.09	692	41.3	74.6	76.5	70.6	72.3	7.9%	4.3%	55.0%
2007	13.3	0.10	690	41.7	74.8	76.6	69.1	70.8	7.0%	3.8%	54.4%
2008	11.9	0.08	713	41.6	74.7	75.8	61.2	62.1	3.0%	1.5%	49.4%
2009	39.6	0.15	754	36.5	74.8	75.6	53.6	54.2	0.5%	0.2%	36.5%
2010	44.8	0.23	761	33.5	75.2	76.1	52.7	53.3	0.2%	0.1%	32.7%
2011	45.2	0.31	762	33.4	75.3	76.1	51.8	52.4	0.1%	0.0%	33.1%
2012	147.2	0.59	770	31.8	74.7	75.6	52.5	53.2	0.0%	0.0%	27.6%
2013	127.1	0.62	763	32.9	75.0	76.0	58.0	58.7	0.0%	0.0%	23.0%
2014	80.4	0.60	752	34.4	76.0	76.9	65.1	65.9	0.0%	0.0%	17.0%
2015	145.8	0.81	754	34.0	75.4	76.4	68.6	69.5	0.0%	0.0%	6.7%
2016	20.5	0.88	750	34.4	75.3	76.0	70.9	71.7	0.0%	0.0%	0.0%

Source: Fannie Mae, Loan Performance

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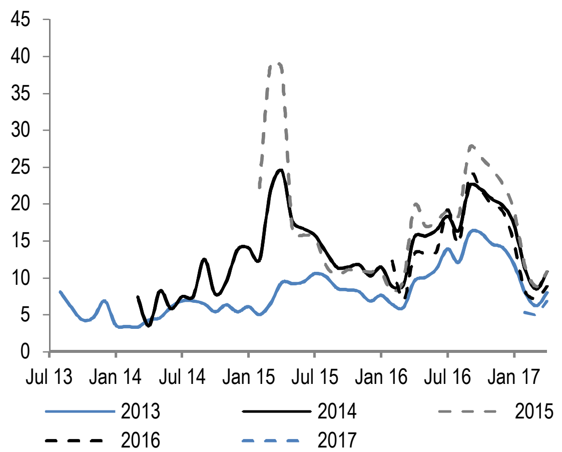
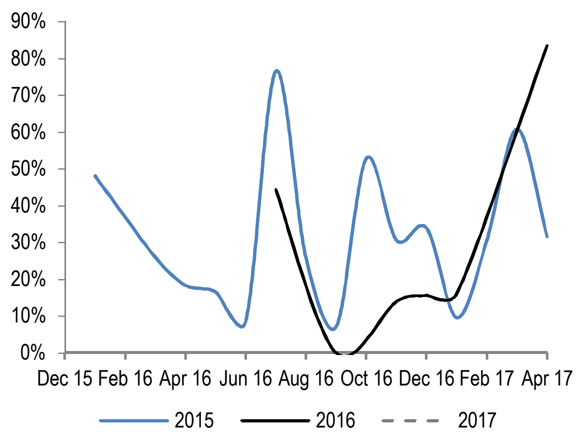
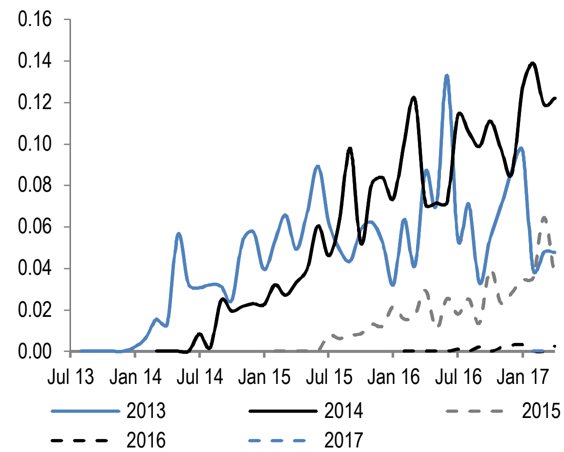
Appendix 5: STACR Low LTV CPR by vintage



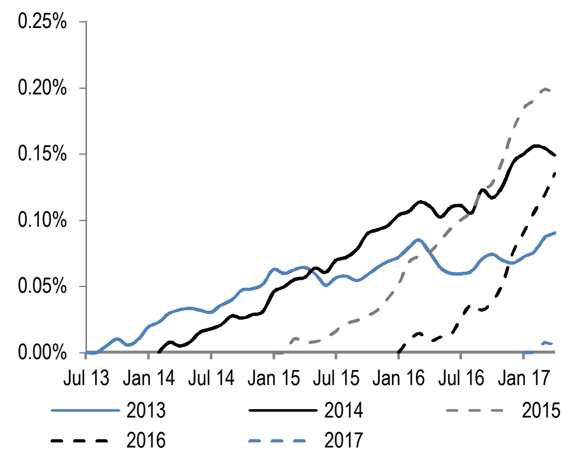
Appendix 6: STACR Low LTV Severities by vintage



Appendix 7: STACR Low LTV CDR by vintage



Appendix 8: STACR Low LTV 60+ Day Delinquencies by vintage



Appendix 9: STACR Low LTV Vintage Stratifications

Vintage	Severity Type	UPB ($bn)	Factor	Curr WALA	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Curr LTV	Curr CLTV	Cumulative Performance Losses	C.E. / Default	Severity
2013	Fixed	39.5	0.68	52	766	32	74.5	75.4	54.2	54.9		0.14%	
2014	Fixed	58.2	0.61	43	759	33	75.3	76.1	59.9	60.6		0.14%	
2015	Fixed	15.1	0.55	33	753	34	76.2	76.9	64.8	65.4		0.13%	
	Actual	71.8	0.73	36	758	34	75.2	76.0	62.2	63.0	0.00%	0.01%	26.6%
2016	Actual	98.7	0.84	18	751	35	75.4	76.3	69.6	70.3	0.00%	0.00%	29.8%
2017	Actual	94.0	0.99	7	751	35	75.1	75.9	74.1	74.9	0.00%	0.00%	0.0%

Source: J.P. Morgan, Freddie Mac

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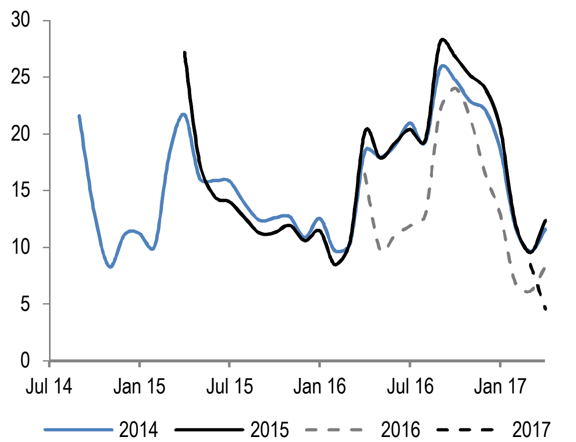
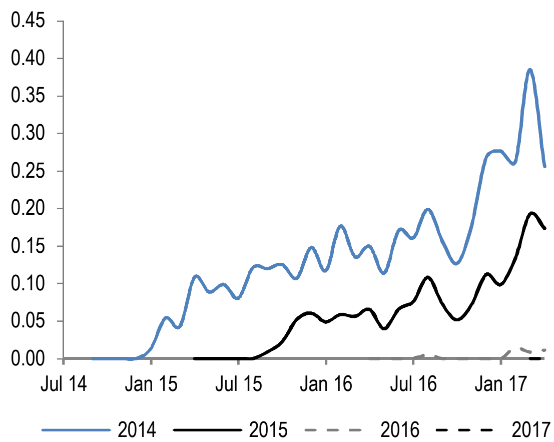
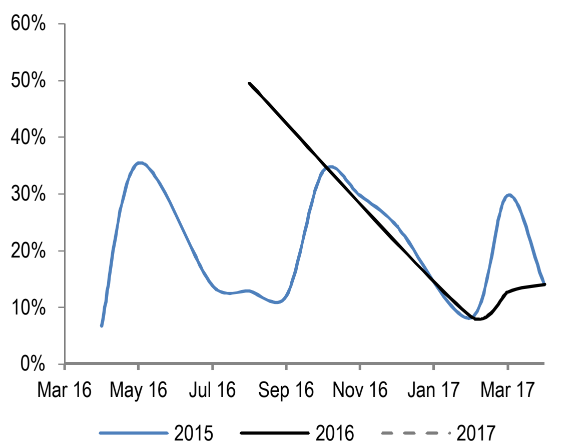
Appendix 10: STACR High LTV CPR by vintage



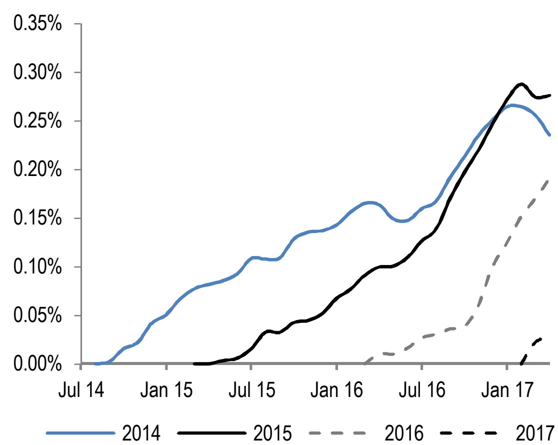
Appendix 12: STACR High LTV CDR by vintage



Appendix 11: STACR High LTV Severities by vintage



Appendix 13: STACR High LTV 60+ Day Delinquencies by vintage



Appendix 14: STACR High LTV Vintage Stratifications

											Cumulative Performance		
Vintage	Severity Type	UPB ($bn)	Factor	Curr WALA	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Curr LTV	Curr CLTV	Losses	C.E. / Default	Severity
2014	Fixed	31.4	0.61	44	756	34	91.7	91.8	73.7	73.8		0.26%	
2015	Fixed	31.9	0.68	42	755	33	91.8	91.8	75.6	75.7		0.17%	
	Actual	26.3	0.72	28	748	35	92.0	92.1	80.8	80.8	0.00%	0.02%	17.2%
2016	Actual	57.8	0.88	18	748	35	91.9	91.9	85.0	85.1	0.00%	0.00%	14.5%
2017	Actual	29.2	0.99	9	747	35	91.8	91.8	89.6	89.6	0.00%	0.00%	0.0%

Source: J.P. Morgan, Freddie Mac

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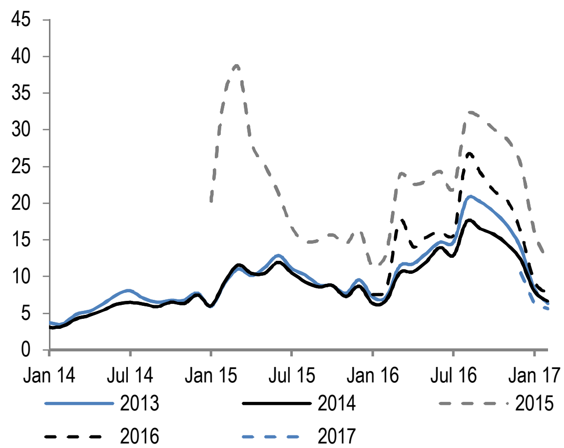
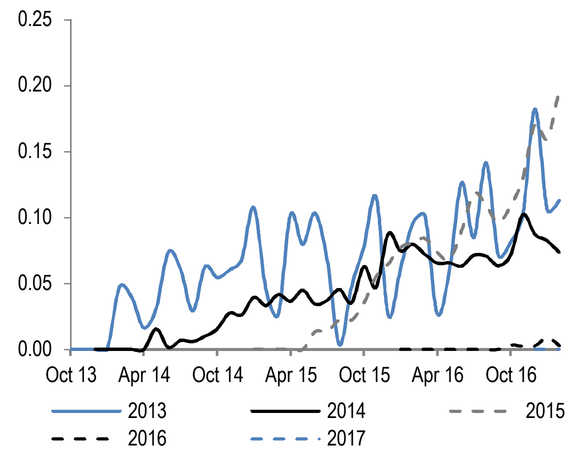
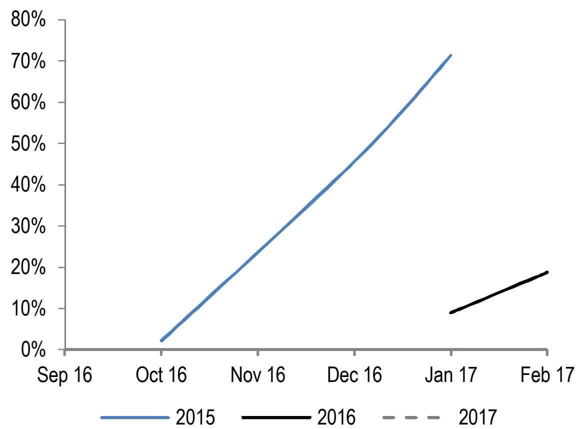
Appendix 15: CAS Low LTV CPR by vintage



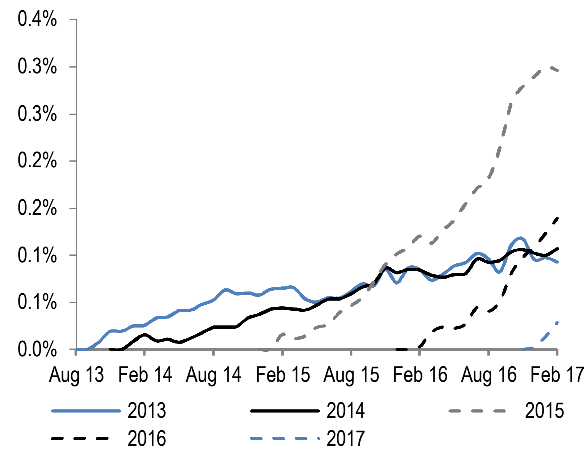
Appendix 17: CAS Low LTV CDR by vintage



Appendix 16: CAS Low LTV severities by vintage



Appendix 18: CAS Low LTV 60+ day delinquencies by vintage



Appendix 19: CAS Low LTV Vintage Stratifications

Vintage	Severity Type	UPB ($bn)	Factor	Curr WALA	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Curr LTV	Curr CLTV	Cumulative Performance Losses	C.E. / Default	Severity
2013	Fixed	17.5	0.65	54	766	32	74.9	75.8	53.8	54.5		0.18%	
2014	Fixed	121.0	0.71	47	763	32	74.6	75.6	57.2	57.9		0.12%	
2015	Fixed	52.2	0.60	36	749	34	76.0	76.8	64.1	64.8		0.14%	
	Actual	18.6	0.69	28	747	34	76.0	76.9	66.4	67.2	0.00%	0.00%	24.0%
2016	Actual	119.8	0.84	19	749	34	75.4	76.3	69.4	70.3	0.00%	0.00%	12.0%
2017	Actual	42.7	0.98	9	749	34	75.2	76.0	73.3	74.0	0.00%	0.00%	0.0%

Source: J.P. Morgan, Fannie Mae

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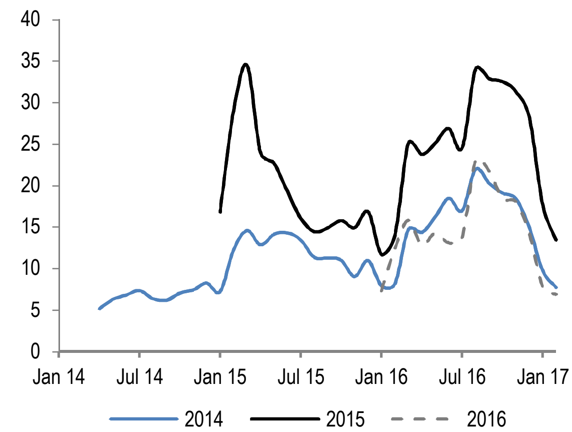
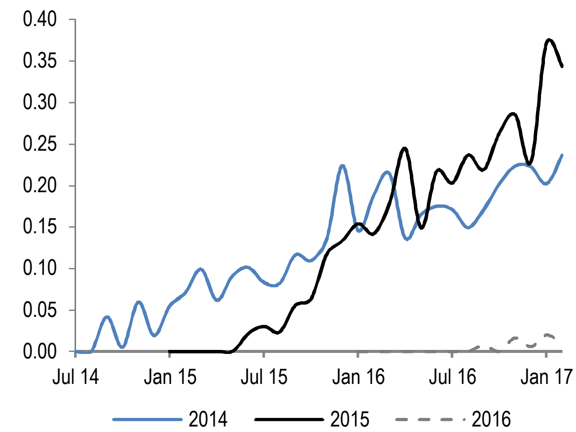
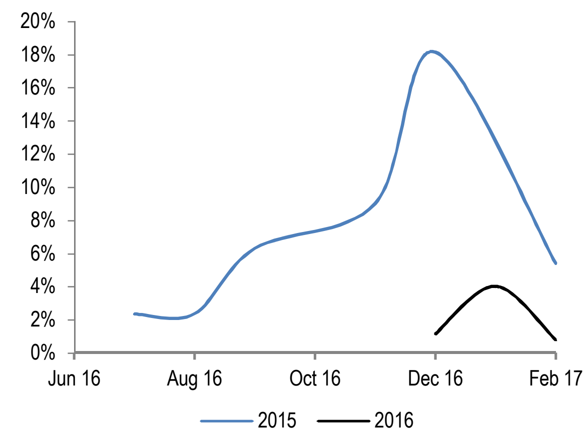
Appendix 20: CAS High LTV CPR by vintage



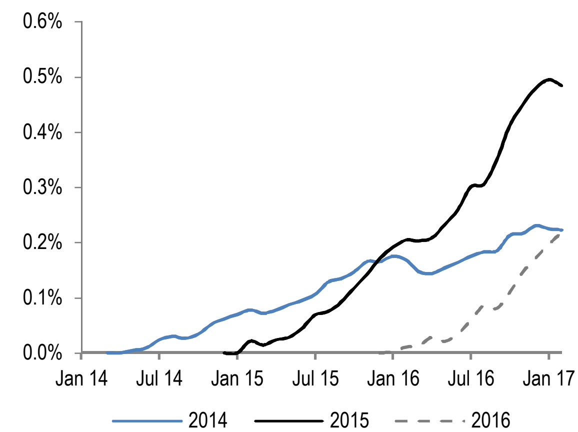
Appendix 22: CAS High LTV CDR by vintage



Appendix 21: CAS High LTV severities by vintage



Appendix 23: CAS High LTV 60+ day delinquencies by vintage



Appendix 24: CAS High LTV Vintage Stratifications

Vintage	Severity Type	UPB ($bn)	Factor	Curr WALA	Orig FICO	Orig DTI	Orig LTV	Orig CLTV	Curr LTV	Curr CLTV	Cumulative Performance Losses	C.E. / Default	Severity
2014	Fixed	33.7	0.66	45	756	33	91.6	91.6	72.6	72.6		0.26%	
2015	Fixed	32.5	0.58	36	745	35	92.5	92.5	78.9	78.9		0.29%	
	Actual	12.6	0.69	28	743	35	92.1	92.2	81.0	81.0	0.00%	0.03%	8.2%
2016	Actual	84.7	0.87	17	745	35	92.1	92.1	85.5	85.5	0.00%	0.00%	2.8%
2017	Actual	39.8	1.00	7	746	35	92.1	92.1	91.1	91.1	0.00%	0.00%	0.0%

Source: J.P. Morgan, Fannie Mae

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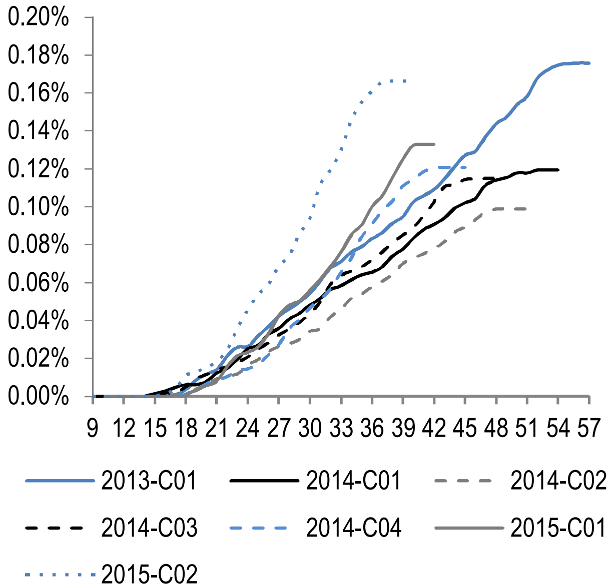
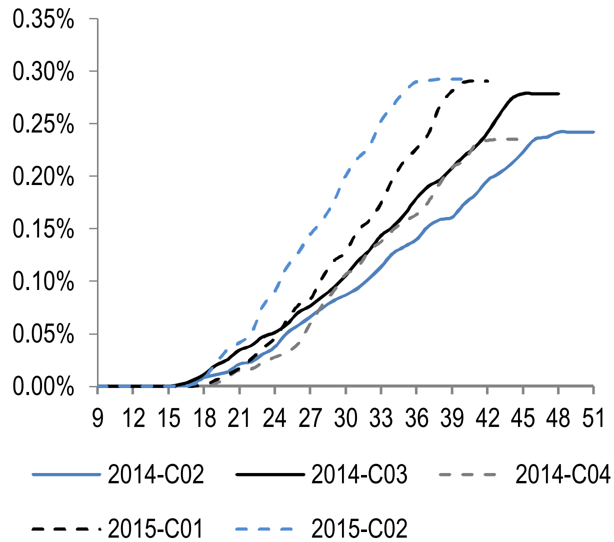
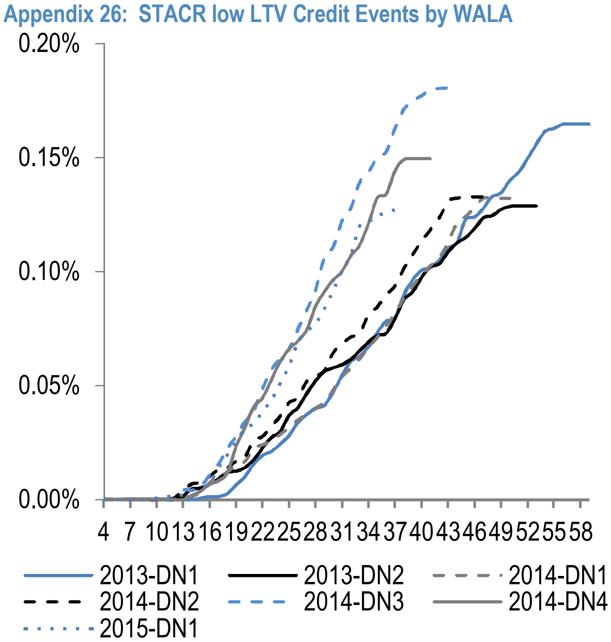
Appendix 25: CAS low LTV Credit Events by WALA



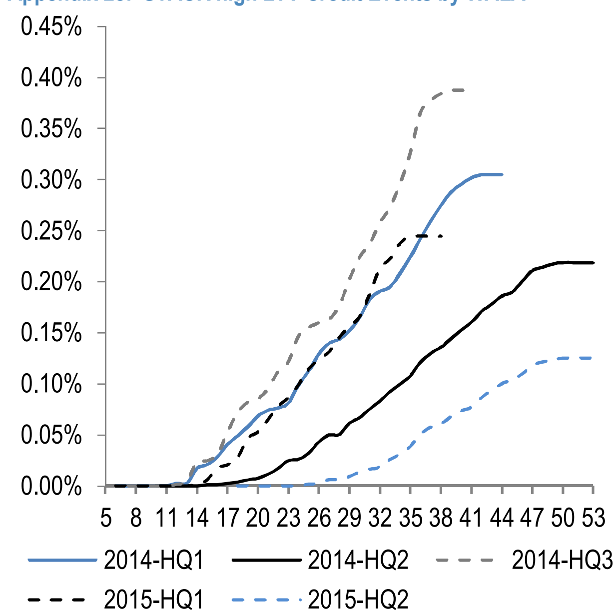
Appendix 27: CAS high LTV Credit Events by WALA



Appendix 26: STACR low LTV Credit Events by WALA



Appendix 28: STACR high LTV Credit Events by WALA



Source: J.P. Morgan, Fannie Mae, Freddie Mac

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