

A primer on constant maturity mortgage (CMM) FRAs

- The approach of Fed balance sheet normalization is arguably a significantly larger event for the MBS market than for Treasuries
- Constant maturity mortgage (CMM) FRAs offer access to the mortgage basis in OTC derivative format with a simple payoff, carry advantage and returns that are highly correlated with various MBS valuation metrics (nominal spreads, OAS, etc.)
- We review CMM index construction, typical structures, forward curve pricing with convexity adjustments and market conventions
- Servicer receivers are typically offset by hedge fund and asset manager payers, but the balance of flows favors the latter...
- ...which combined with attractive carry and no negative convexity has led to significant outperformance of CMM/CMS wideners versus duration-hedged TBA shorts
- Though CMM is in-scope for uncleared margin, IM on spread wideners is significantly less than that posted on cleared swap hedges for TBAs

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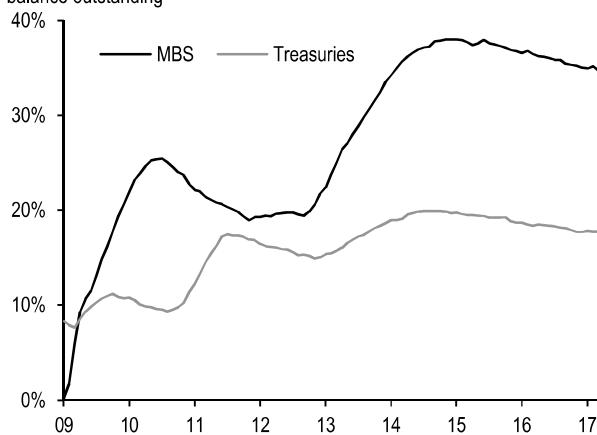
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Introduction

Over the past few years, MBS and MSR hedgers have increasingly turned to OTC mortgage derivatives to manage their risk. This likely owes to a combination of factors, including regulatory incentives, shifts in internal risk management frameworks, and greater familiarity and comfort with the products available. At the same time, we have seen greater interest from the hedge fund and asset manager communities in particular, who increasingly use these products to trade mortgage valuations. **This has all come at an opportune time, given significant trading opportunities related to Fed purchases, the longer-run outlook for non-traditional policy tools, shifts in the composition of ownership, and convexity events (e.g., taper tantrum, 2015 VaR shock, 2016 election, etc.).**

Exhibit 1: Though clearly a significant event in both cases, balance sheet normalization heralds a more dramatic shift in ownership of agency MBS than it does for Treasuries

Fraction of agency MBS and Treasuries owned by the Fed; % of notional balance outstanding



Source: J.P. Morgan, Bloomberg

Going forward, we anticipate the opportunity set in MBS, and consequently interest in OTC mortgage derivatives, will likely increase. This owes primarily to the ongoing Fed tightening cycle, which should bring the start of balance sheet normalization later this year (see [Fed to start shrinking its balance sheet later this year](#), M. Feroli, 4/5/17). **Though the Fed owns a material fraction of marketable Treasury debt as well, there are reasons to believe this is a much bigger event for the mortgage market.** First, the Fed remains the largest single holder of agency MBS, with nearly twice the ownership share of Treasuries (**Exhibit 1**). Second, MBS paydowns are reinvested via competitive bidding in the TBA market, and made up nearly 30% of gross pass-through supply in recent months; by contrast, Treasury reinvestments are add-ons at auction with no price impact

(see discussion in [The Fed's undoing project](#), A. Roever, M. Jozoff et al., 1/27/17).

The combination of potential seismic changes but uncertain timing motivates the search for carry efficient mortgage basis shorts. For much of the past few years constant maturity mortgage (CMM) FRAs have been an attractive instrument for expressing this view, reflecting their lack of negative convexity and an advantageous balance of flows for wideners. In this piece, we review model, valuation and payment conventions for benchmark CMM FRAs, consider the current supply/demand balance in the market, examine their empirical relationship to MBS valuations, and finally consider the impact of uncleared margin rules set to be phased in over the next few years.

Modeling, valuation, and conventions

Calculating the CMM Index

The spot CMM Index is designed to track the 30-day forward par coupon rate for a 30-year fixed-rate conforming mortgage. It is typically interpolated from market-observable FNMA TBA pricing for the pair of the highest coupon currently trading at a discount (C_{disc} at P_{disc}) and the lowest trading at a premium (C_{prem} at P_{prem}) as:

$$C_{par} = C_{disc} + (0.5\%) \times \frac{100 - P_{disc}}{P_{prem} - P_{disc}}$$

where the market TBA prices (\tilde{P}) are adjusted for the coupon delay as:

$$P = \tilde{P} + C \times (\text{Delay}/360)$$

Finally, this coupon rate is converted from a mortgage yield (monthly compounding) to a bond equivalent yield (semi-annual compounding). **It is also important to note that because the CMM index is calculated from TBA prices, it can be precisely replicated with weighted longs in the premium and discount coupons.**

One consideration that has occasionally been important in recent years has been the potential for there to be no discount coupon. In other words, how is the current coupon calculated when all TBAs trade at a premium? Though seemingly an extreme circumstance, this was in fact the case for a nontrivial fraction of the past few years, during which rates were substantially lower. In principle, one can estimate lower coupon

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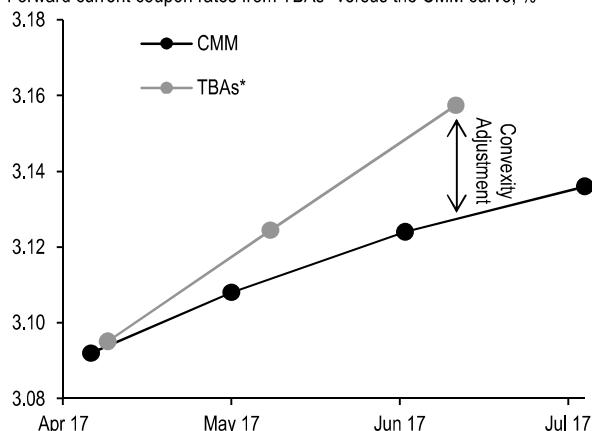
prices after making some assumptions—e.g., constant OAS. However, in practice the more common solution was the introduction of CMM102, which targeting a \$102 premium rather than par, and therefore could be calculated from observable TBA prices.

Pricing CMM forward rates

Since the spot CMM index is calculated from spot TBAs, at first glance one might calculate CMM FRA rates from forward prices on the latter. However, because TBAs are negatively convex, their forward prices imply forward current coupon rates (\widetilde{CC}_T) which are too high relative to CMM FRAs (CMM_T). We can see this in current market pricing, where the term structure of current coupon rates inferred from the first three TBA contracts is considerably steeper than the CMM curve, with a gap that grows approximately linearly with forward term (Exhibit 2).

Exhibit 2: Because CMM FRAs lack the negative convexity embedded in TBAs, the term structure of forward current coupon rates is steeper than the CMM curve

Forward current coupon rates from TBAs* versus the CMM curve; %



* Includes the first three contracts, since there is very little liquidity further out. Forward current coupon rates are calculated using the CMM Index methodology, using a linear interpolation between the highest discount and lowest premium coupons, converted to a bond-equivalent yield.

Note: Data as of 4/4/17.

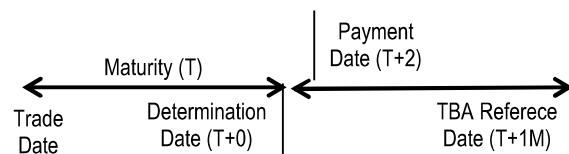
Source: J.P. Morgan

The difference between these two forward curves is the **convexity adjustment**, which assuming a normal distribution can be approximated as:

$$CMM_T \approx \widetilde{CC}_T + \frac{1}{2} \frac{\gamma}{D} \sigma^2 T$$

where D and γ are the spot duration and convexity of the current coupon mortgage. Because $\frac{\gamma}{D} \sigma^2 T < 0$ owing to negative convexity, a fairly priced CMM forward curve is flatter than forward current coupon rates calculated from TBAs. Further, given mortgage Greeks from a prepayment model, the observed slope of that curve can be used to infer the implied volatility of current coupon mortgage rates over the trade horizon.

Exhibit 3: Schematic of typical CMM FRA



Source: J.P. Morgan

Exhibit 4: Indicative characteristics of the current state of the CMM market by tenor

Based on J.P. Morgan estimates

Attribute	Tenor	
	3M	6M
Total size of market (\$k/bp)	\$15,000	\$7,500
Avg daily trading volume (\$k/bp)	\$200	\$100
Social size (\$k/bp)	\$50-200	\$50-100
Typical b/o (bp)	1	1
Initial margin* (\$k per \$100k/bp)	\$319	\$296

* From a preliminary implementation of the ISDA SIMM model. See discussion below for details.

Note: Based on J.P. Morgan estimates as of March 2017.

Source: J.P. Morgan, ISDA

Cashflow mechanics, payment conventions and liquidity

CMM FRAs are typically structured as a single fixed/floating cashflow tied to the CMM Index (described above) with a payment date two business days following the determination date and determination time of 5:00pm¹ (Exhibit 3). The index itself is either obtained from a third party² or dealer as calculation agent based on TBA pricing sourced from

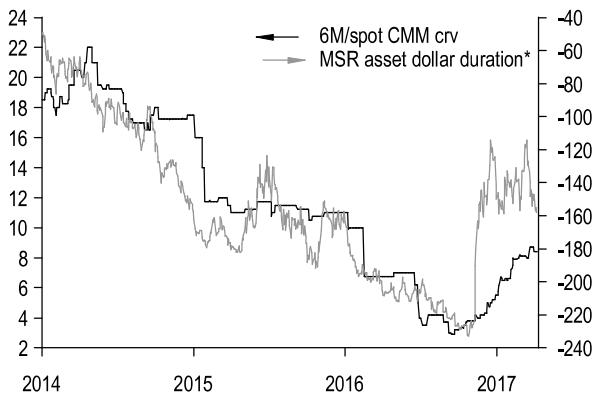
¹ It is important to note that this introduces a determination time offset for CMM versus CMS and CMT, with the former referencing 5:00pm and the latter 11:00am (both EST).

² Reuters Page 19944 typically posts “USD-CMM30-FNMA” at or before 5:00pm EST and it is available on Bloomberg at CMMFIX Index <GO>.

closing levels from the interdealer market³. **The payer owes the fixed rate agreed to as of trade initiation and receives the floating CMM index, and vice versa for the receiver.**

Generally speaking 3- and 6-month benchmark maturities trade actively at comparable daily volume, social size and bid/offer (**Exhibit 4**). Though longer tenors have traded at times—particularly 1-year CMM closer around 2008—more recently they do not make up a meaningful fraction of the market.

Exhibit 5: An increased prevalence of CMM hedges in bank servicing books combined with the decline in rates has flattened the term structure, but the recent sell-off is not yet priced in
Spot versus 6M CMM curve slope (bp; LHS) versus MSR asset dollar durations* (\$bn of 10-year equivalents; RHS)



* We model the MSR asset as a 30 bp IO strip off of the J.P. Morgan Agency MBS Index.

Source: J.P. Morgan

The balance of flows in CMM

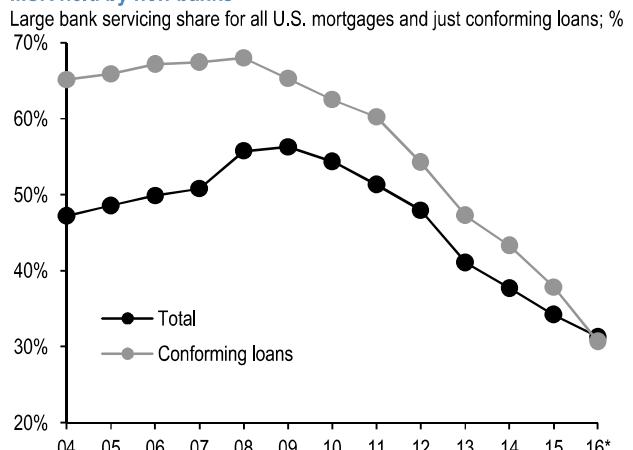
In recent years, we believe the balance of flows in CMM markets has been dominated by mortgage servicers, particularly the larger banks. Because the MSR asset is short duration, they are generally structural receivers of rate—either in swaps, CMM, or other instruments (futures, options, etc.)—and relatively active delta-hedgers. In the past, servicers tended to prefer Libor swaps and the swaptions market for liquidity, flexibility, and limited roll risk. However, more recently there has been a significant shift towards mortgage derivatives, including CMM and TBA options, as a better match for the current mortgage rate (i.e., current coupon) exposure embedded in their servicing rights. **As a result, we believe they constitute the single largest source of structural receive-fixed demand.**

³ For example, the TradeWeb page MBS-Closing-Price page or the dealers' own marks, both of which reflect levels as of approximately 3:00pm EST.

This is reflected in the evolution of the CMM term structure. As rates rallied for most of the past few years, servicers were delivered additional short duration risk from the negative convexity of their MSR. The resulting build-up in the stock of receive-fixed CMM positions outstanding significantly flattened the term structure (**Exhibit 5**). **One can equivalently think of this flow as bidding up the convexity adjustment in CMM rates versus forward TBA-implied current coupon yields (see above).**

The other side of the trade is a mix of hedge funds and some large asset managers. They typically pay fixed in CMM versus CMS or CMT as a short basis trade. And because of the servicer flow described above, which flattened the term structure of CMM relative to other rates, the carry on such positions has generally been decent for most of the past few years.

Exhibit 6: The recent announcement from Citi highlights a broader trend in mortgage servicing, with an increasing share of MSR held by non-banks



Note: Large banks includes JPM, C, WFC, and BAC.

* Excludes MSR held by Citi, including \$300bn total and \$97bn conforming. The former is as of year-end 2015 and the latter is as of year-end 2016.

Source: J.P. Morgan, IMF, FNMA, FHLMC, and GNMA

That said, it is important to note that we are in the midst of a bit of a transition. Though large bank servicers frequently use and rebalance CMM hedges, non-banks are much less active more generally and are not particularly involved in either interest rate or mortgage derivatives. Along those lines, we have been seeing a significant and ongoing shift in MSR away from banks to more non-traditional servicers (see e.g., discussion on the sales of Citi servicing rights to NRZ in [Interest Rate Derivatives](#), [US Fixed Income Markets Weekly](#), 2/3/17 and [MBS](#), [US Fixed Income Markets Weekly](#), 2/3/17). This is particularly pronounced for conforming loan MSRs, of which roughly 30% are now

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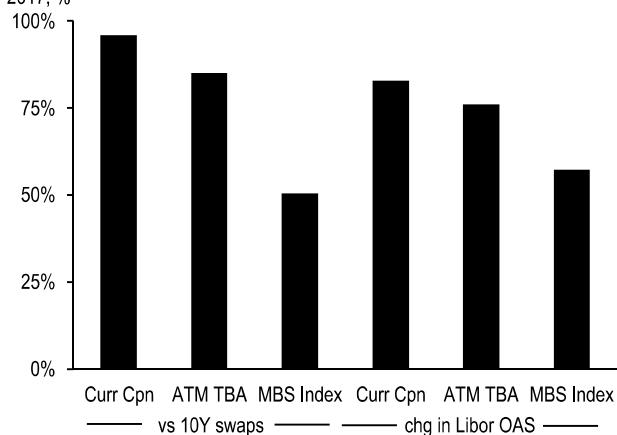
managed by large banks down from nearly 70% around 2008 (**Exhibit 6**). Going forward, we expect this to continue, albeit at a somewhat reduced pace, which suggests carry on CMM/CMS wideners will likely become less attractive over time.

CMM/CMS spreads and the MBS basis

The most common applications of CMM, particularly among the hedge fund and asset manager community, are CMM/CMS and CMM/CMT spreads. These positions pair a pay-fixed exposure in CMM—usually 3- or 6-month tenor—with a matched constant maturity swap (CMS) or Treasury (CMT⁴) exposure. In principle, this provides short exposure to the current coupon mortgage basis via OTC derivatives.

Exhibit 7: CMM/CMS spread returns are highly correlated with current coupon and rolling ATM TBA valuations, including both nominal and OAS, and to a lesser extent a broader index

Correlation of monthly returns for CMM/CMS wideners* versus delta-hedged total returns† and changes in Libor OAS for the current coupon, rolling ATM TBA and J.P. Morgan Agency MBS Index, December 2009 through March 2017; %



* Assumes 1-month CMM and matched 10-year CMS trades, held to expiry.

† Rolling ATM TBA defined as the current coupon rounded to the nearest 0.5% increment, with a minimum coupon of 3% reflecting the relative illiquidity of FN 2.5s. We assume positions are rolled and swap hedges rebalanced as of month-end, and both TBA and index dollar durations from the J.P. Morgan Agency MBS Prepayment Model. We assume index positions are unlevered and TBA positions are from dollar rolls.

Source: J.P. Morgan

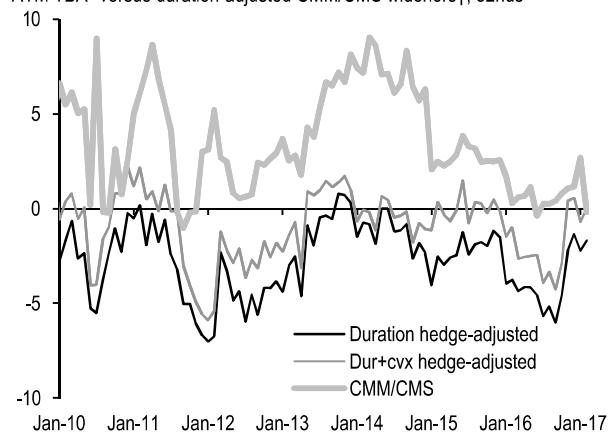
That said, these positions are exposed to additional risks besides the mortgage basis. First, and most

⁴ In practice these days liquidity is a significant constraint on CMT positions. However, over the past few years activity in other OTC Treasury derivatives has picked up, and in practice most CMM/CMT trades typically utilize Then-On-the-Run Treasury (THOR) positions for the rates leg, which can be structured with a yield-based payoff (i.e., no convexity). For details, see discussion in [The expanding market for OTC Treasury Derivatives](#), J. Younger et al., 9/7/16.

importantly, CMM FRAs have no convexity while TBAs, MBS indices, and portfolio loans are all quite negatively convex. **Second**, in addition to volatility exposure in the slope of the CMM forward curve, because CMM/CMS spreads have a static single-tenor duration hedge there may be additional residual curve risk relative to other instruments. **Finally**, it is not clear *a priori* that the returns will correlate well with other measures of mortgage valuations, such as option-adjusted spreads (OAS) for the current coupon, production coupon TBA and broader agency MBS indices.

Exhibit 8: Carry on short mortgage basis exposures has been outright positive for CMM/CMS wideners for much of the past few years, but not so for delta-hedged TBAs...

1-month carry for a duration- and convexity-hedged shorts in the rolling front ATM TBA* versus duration-adjusted CMM/CMS wideners†; 32nds



* Based on dollar roll pricing, rolled to the lowest price actively traded TBA (excluding FN 2.5s due to limited liquidity) as of month-end. Hedge ratios estimated from the J.P. Morgan Agency MBS Prepayment Model, and convexity hedge instrument is a 1Mx10Y ATM straddle.

† Slide on a 1-month CMM/CMS10 widener, also as of month-end.

Source: J.P. Morgan

We therefore perform an empirical back test of CMM/CMS10 returns since January 2010 compared to both duration-hedged returns and changes in Libor OAS for the current coupon, rolling ATM TBA⁵ and the J.P. Morgan Agency MBS Index. For the delta-hedged returns, we assume monthly rolls in CMM and TBA positions (to the ATM coupon as of month-end) and rebalance otherwise static 10-year swap hedges at the same time. The results are summarized in **Exhibit 7**, and show that CMM/CMS returns are highly correlated with both delta-hedged returns and changes in Libor OAS for a range of mortgage product.

⁵ Taken to be the coupon trading closest to par, but floored at FN 3s for reasons of poor liquidity in FN 2.5s.

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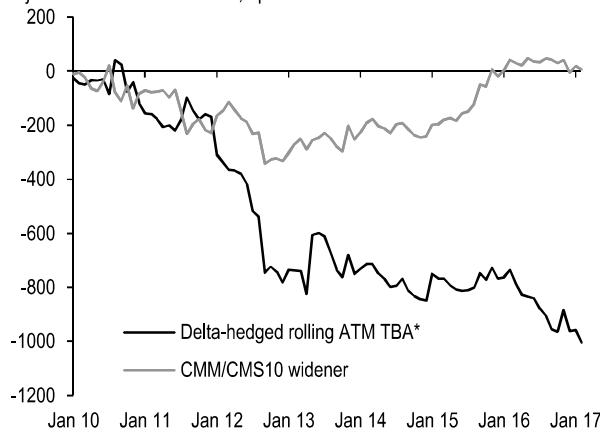
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Though these results demonstrate the utility of CMM/CMS in gaining exposure to mortgage valuations over the short-term, for a more structural position it is important to consider carry. **By this metric, CMM/CMS wideners are the clearly superior way to express a short basis view.** For example, in **Exhibit 8** we compare the *ex-ante* duration- and convexity-hedge adjusted carry for short positions in the rolling ATM TBA versus average monthly carry on 1- and 3-month CMM/CMS wideners. **The results reflect the fact that the rolls have generally traded quite special given the outsized role of Fed purchases as well as the cost of trading short negatively convex instruments like TBAs.** Meanwhile, the flatness of the CMM curve relative to swaps, arguably reflecting rich convexity adjustments owing to servicer hedging flows, has meant CMM/CMS wideners are very frequently outright positive carry. Further, owing again to the convexity differential, TBAs will tend to extend in a large sell-off, and therefore will tend to underperform CMM. **Reflecting this combination of advantageous carry and smaller drawdowns, a structural basis short in CMM/CMS wideners has significantly outperformed a comparable exposure in a delta-hedged rolling ATM TBA over the past few years (Exhibit 9).**

Exhibit 9: ...which combined with a lack of negative convexity means structural short basis positions in CMM/CMS have significantly outperformed TBAs over the past few years

Cumulative returns from delta-hedged rolling ATM TBA shorts* versus duration-adjusted CMM/CMS wideners; bp of notional



* We assume TBAs and 10-year swap hedges are rolled as of month-end, using durations from the J.P. Morgan Agency MBS Model. ATM TBA is defined as the lowest price coupon as of the roll date excluding FN 2.5s given limited liquidity.

† Also rolled as of month-end, and sized to the same dollar duration as the TBA position again using J.P. Morgan model estimates.

Source: J.P. Morgan

The impact of uncleared margin rules

To date, CMM outright and spread trades have not been subject to any regulatory margin requirements. As a

result, though initial (IM) and variation margin (VM) were generally posted, the amounts and terms could vary among different counterparties depending on the specific terms of each CSA. Going forward however, CMM and related instruments are in-scope for uncleared margin requirements which are being phased in over the next few years (for further details, see [To clear or not to clear](#), J. Younger et al., 4/14/16). **At the moment, IM in particular only applies to a small subset of counterparties with the largest gross notional derivatives exposure (mostly dealers), but will expand over the next few years to cover the vast majority of market participants⁶ (Exhibit 10).**

Exhibit 10: Though dealers will be forced to post initial margin on uncleared trades later this year, the timeline for broader implementation spans several years

Implementation timeline for uncleared margin requirements

Compliance date	Trigger level for gross notional	
	Initial margin	Variation margin
September 1, 2016	\$3tn	\$3tn
March 1, 2017	\$3tn	All
September 1, 2017	\$2.25tn	All
September 1, 2018	\$1.5tn	All
September 1, 2019	\$0.75tn	All
September 1, 2020	All	All

Note: Gross notional exposure based on daily average for each business day of March, April and May of the previous year.

Source: J.P. Morgan, Davis Polk & Wardwell LLP

As a result, though not likely to have an immediate impact it is important to consider how the implementation of these rules might affect investment decisions. In the absence of an approved model, CMM trades are subject to Standard Requirements⁷. However, ultimately we expect the market to gravitate to the SIMM⁸ model, which is being developed by ISDA as the industry standard and has already been selectively approved for some products. **By contrast, TBAs do not generally require IM, which means margin considerations on basis exposures constructed via these instruments will be driven by the duration hedges—e.g., swaps presumably cleared through CME or LCH. Further, even under circumstances**

⁶ The final rulemaking originally required VM to be collected starting March of this year. However, owing to a range of issues enforcement was delayed until at least September, though precisely how this was done is an important consideration. For details see [this summary](#) from ISDA and references therein.

⁷ For details see discussion in

https://www.fdic.gov/news/board/2015/2015-10-22_notice_dis_a_fr_final-rule.pdf.

⁸ For an overview of the SIMM model, see [From Principals to Model Specification](#) published 3/3/16 by ISDA.

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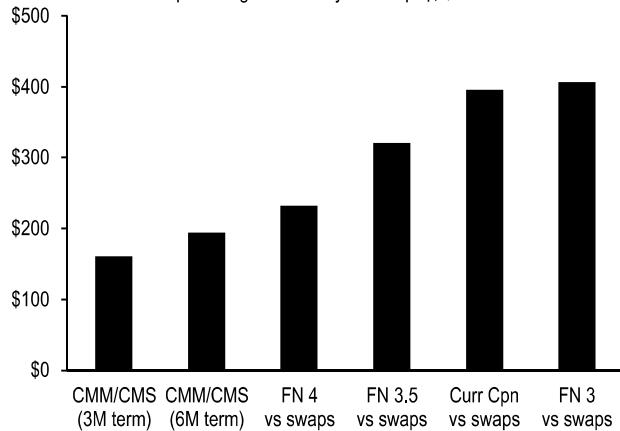
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where IM is posted on TBAs it generally cannot be netted against swap positions.

We therefore compare uncleared margin estimates for CMM/CMS wideners across a range of tenors with TBA-based short basis positions (**Exhibit 11**). The results suggest that, even given no IM requirements for TBAs we find that mortgage derivatives are the more margin-efficient expression of views on MBS. Therefore, while again we do not expect the vast majority of users of CMM to be impacted for some time, we find that uncleared margin rules favor mortgage derivatives for spread trades, particularly those with less free collateral to post.

Exhibit 11: Even after a broader group of counterparties comes in scope for uncleared margin rules, CMM/CMS are more efficient than TBAs hedged with cleared swaps

SIMM* margin estimate for \$100k/bp in CMM/CMS wideners by term as well as TBAs and current coupon hedged with 10-year swapst; \$k



* Estimates based on a preliminary implementation of the SIMM uncleared margin model.

t TBAs do not require IM, so we only include IM for benchmark swap hedges cleared through LCH (assuming client-side IM for a benchmark pay-fixed 10-year USD Libor swap as of April 2017). Dollar duration estimates based on J.P. Morgan Prepayment Model, as of 4/3/17.

Source: J.P. Morgan, LCH, ISDA

relative to rolling delta-hedged TBA positions.

Finally, though at the moment only large dealers are currently in-scope for uncleared margin rules, we find that—assuming SIMM or a similar model is approved for use with CMM—these instruments are also advantageous from a margining perspective.

Conclusions

CMM offer derivative exposure to current coupon mortgage rates without negative convexity. By pairing these positions with a CMS or CMT/THOR duration hedge, one can construct positions for which returns are highly correlated with a variety of mortgage valuation metrics, including nominal and option-adjusted spreads. Servicer hedging flows have tended to ricken convexity adjustments, causing the CMM term structure to trade somewhat flat compared to forward current coupon yields as well as other interest rates. As a consequence, CMM/CMS wideners tend to have more attractive carry, which combined with a lack of negative convexity exposure makes them attractive

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