Interest Rate Derivatives Seminar Series

Introduction to swaps and drivers of swap spreads: | September 2020

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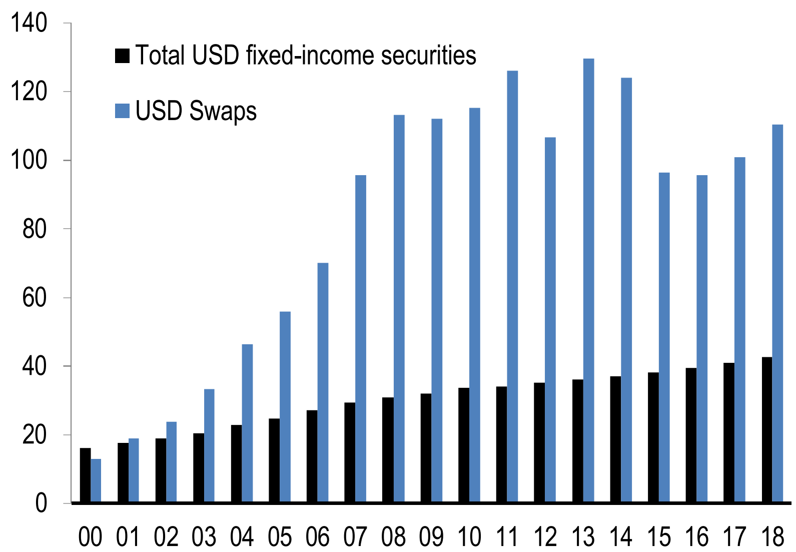
Swaps are among the most popular derivatives

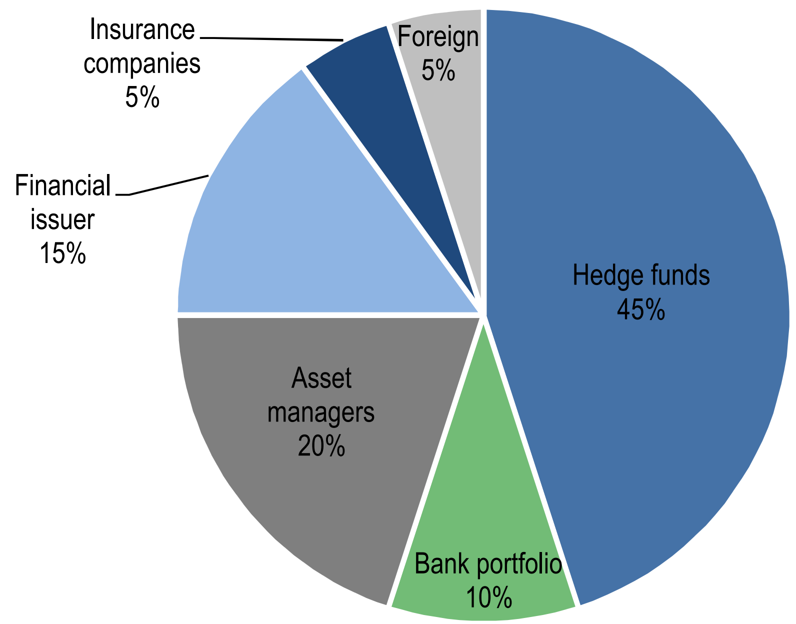
The notional value of swaps outstanding now dwarfs all outstanding fixed-income securities

Total USD fixed-income securities (incl. Treasuries, munis, MBS, credit, SPG) versus notional balanced of USD interest rate swaps, as of year-end; $tn



Source: J.P. Morgan, BIS, SIFMA

Swap market participants



Source: J.P. Morgan

- Market in its various guises has nearly $100 trillion notional outstanding vs. total outstanding public debt of US Government of $14 trillion

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What are swaps?

- A swap is a contractual agreement to exchange one set of cash flows for another, where the cash flows depend on some market variable
- Swaps are therefore derivatives
- A common Interest Rate Swap example - exchanging a set of fixed payments for payments linked to 3M LIBOR
- E.g., receiving 2.80% for 30Y versus paying floating LIBOR for 30Y. This is equivalent to:
  - “selling” a floating rate savings account, and…
  - …“buying” a 2.80% coupon 30Y bond, but…
  - …without the exchange of assets & associated costs

Terminology: Paying fixed vs. receiving floating

- Short swaps
- Short fixed coupon bonds
- Short duration
- Payer
- Borrowing

Terminology: Receiving fixed vs. paying floating

- Long swaps
- Long coupon fixed bonds
- Long duration
- Receiver
- Lending

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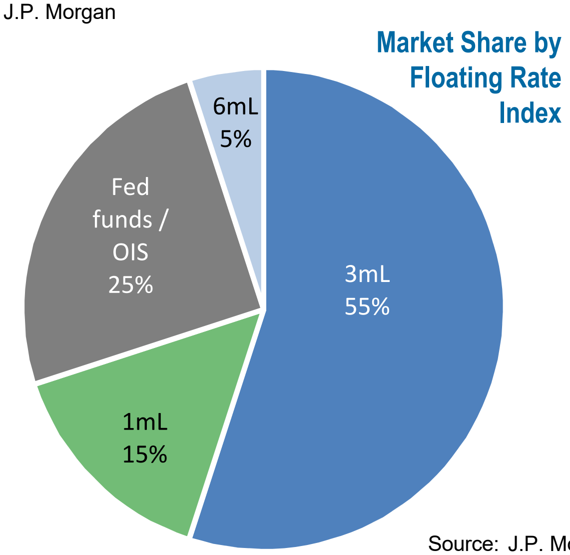
Why are they so popular, and what are they used for?

- Self-funded, “no-money-down”
- Better liquidity relative to other asset classes
- Well-defined curve exists to long maturities
- Efficient way to keep Fixed/Floating debt markets aligned
- The swaps curve has become a benchmark curve, against which all other fixed income asset classes are valued
- Asset swaps are efficient ways to structure cross market relative value trades

Tenor	Avg Daily Volume ($mn/bp)	Social size ($k/bp)	Bid/offer (bp running)
<2yr	1.5	250k	0.4
2Y	4	200k	0.4
5Y	6.5	150k	0.4
10Y	7	150k	0.4
30Y	3	150k	0.4
>30Y	0		

Source: J.P. Morgan



Source: J.P. Morgan

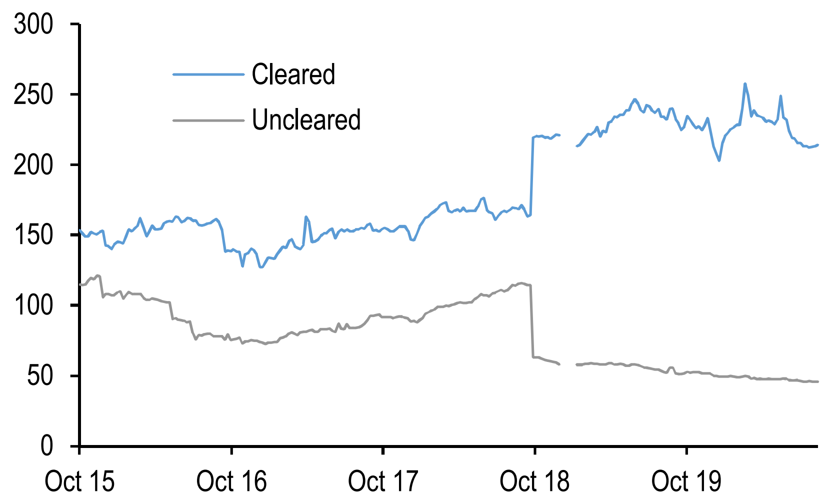
Uses of Swaps

- Manage duration and yield curve risk
- The size and the liquidity of the swaps market make it attractive for tactical duration and yield curve management
- Create synthetic assets
- Buy short-duration assets and receive in an interest rate swap to create a synthetic fixed-rate bond
- Trade asset swap spreads
- Asset swap spreads on Treasuries and spread products alike offer attractive relative value/cross-market trading opportunities

The vast majority of swaps are now cleared, and total activity remains fairly concentrated among dealers

Most new swaps are cleared, and around 80% of existing gross notional outstanding

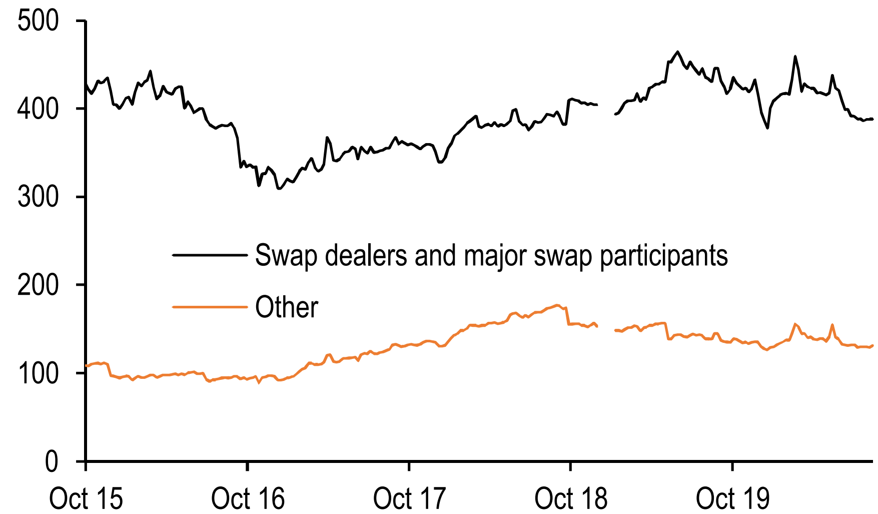
Swaps total gross notional outstanding by clearing status; $tn



Source: J.P. Morgan, CFTC

Swap dealers and MSPs account for around 74% of total swap activity, down from 80% 5 years ago

Swaps total gross notional outstanding by participant type; $tn



Source: J.P. Morgan, CFTC

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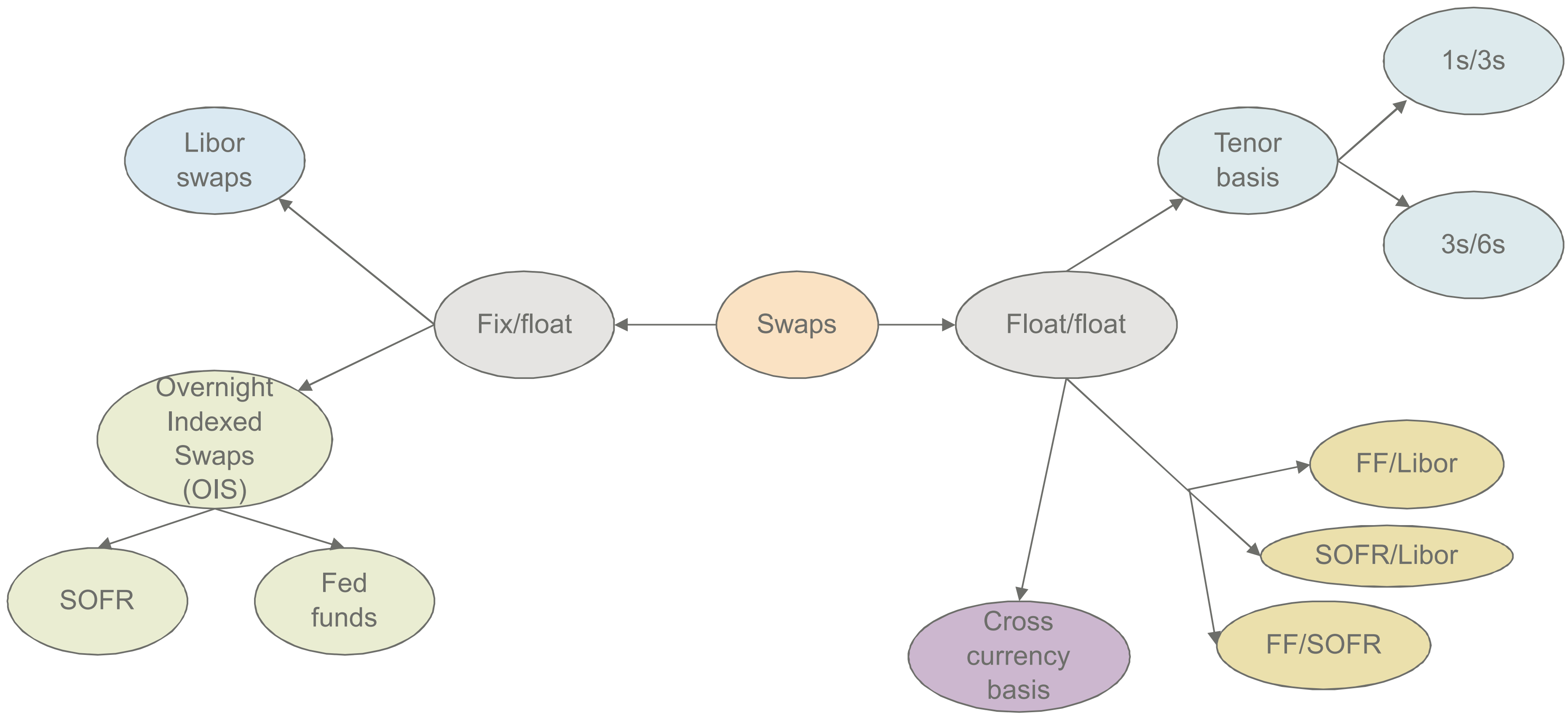
Types of swaps



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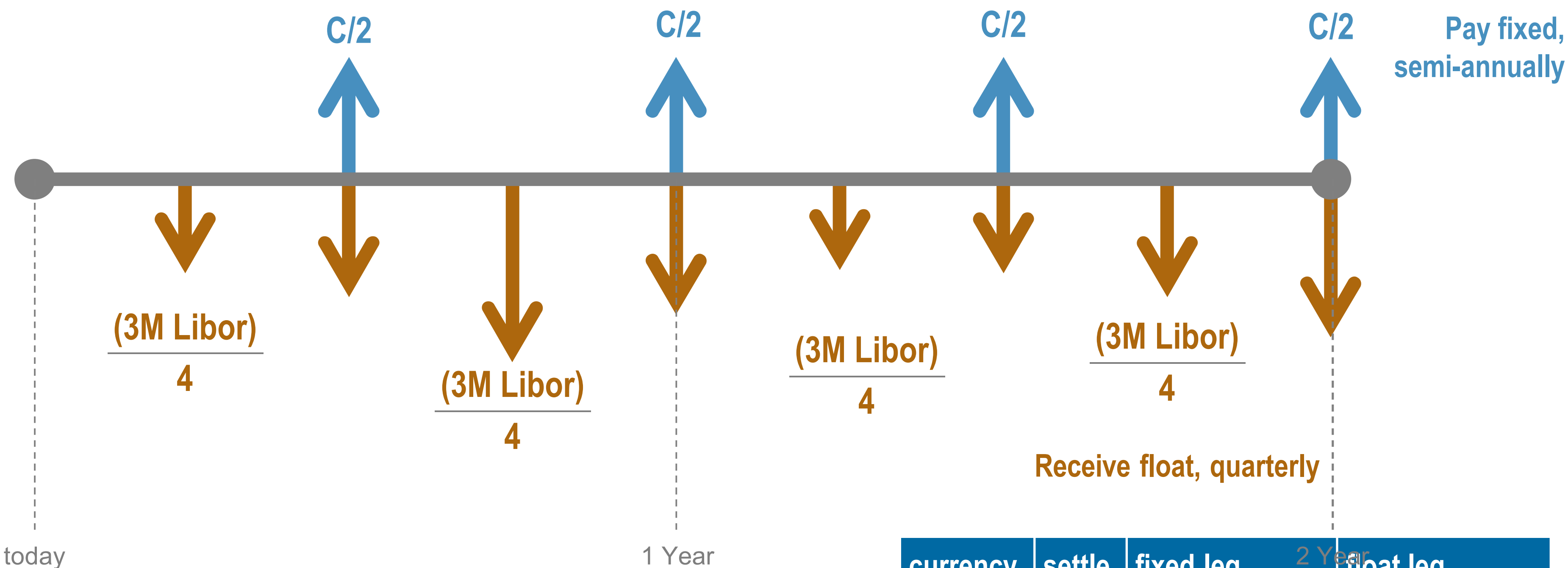
Basic structure of a swap



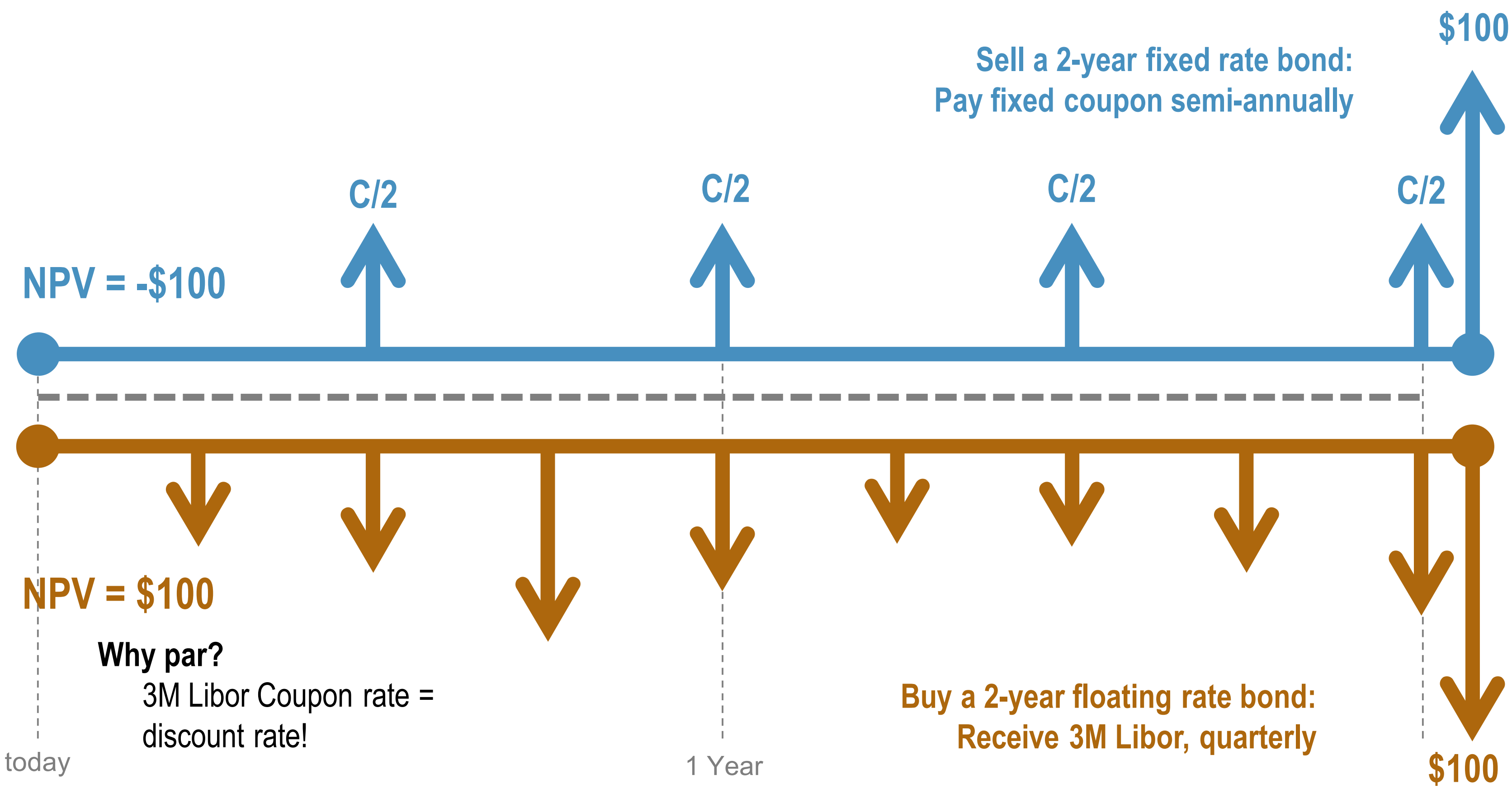
Standard, on market
2Y USD pay-fixed swap

- Fixed rate coupon paid semi-annually (negative NPV)
- 3-month Libor received quarterly, fixed 3 months in advance (positive NPV)
- At inception, the NPV of the two legs are equal in magnitude (by design!)

currency	settle	fixed leg		float leg	
USD	T+2	30/360	6M	Act/360	3M
EUR	T+2	30/360	1Y	Act/360	6M
CAD	T+0	Act/365	6M	Act/365	6M
JPY	T+2	Act/365	6M	Act/360	6M
GBP	T+0	Act/365	6M	Act/365	6M
CHF	T+2	30/360	1Y	Act/360	6M

Source: J.P. Morgan

Basic structure of a swap – coupon found by equating both “legs” of the trade



Standard, on market
2Y USD pay-fixed swap

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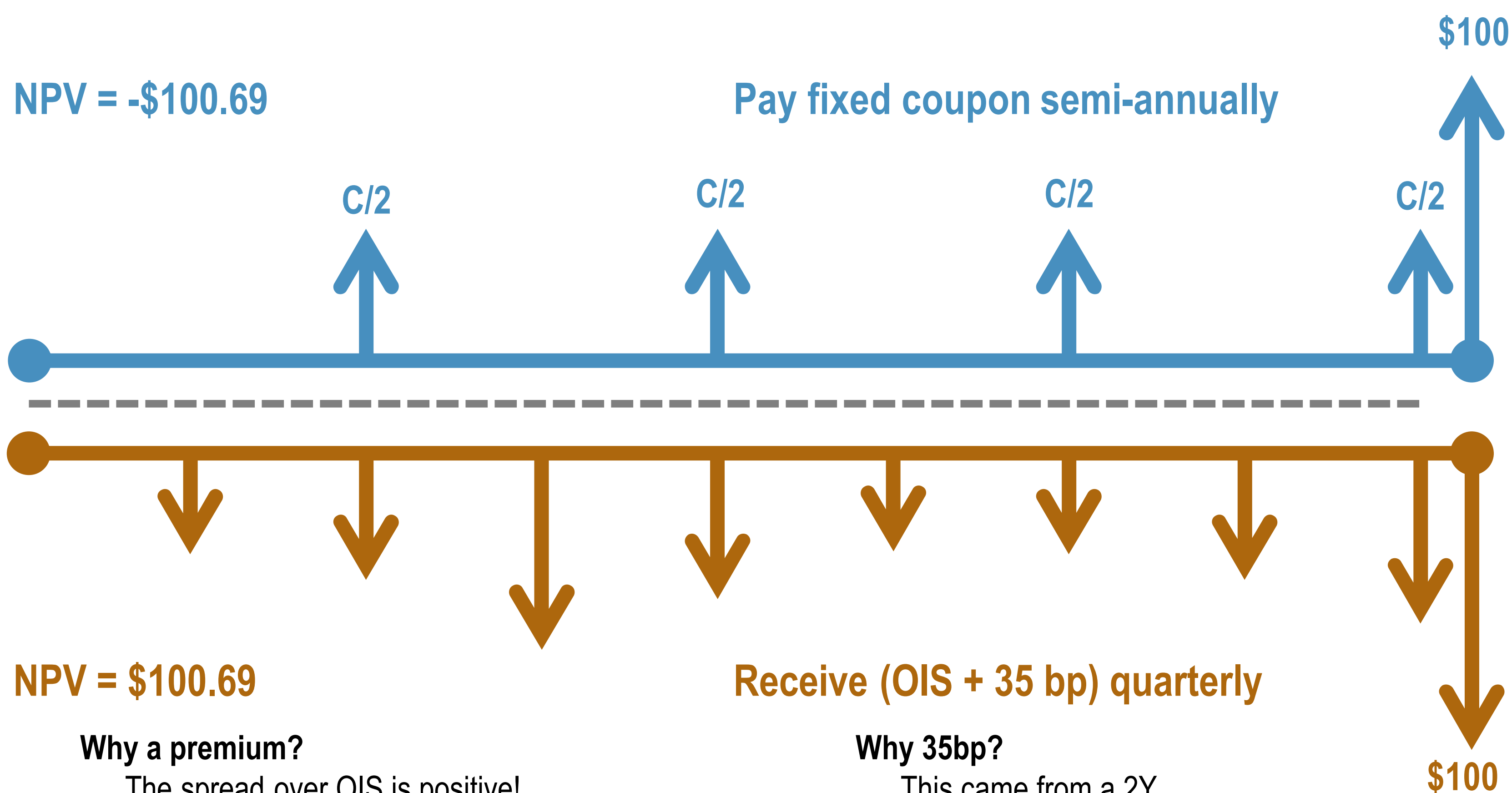
Basic structure of a swap – OIS discounting



Why a premium?

The spread over OIS is positive! Said another way: the Libor coupons are higher than the OIS discount rates.

Why 35bp?

This came from a 2Y Libor/FF basis swap

Cleared swaps are discounted with OIS

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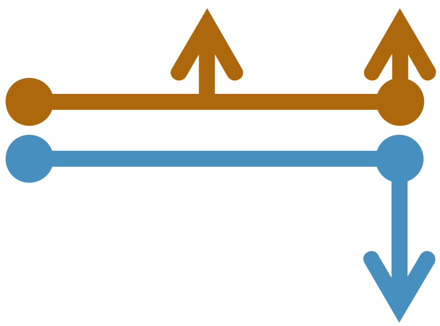
Carry on swaps may be computed from forward par rates

Carry: Coupon income less financing cost from holding the trade



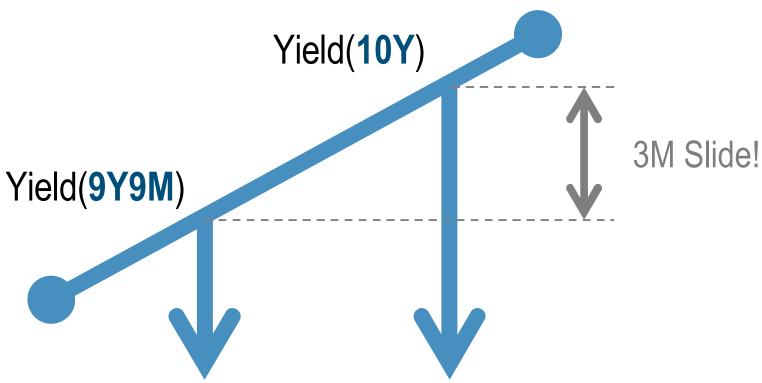
Yield(10Y) + Carry(3M) = Yield(3Mx9Y9M)

(from no arbitrage)

Carry(3M) = Yield(3Mx9Y9M) - Yield(10Y)

(subtraction)

Slide: Expected gain/loss from rolling down the yield curve



slide(3M) = Yield(10Y) - Yield(9Y9M)

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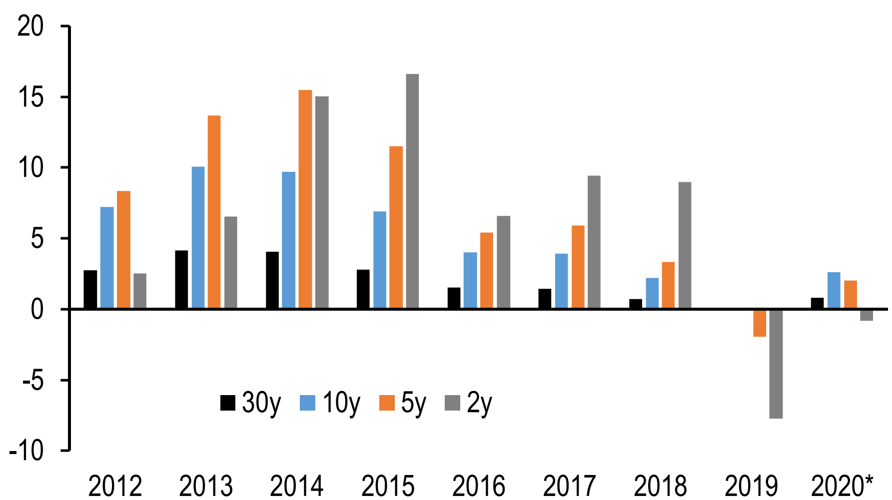
Carry on swaps may be computed from forward par rates

- Carry + Slide is loosely referred to as just carry, and frequently thought of as the cost of holding a trade

$$\underbrace{\text{Yield}(1Yx9Y) - \text{Yield}(10Y)}_{\text{carry}} + \underbrace{\text{Yield}(10Y) - \text{Yield}(9Y)}_{\text{slide}} = \underbrace{\text{Yield}(1Yx9Y) - \text{Yield}(9Y)}_{\text{carry + slide}}$$

- An investor receiving fixed in a 10-year swap today (or equivalently, in a 1Yx9Y forward starting swap) expects to make 27bp over a year if the spot yield curve remains unchanged
- Thus, being long 10s is said to carry positively, while shorts are negative carry trades
- It is valid to think of carry + slide as breakeven moves in spot yields; to think of it as projected P/L is a stretch

3M carry and slide in various swaps as of Jan each year



Source: J.P. Morgan

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Some variations on the vanilla interest rate swap

Instrument	Description
Forward Rate Agreement (FRA)	Pays the difference between the reference rate on a given date and some pre-determined rate, with settlement occuring at the start of the interest period
Tenor basis swap	Swaps one tenor of Libor for another, plus/minus a fixed spread, with the payment frequency usually matching the tenor of libor on each respective leg
Cross currency basis swap	Initial and end period exchange of notional at agreed FX rate, with interest paid/received on a respective index for each currency, plus/minus a fixed spread
Overnight indexed swap (OIS)	Exchanges a fixed leg for a floating leg linked to the compounded rate on some overnight index (e.g. SOFR, FF…). Payment is usually made annually, with a offset to account for uncertainty regarding the final amount until the end of the period.
FF/Libor swaps	Exchange quarterly Libor payments for the quarterly (arithmetic) average of Fed funds rates, plus a fixed spread

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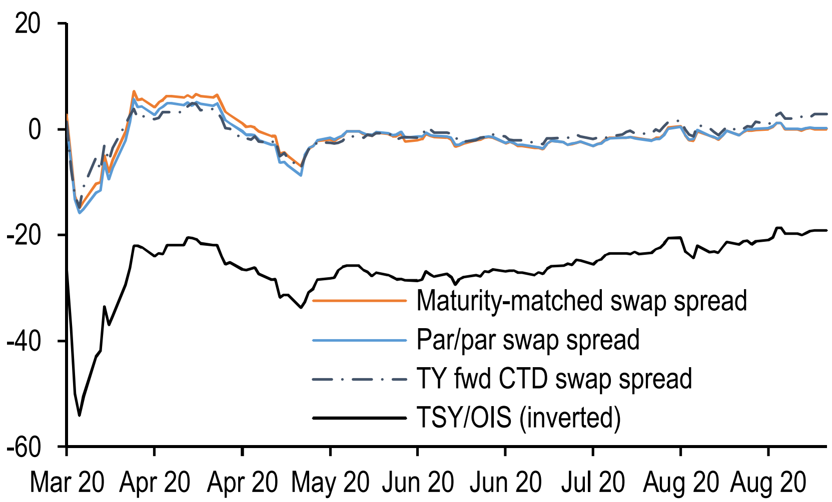
Swap spreads usually pair a cash security with a duration equivalent amount of an interest rate swap, but this can still take a variety of shapes

There are a variety of ways to construct "swap spreads"

Various 10-year swap spreads



Term	Meaning
Maturity matched	Maturity of the swap is identical to the maturity of the security
Par/par	Swap rate coupon is set to match that of the fixed rate coupon on the security
True	Coupon and maturity are matched
Futures invoice spread	Trades a duration equivalent amount of Treasury futures with a forward starting swap maturity on the same date as the likely CTD (and starting on the likely futures delivery date)
Tsy/OIS	Treasury swapped to a maturity matched OIS rate

Source: J.P. Morgan

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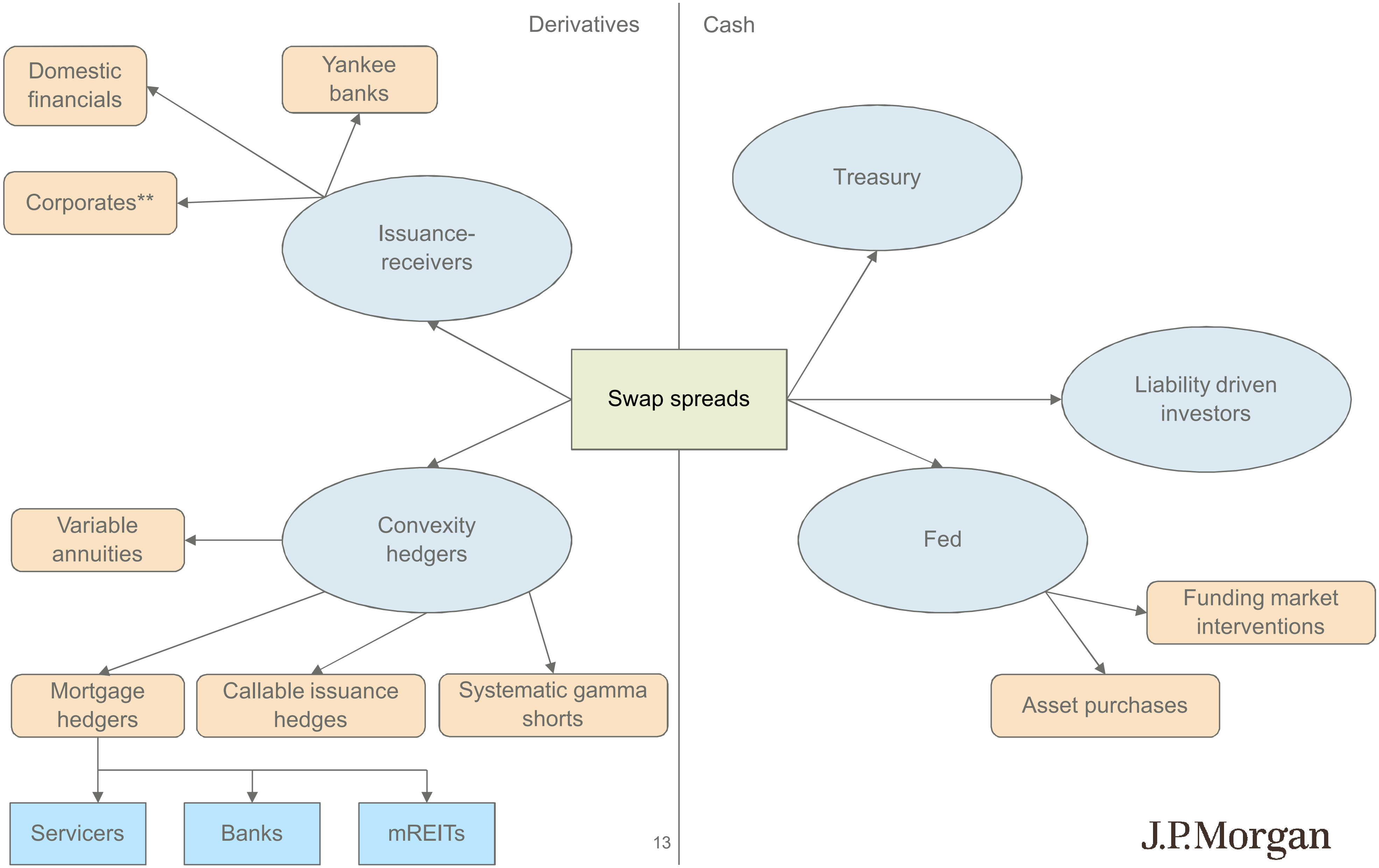
Structural receivers and payers of swap spreads



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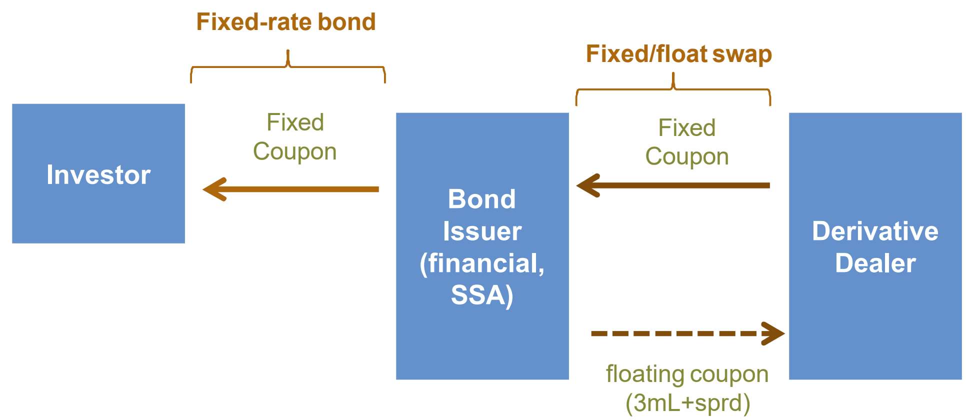
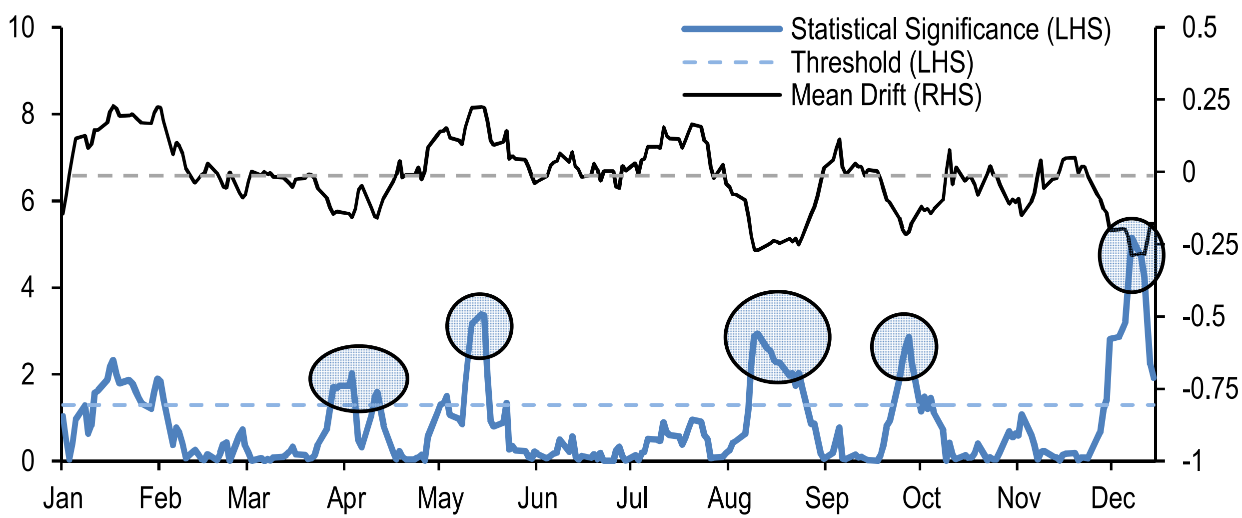
Issuance-related receiving can often drive moves in swap spreads

Issuance-related receiving: The Basic Strategy:

- Create a synthetic liability by
  - Issuing a fixed-rate bond
  - Receiving fixed in an interest rate swap with matched details (coupon & maturity)
- This is done for ALM matching purposes: floating rate assets funded with floating rate liabilities



10-year swap spreads exhibit a few robust cyclicals likely tied to issuance-related receiving



Statistical significance* (LHS; unitless) and mean drift** (RHS; bp/day) of daily swap spread moves within a rolling forward-looking 2-week window stacked across 2001-17 by day of year

* Ttest on daily moves within a forward-looking 2w window stacked across years with a zero-mean (assumes normally distributed moves); shown above is the negative log (base 10) of the p-value, with 1.3 (p=5%) corresponding to a statistically significant result (e.g. across all years, spread moves were inconsistent with an unbiased random walk).

** Mean drift is the average of all daily changes within the rolling 2w window with negative values corresponding to observed spread tightening and positive values to widening.

Source: J.P. Morgan

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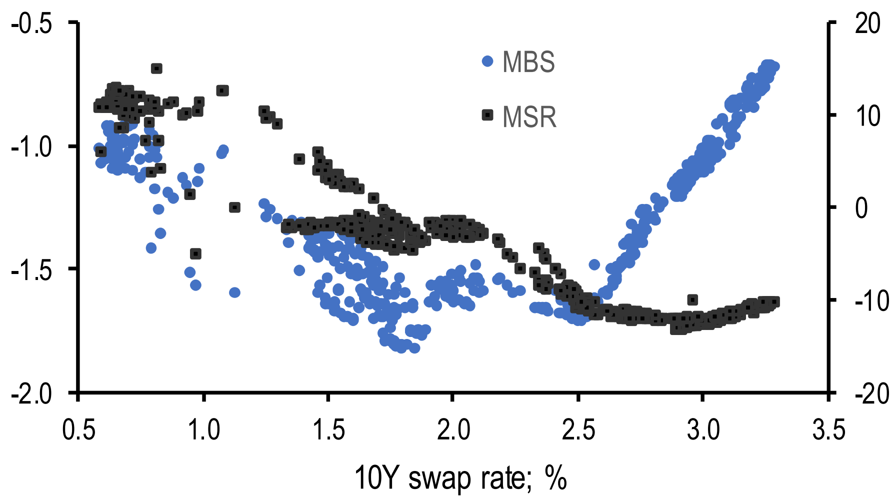
… who are increasingly dominated by mortgage accounts, and which have regained much of their negative convexity

Off-the-shelf prepayment models would suggest that the reactivity of mortgage durations to rates will only grow in a sell-off, pointing to the risk of a convexity event

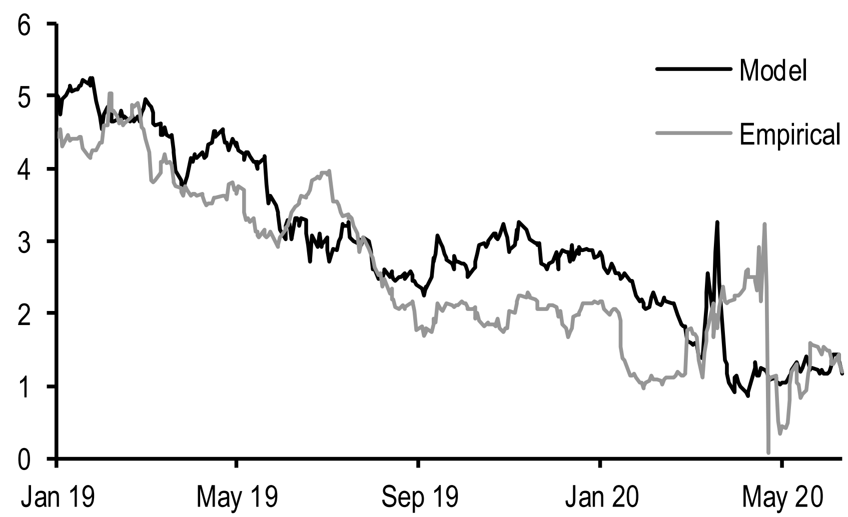
Option-adjusted convexity for the J.P. Morgan Agency MBS (LHS) and MSR (RHS) indices, sampled over the past two years; years per 100 bp



Note; The MSR index represents a 30 bp IO strip off the same pools, priced at the same OAS.
Source: J.P. Morgan

Model durations have been much stickier than the empirical relationship between TBA prices and moves in rates …

TBA-equivalent* index durations derivative from model and empirical estimates; years



* A weighted average across coupons based on monthly current balance data (including 2s through 6s). Empirical durations are a 1-month regression of daily percentage changes in TBA prices versus 10-year Treasury yields.
Source: J.P. Morgan

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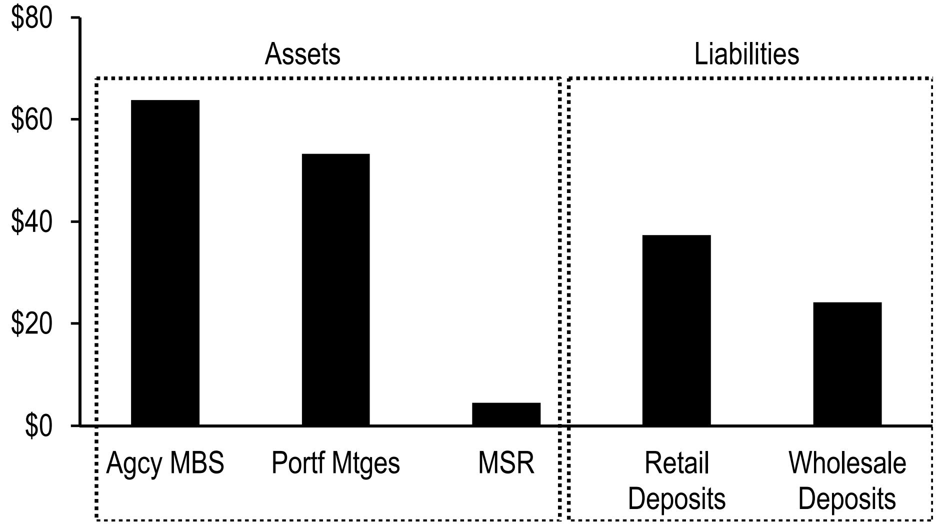
Is bank convexity hedging lying in wait?

At this point the contraction of dynamically hedged mortgages likely rivals convexity flows triggered by the taper tantrum, but pails in comparison to larger events in 2003 and 2008

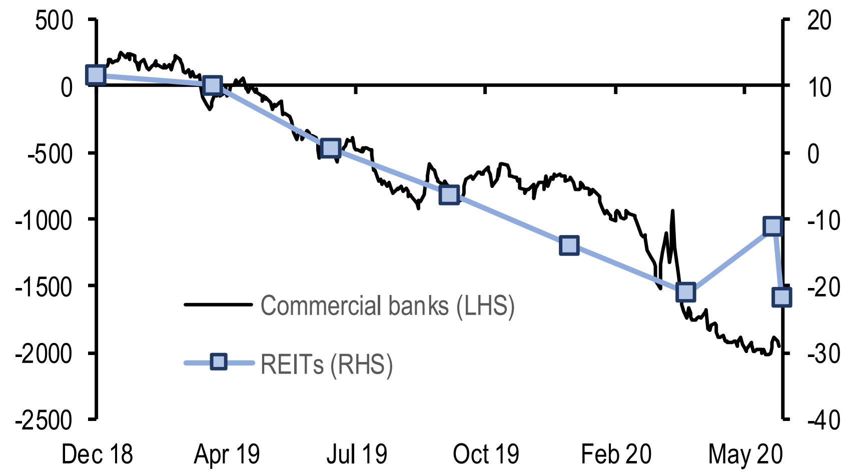
Duration delivery to dynamic mortgage hedgers* in prior duration events, with sell-offs and rallies indicated; $mn per bp



* For details on how we model each component, see discussion and footnotes in Interest Rate Derivatives, US Fixed Income Markets Weekly, J. Younger et al., 3/30/19.
Source: J.P. Morgan, OFHEO, company filings, SNL Financial, FNMA, FHLMC

Banks and REITs in particular came into 2Q quick short the market, and are unlikely to have covered that position before yields began to rise

Commercial bank net duration* (LHS) and mREIT duration gap† (RHS); both axes in $mn per bp



* Based on FRB H.8 data and LCR disclosure on deposit size and mix, as well as portfolio and pass-through exposure to mortgages among large commercial banks,
† Based on a quadratic fit to reported interest rate sensitivities among the five largest mREITs, extrapolated to present using coefficients measures as of 1Q-end.
Source: J.P. Morgan, company disclosure

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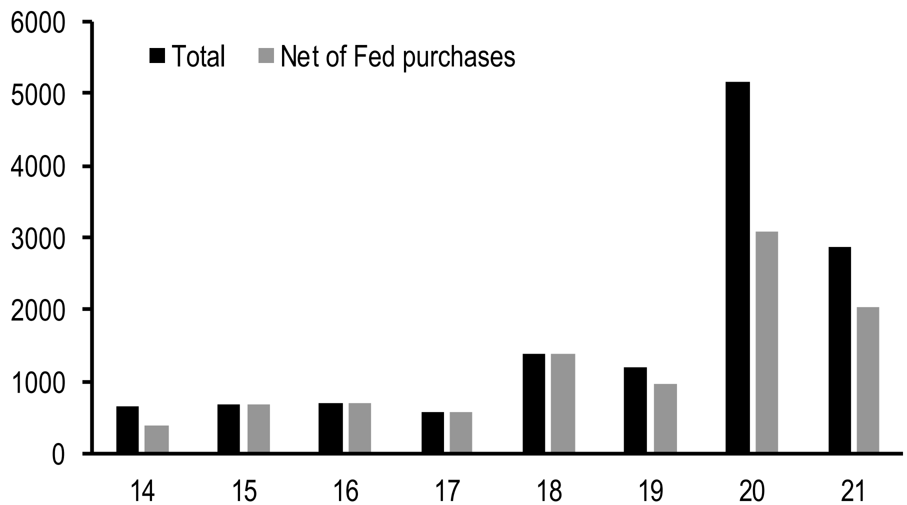
We are heading for a historically wide budget deficit, and the Fed is unlikely to take the other side of the resultant supply; 30-year spreads have room to narrow

Issuance is set to continue to ramp up, outpacing Fed asset purchases

Actual and forecast net issuance of marketable Treasury debt, total and net of Fed purchases; $bn



Source: J.P. Morgan, U.S. Treasury, NYFRB

Bond spreads have only now caught up to levels implied by their drivers and, barring a significant acceleration in Fed purchases, can narrow significantly further

10-year regression of 6-month changes in 30-year matched-maturity swap spreads versus drivers, through year-end 2020

			4/30 to year-end	
Factor	Coeff	T-stat	Level	Sprd impact
Intercept	-2.20	-9.5		
3M GC/OIS spreads	-0.29	-14.6	5	-1.4
10s/30s Tsy crv; bp	-0.417	-47.4	0	0.0
% chg WAM-wtd public Tsy debt; yrs * $bn	-0.32	-8.1	14.3	-4.6
VA hedging demand; $bn 20s	-0.121	-24.1	0	0.0
Fed custody hldgs; $bn	0.049	30.3	-120	-5.9
R-squared	72%			
Std. err	6.4			
6M change as of 4/30 and through YE	-7.7			-14.1
Actual as of 4/30 and YE projection	-46			-60

Note: Absolute rather than % changes unless otherwise specified. We assume the Fed purchases a representative sample of 2020 issuance. Yield curve changes through year-end based on J.P. Morgan forecasts. We assume incremental further narrowing in term GC/OIS on the back of Fed purchases and other liquidity support, but not including explicit regulatory relief. Fed custody holdings are assumed to decline incrementally further to total ~$200bn for 2020.

Source: J.P. Morgan, NYFRB, U.S. Treasury

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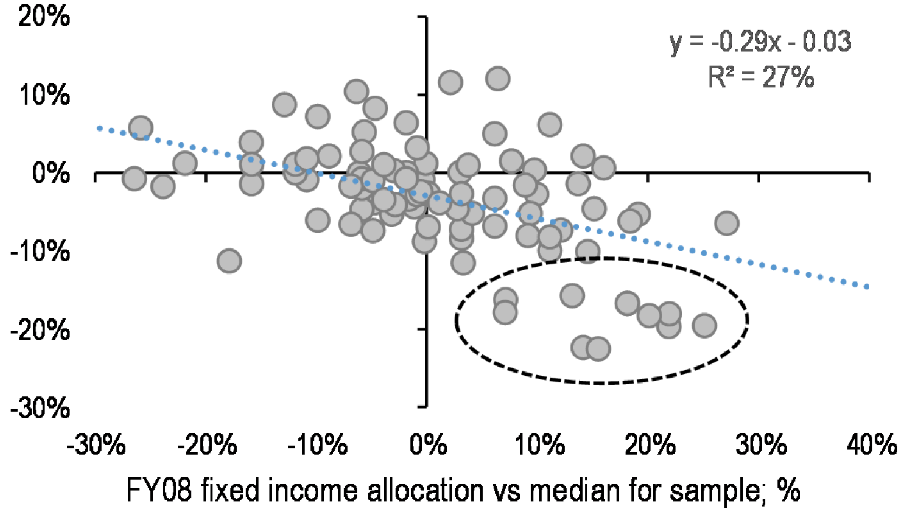
Back in 2008, pensions took profits on their risk-free rate hedges in the wake of equity volatility, and we see evidence of this in net STRIPing activity in March and April

Pension plans with higher allocations to fixed income heading into 2009 tended to reduce their exposure over the subsequent year

Change in fixed income allocation from FY08 to FY09, adjusted for valuation* effects; %

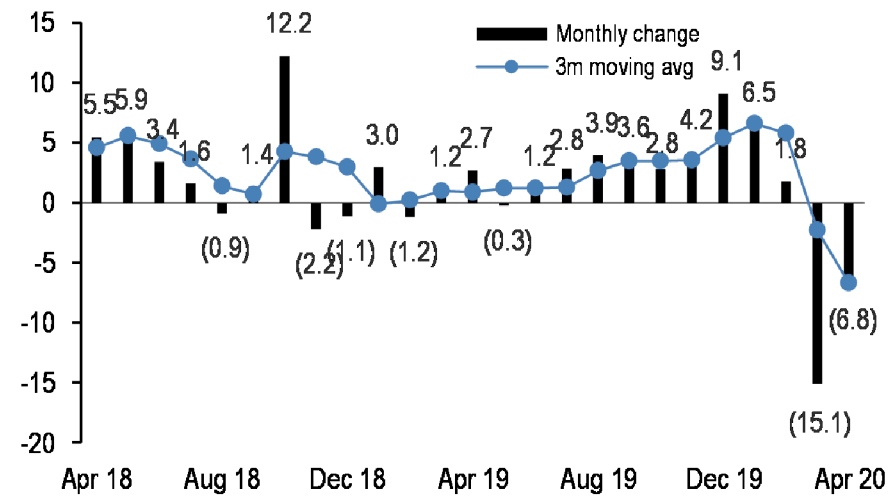


* We assume S&P500 and JULI returns for the year ending 12/31/09, but keep the market value of "other" stable over that period.

Source: J.P. Morgan, Milliman

P-STRIPS outstanding decreased in both March and April

Monthly change in P-STRIPS outstanding and 3-month average; $bn



Source: US Treasury

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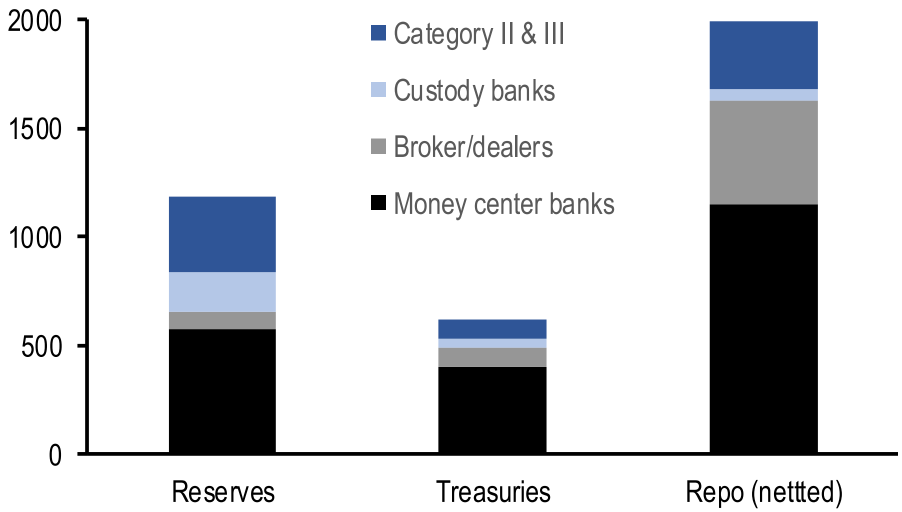
Temporary SLR relief is unlikely to have a significant market effect unless repo is in-scope, the costs of participating are not too high, and GSIB surcharges are addressed

The GSIBs, particularly money center banks, dominate the impact from temporarily excluding reserves, portfolio Treasuries, and Treasury repo from total leverage exposure …

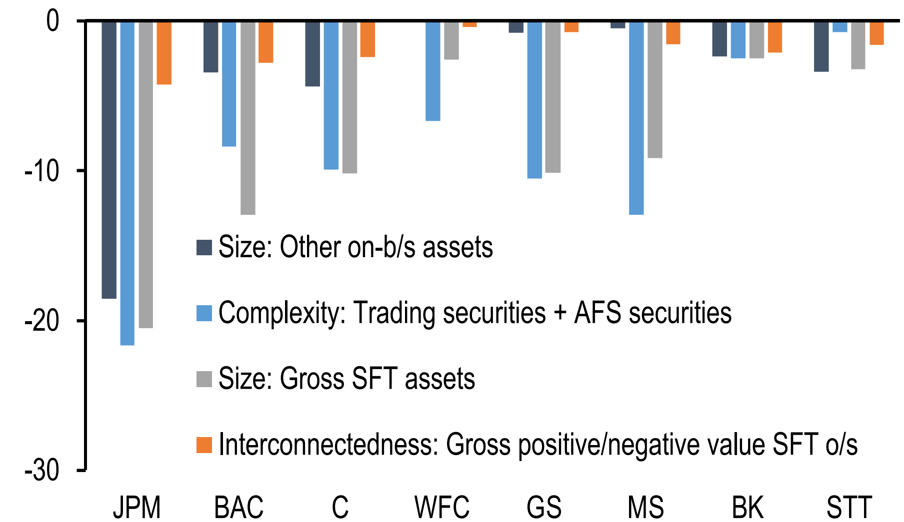
Contribution to 1Q 2020 total leverage exposure by institutions in-scope of SLR and eSLR; $bn



Source: J.P. Morgan, FFIEC 101, SNL Financial

… and these channels each contribute to the GSIB score as well, which is a functionally binding constraint on bank activity

Change in GSIB score under assumed carve outs for Treasuries, reserves, and Treasury repo as of 1Q 2020 disclosure; Method II points



Note: For on balance sheet assets, we assume AFS, HTM and trading securities that are Treasuries are excluded, and reserve assets are excluded. For trading and AFS securities we assume the latter in the complexity calculation. For gross SFT assets and gross positive/negative SFT outstanding, we assume the share of gross dealer repo positions that are Treasury is approximately 60%, as per the NY Fed primary dealer survey data. Source: J.P. Morgan, FFIEC FRY15.
Source: J.P. Morgan, FFIEC, FRBNY

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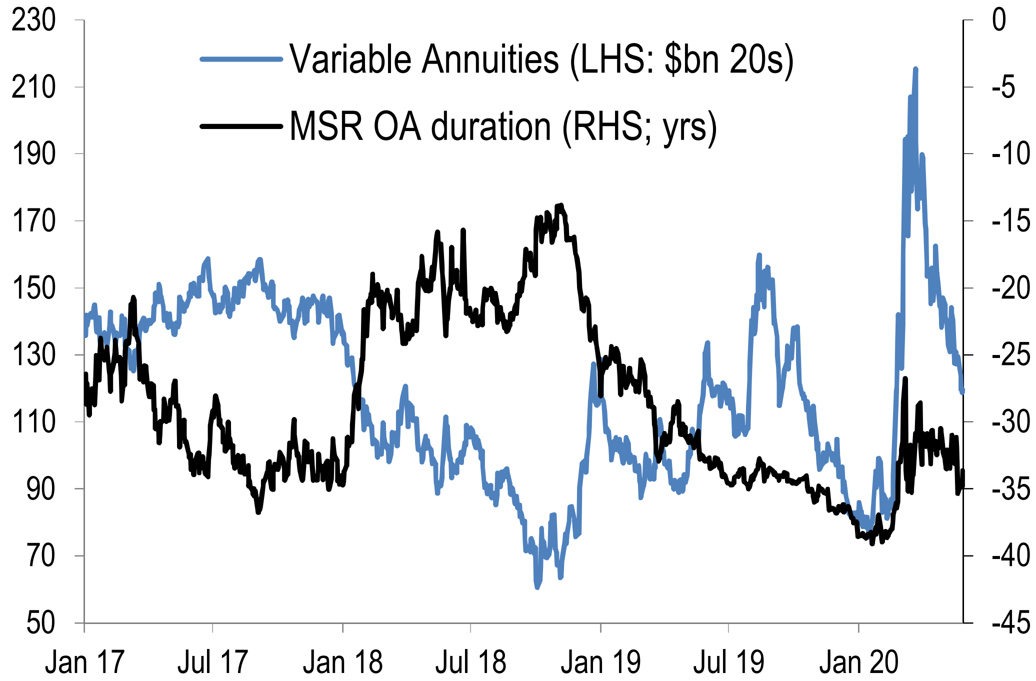
Variable annuities extended significantly as rates and equities declined in March, but have since reversed most of those moves

Variable annuity durations extended significantly as equities and rates declined in March, but have since mostly reversed those moves, and MSR durations have turned more negative

Variable annuity liability duration (LHS; $bn of 20-year equivalents) and MSR option-adjusted duration (RHS; yrs)



Source: J.P. Morgan

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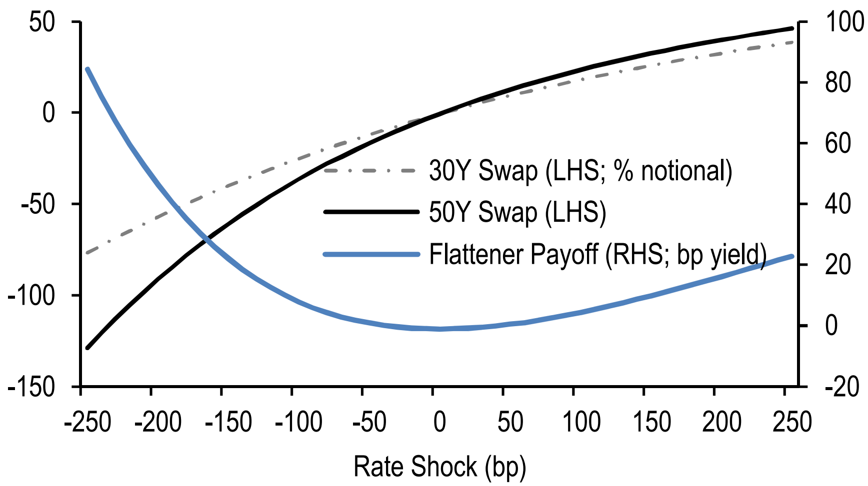
Long-dated curve flatteners can behave like options under parallel yield moves

Duration-neutral flatteners at the ultra-long end will have an option like positive payoff under a parallel movement of the curve

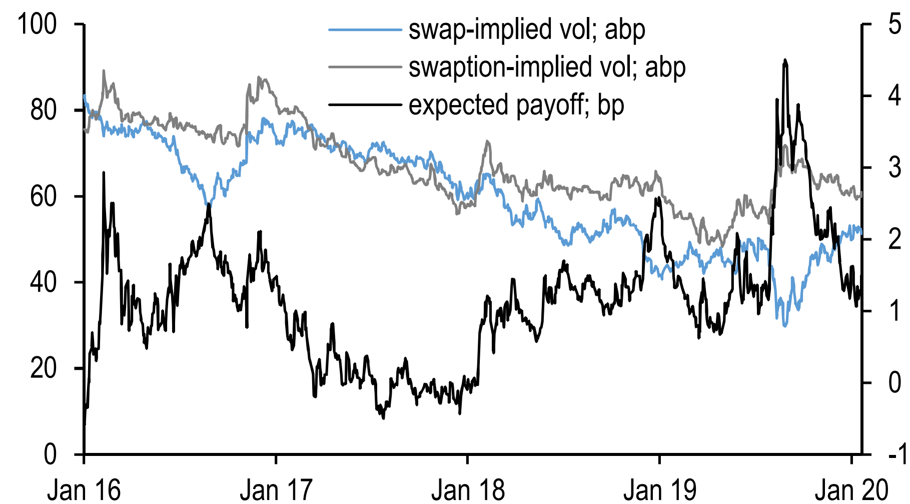
30Y and 50Y swap price under various rate shocks (LHS; % notional) and the payoff of the combined flattener (pay in 30Y vs receive in 50Y. RHS; bp yield); parallel shift in the curve



Source: J.P. Morgan

We employ a convexity valuation framework to determine "fair value" in holding duration-neutral long-end flatteners

1Y Expected payoff vs (carry)+ ex-ante roll among various curve flatteners; bp yield



*Implied volatility on a 20s/40s flattener comes from solving for the level of prevailing volatility that would make the flattener's expected convexity P/L precisely offset 1-year slide under parallel rate shocks. Expected payoff comes from using swaption-implied vol to solve for the flattener's expected convexity P/L. For details see An option by any other name, J. Younger et al., 2/3/17. Source: J.P. Morgan

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