

European Rates Watch

EUR Vol – changing curve dynamics

Curve: front-end no longer in the driver's seat this summer

The summer saw curve dynamics change. The 2y stopped leading the moves, with 2s5s and 2s10s bull-flattening and bear-steepening instead. We had made the case for the bull-flattening dynamic back in June ([EUR Vol, 20-Jun](#)), but it is when seeing the large underperformance in 1y1y late June that we also argued that the front-end had probably exhausted its sell-off potential, creating potential for bear-steepening scenarios (see [Liquid insight, 4-Jul](#)). Both materialised, with 65% of daily moves in 2s5s over Jun-Aug appearing to be driven by the 5y sector, vs less than 30% back in Mar-May (Exhibit 8). This led to a richening of right-hand side vol versus left hand side (Exhibit 4).

Bear-steepening case held, but less pronounced than in US

Our expectations for a Bund sell-off and curve steepening hinged on the combination of: (1) hard data coming in better than surveys implied, (2) supply pressures being elevated in core countries, with the greatest impact being on the belly of the curve, and (3) an environment where investors' duration positioning is already long. This combination ended up materialising in a pronounced manner in the US. In Euro, weak PMIs diminished the pressure and led to an outperformance of European rates vs US rates in the sell-off. Buying dips was more pronounced in Euro ([FX & Rates sentiment survey](#)).

We maintain a bearish bias for the next few weeks...

First because we expect the ECB to hike, but also because supply will be elevated in DV01 terms (Exhibit 10 of [Supply weekly](#)) and concentrated in France & Germany, at a time when duration positioning in core EUR rates is the most overweight in two decades (based on [FX & Rates sentiment survey](#)). We would need to see continued downside surprises in the macro data for supply not to drive yields higher. However, higher yields by end of Sep will be a buying opportunity. We see the peak at 2.65% in 10y Bunds before the rally gains momentum in Q4. Past Sep, issuance will fall, the last ECB hike will be behind us, and the tightening in credit conditions may accelerate. Lower inflation will raise real rates, TLTRO repayments will raise funding costs & fiscal support will fade.

... and close our 1y fwd 2s5s bull flattener

We continue to believe any sell-off will be led by the 5-10y sector. However, when it comes to rallies, we see risks that the curve bull-steepens around the Sep ECB meeting. The US curve has shown signs of bull steepening in the past week and a dovish ECB meeting could result in the pricing of more rapid ECB cuts, until central banks manage to horn in the message of high rates for longer. We therefore tactically close our 1y fwd 2s5s bull flattener (entered at zero cost, currently valued at €125K – [EUR Vol, 20-Jun](#)). Further out, as we approach Dutch Pension Fund indexation decisions for Jan-24 (with announcements spread over late Oct-early Dec), we believe receiving activity from Dutch PFs will pick up, driving 10s30s flatter at least vs 2s10s. The flattening pressures should be lower than last year, but still important (see [European Rates Watch, 30-Jun](#)). Buying the 2y30y vol in forward space (1-2y fwd) appears historically attractive (Exhibit 40).

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Refer to important disclosures on page 10 to 12. Analyst Certification on page 9. 12599798

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ULC – Upper left corner

URC – Upper right corner

LLC – Lower left corner

LRC – Lower right corner

ATM – At the money

ITM – In the money

OTM – Out of the money

CB - Central Bank

OIS – Overnight Index Swap

PC – principal component

TLTRO - targeted longer-term refinancing operations

PF – pension funds

For a complete list of our open trade recommendations, as well as our trade recommendations closed over the last 12 months, please see our [Global Rates Weekly](#).

Levels for indication purposes only as of Friday's Sep 1st

Levels and Recent Moves

As rates came off their mid August highs, gamma corrected lower (Exhibit 3). 1y+ expiries were less affected and remain slightly rich historically (Exhibit 2). The result is a notable move in calendar spreads, with 1y10y-1m10y implied vol spread trading at around its highest level of the past year (Exhibit 7).

The change in curve directionality has led to a richening of right-hand side volatility vs left-hand side. 3m10y implied vol now trades flat vs 3m2y (Exhibit 6).

Exhibit 1: ATM Normal Volatility Grid

102.9bp for 1y10y volatility

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	58.6	86.6	91.3	98.0	96.7	93.6	82.8
3M	67.8	98.0	100.5	102.6	100.2	96.7	87.1
6M	90.4	110.2	110.3	107.1	104.4	100.3	88.5
1Y	112.8	118.2	115.1	110.6	107.5	102.9	90.6
2Y	114.6	114.7	112.2	108.1	105.2	101.6	87.8
3Y	110.5	110.3	108.2	103.9	101.4	97.7	83.5
4Y	106.1	105.5	102.9	99.2	97.0	93.6	79.9
5Y	101.7	101.4	99.3	95.1	93.0	89.7	77.1
10Y	87.8	87.6	85.6	81.6	79.1	75.4	63.8
30Y	67.0	66.9	64.6	60.1	56.7	52.5	42.5

Source: BofA Global Research

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Exhibit 2: ATM Volatility Grid - 3m Z-Scores

Gamma cheap on 3m Z-Scores, elsewhere girls looks fair to slightly rich

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-0.4	-1.6	-1.6	-1.2	-0.8	-0.2	-0.1
3M	-0.5	-1.4	-1.4	-0.7	-0.4	0.1	0.2
6M	-0.7	-0.5	-0.3	-0.1	0.1	0.3	0.3
1Y	0.0	0.1	0.3	0.6	0.7	0.7	0.6
2Y	0.4	0.2	0.3	0.5	0.6	0.7	0.4
3Y	0.6	0.6	0.6	0.6	0.6	0.5	0.1
4Y	0.7	0.6	0.6	0.6	0.6	0.5	0.3
5Y	0.8	0.8	0.8	0.8	0.7	0.7	0.6
10Y	1.2	1.1	1.1	1.1	1.1	1.0	1.1
30Y	0.8	0.8	0.8	0.8	0.8	0.8	1.3

Source: R BofA Global Research

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Exhibit 3: ATM Normal Volatility Grid - CoW

Underperformance of gamma (short expiries) over the last week

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-3.8	-9.3	-11.4	-15.3	-15.1	-14.6	-15.4
3M	-2.6	-8.1	-8.4	-8.9	-8.9	-8.9	-10.4
6M	-9.2	-9.6	-8.5	-6.0	-6.3	-6.7	-7.7
1Y	-6.0	-5.2	-4.6	-3.5	-3.9	-4.5	-5.1
2Y	-3.3	-3.6	-3.5	-3.5	-3.5	-3.7	-4.1
3Y	-2.6	-2.3	-2.5	-2.7	-3.0	-3.3	-3.6
4Y	-2.3	-2.3	-2.3	-2.5	-2.5	-2.6	-2.8
5Y	-2.0	-1.8	-1.8	-1.8	-1.8	-1.8	-1.9
10Y	-1.2	-1.2	-1.2	-1.1	-1.1	-1.0	-0.9
30Y	-1.1	-1.2	-1.1	-1.1	-1.0	-0.8	-0.7

Source: BofA Global Research

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Exhibit 4: ATM Straddle Premiums (indicative only)

6.8% straddle premiums for 1y10y

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	0.1%	0.4%	0.6%	1.0%	1.4%	1.8%	3.8%
3M	0.3%	0.7%	1.1%	1.9%	2.5%	3.3%	7.1%
6M	0.5%	1.2%	1.7%	2.7%	3.6%	4.7%	10.0%
1Y	0.8%	1.7%	2.5%	3.9%	5.2%	6.8%	14.2%
2Y	1.2%	2.3%	3.4%	5.2%	6.9%	9.1%	19.0%
3Y	1.4%	2.7%	3.9%	6.0%	8.0%	10.5%	21.6%
4Y	1.5%	2.9%	4.1%	6.4%	8.6%	11.3%	23.4%
5Y	1.5%	3.0%	4.3%	6.7%	8.9%	11.7%	24.7%
10Y	1.6%	3.2%	4.6%	7.0%	9.3%	12.2%	25.8%
30Y	1.3%	2.6%	3.7%	5.6%	7.3%	9.4%	19.9%

Source: BofA Global Research

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Exhibit 5: 1y10y volatility

Current level 102.9bp

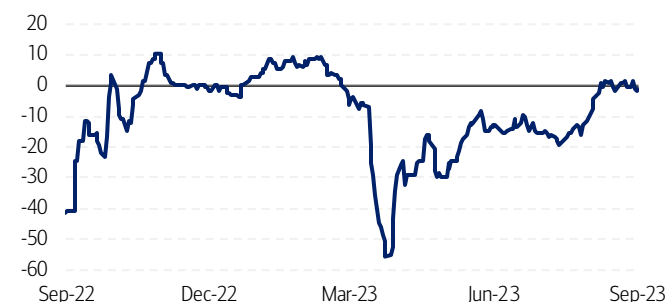


Source: BofA Global Research; Bloomberg

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Exhibit 6: 3m10y vs. 3m2y Normal Volatility

Left side now trading flat to right side



Source: BofA Global Research; Bloomberg

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Exhibit 7: 1y10y vs. 1m10y Normal Volatility

Vol term structure steepened over the past week

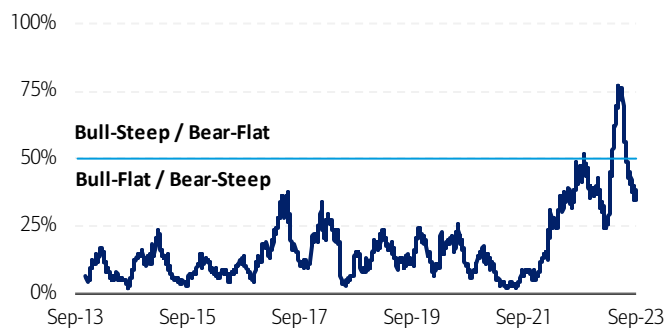


Source: BofA Global Research; Bloomberg

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Exhibit 8: 2s5s curve directionality

Front-end driving 35% of the 2s5s curve directionality over last 3m



Source: BofA Global Research

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Ratios implied/delivered

Exhibit 9: Implied vs. Delivered (21d) Ratio

Ratios of Implied to 21d delivered rich on the left side

	1y	2y	3y	5y	7y	10y	30y
1m	109%	112%	107%	103%	99%	95%	93%
3m	106%	117%	112%	104%	101%	96%	97%
6m	113%	120%	115%	105%	102%	98%	98%
1y	112%	116%	111%	104%	102%	99%	100%
2y	111%	108%	102%	99%	98%	98%	97%

Source: BofA Global Research

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Exhibit 10: Implied vs. Delivered (63d) Ratio

Ratios of Implied to 63d delivered >100% across the grid

	1y	2y	3y	5y	7y	10y	30y
1m	110%	106%	100%	102%	103%	102%	109%
3m	97%	106%	103%	103%	104%	104%	114%
6m	102%	108%	107%	104%	106%	106%	115%
1y	100%	105%	106%	105%	107%	108%	117%
2y	101%	105%	102%	105%	106%	108%	114%

Source: BofA Global Research

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Exhibit 11: 3m Z-Scores for Implied vs. Delivered (21d) Ratio

Ratios of implied/21d delivered fair/rich for intermediates on the left side, cheap on the right

	1y	2y	3y	5y	7y	10y	30y
1m	-0.6	-0.7	-0.4	-0.5	-0.7	-0.8	-1.4
3m	0.2	0.1	0.1	-0.2	-0.5	-0.6	-1.2
6m	0.3	0.5	0.4	-0.1	-0.4	-0.6	-1.3
1y	0.8	0.7	0.3	-0.1	-0.3	-0.6	-1.4
2y	0.6	0.1	-0.1	-0.6	-0.8	-0.9	-1.6

Source: BofA Global Research

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Exhibit 12: 3m Z-Scores for Implied vs. Delivered (63d) Ratio

Ratios of implied/63d delivered look cheap in the belly vs the wings (left and right side of the grid)

	1y	2y	3y	5y	7y	10y	30y
1m	0.5	-0.5	-0.6	-0.8	-0.9	-0.6	-0.1
3m	0.7	0.1	-0.1	-0.2	-0.5	-0.4	0.2
6m	0.6	0.6	0.4	0.1	-0.2	-0.2	0.3
1y	1.0	0.9	0.7	0.3	-0.2	-0.2	0.5
2y	0.8	0.1	-0.4	-1.0	-1.1	-0.9	0.3

Source: BofA Global Research

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Volatility Grid Relative Value

PCA Z-SCORES

Exhibit 13: 3m Z-Scores w/ PCA framework

Richness virtually across the grid except for short gamma and 30y tails

	1y	2y	3y	5y	7y	10y	30y
3m	1.5	-2.7	-2.7	-3.3	-2.5	-1.2	-2.6
6m	-1.6	0.0	0.9	0.2	0.0	0.3	-2.7
1y	1.3	2.2	2.6	2.3	3.3	3.3	0.1
2y	2.3	1.8	2.1	1.8	1.0	1.2	-1.5
5y	1.7	1.5	1.5	1.6	1.5	0.8	-0.2
10y	1.8	1.6	2.5	2.6	2.4	2.4	1.4

Source: BofA Global Research

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Exhibit 14: 3m Z-Scores w/ PCA framework w/o rates directionality

Richness virtually across the grid except for short gamma and 30y tails

	1y	2y	3y	5y	7y	10y	30y
3m	0.0	-1.0	-1.1	-0.9	-0.8	-0.5	-0.6
6m	-0.6	-0.4	-0.3	-0.3	-0.3	-0.1	-0.5
1y	0.1	0.2	0.3	0.3	0.4	0.3	0.0
2y	0.5	0.3	0.2	0.2	0.1	0.1	-0.3
5y	0.7	0.7	0.6	0.5	0.5	0.3	-0.1
10y	1.0	0.9	0.9	0.9	0.8	0.8	1.0

Source: BofA Global Research

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Exhibit 15: 6m Z-Scores w/ PCA framework

Richness virtually across the grid except for short gamma...

	1y	2y	3y	5y	7y	10y	30y
3m	1.2	-0.9	-1.3	-0.7	-0.6	-0.3	-0.7
6m	-0.3	-0.2	0.3	0.1	0.3	0.4	-0.5
1y	0.9	1.3	1.7	1.5	1.3	1.4	0.5
2y	0.7	0.3	0.3	0.4	0.4	0.7	-0.2
5y	0.8	0.7	0.7	0.7	0.4	0.5	0.0
10y	1.2	1.1	1.1	1.2	1.1	1.2	1.4

Source: BofA Global Research

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Exhibit 16: 6m Z-Scores w/ PCA framework w/o rates directionality

... most of the grid looks fair/cheap when directionality is considered

	1y	2y	3y	5y	7y	10y	30y
3m	-0.7	-1.0	-1.0	-0.7	-0.6	-0.5	-0.4
6m	-0.9	-0.7	-0.6	-0.6	-0.5	-0.3	-0.3
1y	-0.5	-0.4	-0.3	-0.2	-0.1	0.0	-0.1
2y	-0.1	-0.3	-0.3	-0.1	-0.2	0.0	-0.4
5y	0.2	0.2	0.1	0.0	-0.1	-0.1	-0.2
10y	0.5	0.4	0.4	0.4	0.3	0.3	0.8

Source: BofA Global Research

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Exhibit 17: 1y Z-Scores w/ PCA framework

Richness/cheapness of grid more dispersed

	1y	2y	3y	5y	7y	10y	30y
3m	0.0	-1.2	0.0	0.2	0.1	-0.5	-0.6
6m	-0.7	-0.3	0.3	1.2	1.1	0.5	-0.7
1y	1.1	1.2	0.2	0.5	0.3	1.2	-0.1
2y	-0.3	-0.7	-0.5	-1.1	0.8	0.4	-0.8
5y	-0.7	-0.7	0.7	0.4	0.2	0.0	-0.1
10y	0.2	0.0	0.1	0.0	-0.2	-0.3	0.1

Source: BofA Global Research

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Exhibit 18: 1y Z-Scores w/ PCA framework w/o rates directionality

Cheapness across the grid when directionality with rates is considered

	1y	2y	3y	5y	7y	10y	30y
3m	-1.5	-1.3	-1.4	-1.4	-1.4	-1.4	-1.1
6m	-1.2	-0.9	-0.9	-1.1	-1.2	-1.2	-1.1
1y	-0.3	-0.3	-0.5	-0.7	-0.8	-0.8	-0.9
2y	-0.2	-0.4	-0.5	-0.6	-0.7	-0.7	-0.9
5y	-0.6	-0.6	-0.6	-0.7	-0.7	-0.7	-0.7
10y	-0.6	-0.7	-0.7	-0.7	-0.7	-0.7	-0.4

Source: BofA Global Research

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Skew Relative Value

Exhibit 19: Skew 25% delta

Rich receiver skew for intermediates in the belly and LRC

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	1.5	1.8	1.4	0.5	0.2	-0.1	0.1
3M	3.2	3.8	3.1	1.5	1.0	0.3	0.7
6M	5.6	5.7	4.6	2.4	1.7	0.8	1.4
1Y	7.7	6.6	5.1	2.5	1.7	0.5	1.4
2Y	3.4	2.6	2.3	1.8	1.4	0.8	1.7
3Y	1.5	1.0	0.9	0.9	0.6	0.3	1.5
4Y	0.2	-0.2	0.0	0.2	0.1	0.0	1.4
5Y	-0.9	-1.2	-0.8	-0.2	-0.2	-0.2	1.3
10Y	-2.8	-2.8	-2.2	-1.3	-0.4	0.8	1.8
15Y	-1.9	-2.0	-1.5	-0.4	0.2	1.0	1.7
30Y	-2.9	-2.9	-2.0	-0.5	0.0	0.4	0.8

Source: BofA Global Research

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Exhibit 20: Skew 75% delta

Payer skew rich for intermediates in the left side and belly

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-0.9	-0.9	-0.5	0.5	0.8	1.2	0.8
3M	-1.2	-0.9	-0.1	1.7	2.2	2.7	2.0
6M	-0.9	0.0	1.2	3.2	3.7	4.4	3.1
1Y	1.5	2.2	3.2	4.8	5.2	5.7	3.9
2Y	7.2	7.0	6.8	6.3	6.3	6.3	4.1
3Y	7.9	7.6	7.3	6.6	6.6	6.5	4.2
4Y	8.1	7.8	7.4	6.7	6.6	6.4	4.3
5Y	8.2	7.9	7.5	6.7	6.5	6.3	4.3
10Y	8.8	8.8	8.2	7.0	6.1	4.9	3.4
15Y	7.8	7.9	7.1	5.8	5.2	4.4	3.2
30Y	6.3	6.2	5.2	3.4	3.3	3.2	2.5

Source: BofA Global Research

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Exhibit 21: Breakeven Widths for Costless Receiver Ladders

105bp breakeven width for 1y10y receiver ladders

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	18	26	28	29	29	28	24
3M	38	55	55	54	52	50	46
6M	73	88	87	81	77	73	66
1Y	129	133	127	116	111	105	94
2Y	173	171	166	159	154	147	130
5Y	226	225	221	214	210	202	180
10Y	266	265	261	254	251	246	215

Source: BofA Global Research

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Exhibit 22: Breakeven Widths for Costless Payer Ladders

116bp breakeven width for 1y10y payer ladders

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	17	25	27	29	29	28	25
3M	34	50	52	55	54	53	47
6M	64	80	81	82	81	79	68
1Y	116	124	123	122	119	116	99
2Y	184	184	179	172	169	164	137
5Y	270	268	261	247	242	231	192
10Y	345	344	332	310	295	273	226

Source: BofA Global Research

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Exhibit 23: 3m Z-Score Receiver Skew (w/o fwds & ATM direction)

Receiver skew cheap virtually across the grid, particularly on the right

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-1.0	-0.7	-0.5	-1.4	-1.4	-1.8	-2.0
3M	0.7	-1.1	-2.3	-2.5	-2.6	-2.6	-3.1
6M	-1.0	-0.7	-2.2	-2.3	-2.4	-2.6	-2.8
1Y	-1.3	-1.2	-1.3	-1.7	-1.7	-1.8	-2.3
2Y	-1.2	-1.4	-1.5	-1.0	-1.4	-1.8	-2.2
5Y	-0.5	-0.5	-0.2	1.4	0.4	-1.2	-1.3
10Y	-1.2	-1.1	-1.0	0.4	-0.5	-1.5	-2.3

Source: BofA Global Research

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Exhibit 24: 3m Z-Score Payer Skew (w/o direction w/ fwds & ATM)

Payer skew rich broadly across the grid, particularly on the right

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-0.7	-0.5	-0.5	-0.4	-0.6	-0.4	-0.2
3M	0.2	0.9	1.4	1.7	1.8	1.7	2.0
6M	-0.3	-0.1	0.5	1.2	1.2	1.2	1.7
1Y	1.2	1.1	1.3	2.4	1.4	1.4	2.0
2Y	0.5	0.9	1.1	1.2	1.2	0.9	0.7
5Y	1.4	1.3	1.4	1.3	1.0	0.9	0.0
10Y	0.8	0.7	0.7	0.4	0.5	0.6	0.8

Source: BofA Global Research

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Exhibit 25: Ratio of Payer/Receiver BE widths for Costless Ladders

Ratios of breakeven widths < 100% only in the ULC

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	94%	95%	97%	100%	101%	102%	101%
3M	89%	91%	95%	101%	103%	105%	103%
6M	87%	91%	94%	101%	104%	107%	104%
1Y	90%	93%	97%	105%	107%	111%	106%
2Y	106%	108%	108%	108%	109%	111%	105%
5Y	119%	119%	118%	115%	115%	114%	107%
10Y	130%	130%	127%	122%	118%	111%	105%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 26: 3m Z-Score Ratio of Payer/Receiver Skew

Z-Scores show rich payer vs receiver skew virtually across the grid

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	2.3	1.1	2.7	1.5	1.4	0.4	1.3
3M	1.6	0.7	1.1	2.2	2.2	1.5	1.6
6M	1.0	1.1	1.6	2.0	2.6	2.1	2.0
1Y	1.5	1.2	1.7	2.2	2.2	2.1	1.9
2Y	1.5	1.5	1.7	2.0	2.0	2.0	1.8
5Y	0.9	0.9	0.8	-0.2	0.5	-0.5	-1.8
10Y	0.8	0.8	0.8	-0.2	0.7	1.5	1.4

Source: BofA Global Research

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Conditional Curve Trades

Exhibit 27: Bull Flattener (pickup to forwards for ATM)

Buy longer maturity receiver, sell shorter maturity receiver

ATM	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	-1.8	0.5	4.5	2.2	6.2	4.1
6M	1.7	5.4	11.5	3.6	9.9	6.6
1Y	6.0	11.4	20.1	5.7	15.0	9.6
1.5Y	7.7	14.3	25.8	6.9	18.9	12.5
2Y	7.1	13.7	27.5	6.9	21.3	14.9

Source: BofA Global Research

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Exhibit 29: Bull Steepener (pickup to forwards for ATM)

Sell longer maturity receiver, buy shorter maturity receiver

ATM	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	1.8	-0.5	-4.5	-2.2	-6.2	-4.1
6M	-1.7	-5.4	-11.5	-3.6	-9.9	-6.6
1Y	-6.0	-11.4	-20.1	-5.7	-15.0	-9.6
1.5Y	-7.7	-14.3	-25.8	-6.9	-18.9	-12.5
2Y	-7.1	-13.7	-27.5	-6.9	-21.3	-14.9

Source: BofA Global Research

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Exhibit 31: Bear Flattener (pickup to forwards for ATM)

Sell longer maturity payer, buy shorter maturity payer

ATM	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	1.9	-0.5	-3.9	-2.5	-5.7	-3.5
6M	-1.6	-5.6	-11.1	-3.8	-9.6	-6.0
1Y	-6.0	-12.0	-20.1	-6.2	-14.9	-9.2
1.5Y	-8.1	-15.2	-25.8	-7.4	-18.8	-12.3
2Y	-7.5	-14.6	-27.7	-7.4	-21.3	-14.6

Source: BofA Global Research

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Exhibit 33: Bear Steepener (pickup to forwards for ATM)

Buy longer maturity payer, sell shorter maturity payer

ATM	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	-1.9	0.5	3.9	2.5	5.7	3.5
6M	1.6	5.6	11.1	3.8	9.6	6.0
1Y	6.0	12.0	20.1	6.2	14.9	9.2
1.5Y	8.1	15.2	25.8	7.4	18.8	12.3
2Y	7.5	14.6	27.7	7.4	21.3	14.6

Source: BofA Global Research

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Exhibit 28: Bull Flattener (pickup to forwards for -25bp OTM)

Buy longer maturity receiver, sell shorter maturity receiver

-25bp	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	-1.6	2.2	7.8	3.8	9.2	5.7
6M	3.4	8.5	16.4	5.3	13.5	8.6
1Y	8.3	15.1	25.4	7.5	18.3	11.3
1.5Y	9.7	17.6	30.7	8.7	22.5	14.5
2Y	8.3	16.1	31.6	8.3	24.6	17.0

Source: BofA Global Research

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Exhibit 30: Bull Steepener (pickup to forwards for -25bp OTM)

Sell longer maturity receiver, buy shorter maturity receiver

-25bp	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	1.6	-2.2	-7.8	-3.8	-9.2	-5.7
6M	-3.4	-8.5	-16.4	-5.3	-13.5	-8.6
1Y	-8.3	-15.1	-25.4	-7.5	-18.3	-11.3
1.5Y	-9.7	-17.6	-30.7	-8.7	-22.5	-14.5
2Y	-8.3	-16.1	-31.6	-8.3	-24.6	-17.0

Source: BofA Global Research

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Exhibit 32: Bear Flattener (pickup to forwards for +25bp OTM)

Sell longer maturity payer, buy shorter maturity payer

+25bp	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	4.0	1.1	-4.7	-3.0	-8.4	-5.7
6M	-1.1	-5.6	-13.7	-4.6	-12.9	-8.8
1Y	-6.3	-13.0	-23.6	-7.0	-18.2	-12.1
1.5Y	-8.9	-17.1	-30.1	-8.5	-22.7	-15.2
2Y	-8.7	-16.7	-32.4	-8.5	-25.2	-17.7

Source: BofA Global Research

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Exhibit 34: Bear Steepener (pickup to forwards for +25bp OTM)

Buy longer maturity payer, sell shorter maturity payer

+25bp	2/5s	2/10s	2/30s	5/10s	5/30s	10/30s
3M	-4.0	-1.1	4.7	3.0	8.4	5.7
6M	1.1	5.6	13.7	4.6	12.9	8.8
1Y	6.3	13.0	23.6	7.0	18.2	12.1
1.5Y	8.9	17.1	30.1	8.5	22.7	15.2
2Y	8.7	16.7	32.4	8.5	25.2	17.7

Source: BofA Global Research

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Forward Volatility

Exhibit 35: 6m Forward Volatility

101.1bp for 6m fwd 1y10y

	1y	2y	5y	10y	30y
1m	101.8	109.5	111.1	104.1	93.3
3m	106.0	112.4	111.2	103.2	92.0
6m	110.6	116.3	110.7	103.0	90.6
1y	108.7	116.6	108.8	101.1	87.4
2y	112.4	111.7	104.2	97.4	82.8
5y	98.0	97.7	90.9	85.3	73.0
10y	83.9	83.7	78.1	72.2	60.7

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 36: 6m Fwd vol as % ATM

98% of ATM for 6m fwd 1y10y

	1y	2y	5y	10y	30y
1m	174%	126%	113%	111%	113%
3m	156%	115%	108%	107%	106%
6m	122%	106%	103%	103%	102%
1y	96%	99%	98%	98%	96%
2y	98%	97%	96%	96%	94%
5y	96%	96%	96%	95%	95%
10y	96%	96%	96%	96%	95%

Source: BofA Global Research

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Exhibit 37: 3m Z-Score 6m Fwd vol % ATM

-0.4 Z-Score for 6m fwd 1y10y

	1y	2y	5y	10y	30y
1m	0.4	2.1	1.9	1.0	1.1
3m	0.8	1.9	1.9	0.9	0.8
6m	1.3	1.2	1.1	0.4	0.3
1y	1.5	1.0	0.1	-0.4	-0.7
2y	0.0	0.3	-0.5	-0.8	-0.8
5y	-0.8	-0.8	-0.7	-0.4	-0.1
10y	-0.6	-0.6	-0.5	-0.4	-0.2

Source: BofA Global Research

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Exhibit 38: 1y Forward Volatility

98.1bp for 1y fwd 1y10y

	1y	2y	5y	10y	30y
1m	106.3	110.6	103.5	96.2	81.7
3m	114.0	116.3	106.1	97.9	82.6
6m	118.4	119.9	107.9	99.3	83.8
1y	104.5	111.3	104.2	98.1	83.0
2y	108.1	107.8	100.2	93.6	78.1
5y	94.5	94.5	87.8	82.0	69.5
10y	81.6	81.5	76.0	70.0	58.0

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 39: 1y Fwd vol as % ATM

95% of ATM for 1y fwd 1y10y

	1y	2y	5y	10y	30y
1m	181%	128%	106%	103%	99%
3m	168%	119%	103%	101%	95%
6m	131%	109%	101%	99%	95%
1y	93%	94%	94%	95%	92%
2y	94%	94%	93%	92%	89%
5y	93%	93%	92%	91%	90%
10y	93%	93%	93%	93%	91%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 40: 3m Z-Score 1y Fwd vol % ATM

-1.0 Z-Score for 1y fwd 1y10y

	1y	2y	5y	10y	30y
1m	0.0	1.6	0.7	-0.2	-0.4
3m	0.8	2.1	0.6	-0.2	-0.6
6m	2.0	1.4	0.1	-0.4	-0.7
1y	0.3	-0.5	-1.2	-1.0	-1.1
2y	0.1	0.2	-0.8	-1.1	-1.2
5y	-0.8	-0.8	-0.7	-0.4	-0.1
10y	-0.6	-0.6	-0.6	-0.5	-0.4

Source: BofA Global Research

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Exhibit 41: 2y Forward Volatility

89.0bp for 2y fwd 1y10y

	1y	2y	5y	10y	30y
1m	114.2	105.7	93.1	85.9	69.0
3m	110.1	105.1	94.6	87.6	70.7
6m	110.9	106.0	96.2	89.2	72.1
1y	92.8	100.1	94.8	89.0	72.4
2y	97.1	99.3	92.0	86.0	70.5
5y	89.4	89.7	82.0	77.3	63.4
10y	79.4	79.6	74.2	67.2	54.1

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 42: 2y Fwd vol as % ATM

86% of ATM for 2y fwd 1y10y

	1y	2y	5y	10y	30y
1m	195%	122%	95%	92%	83%
3m	162%	107%	92%	91%	81%
6m	123%	96%	90%	89%	81%
1y	82%	85%	86%	86%	80%
2y	85%	87%	85%	85%	80%
5y	88%	88%	86%	86%	82%
10y	90%	91%	91%	89%	85%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 43: 3m Z-Score 2y Fwd vol % ATM

-0.9 Z-Score for 2y fwd 1y10y

	1y	2y	5y	10y	30y
1m	0.0	1.4	0.6	-0.5	-0.8
3m	0.4	2.0	0.6	-0.5	-0.8
6m	0.6	1.0	0.1	-0.7	-0.9
1y	2.1	1.9	-0.1	-0.9	-1.1
2y	1.5	0.2	-0.4	-0.7	-0.6
5y	-0.3	-0.5	-0.4	0.1	0.3
10y	-0.3	-0.3	0.0	0.0	0.2

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 44: 3y Forward Volatility

83.7bp for 3y fwd 1y10y

	1y	2y	5y	10y	30y
1m	94.8	91.8	86.1	80.6	65.5
3m	101.4	97.5	89.2	83.0	67.3
6m	101.6	100.6	91.1	84.7	68.8
1y	82.6	94.5	88.3	83.7	68.8
2y	93.5	96.3	86.6	81.6	67.8
5y	85.5	85.4	78.0	74.1	59.3
10y	78.3	78.6	72.8	64.9	51.1

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 45: 3y Fwd vol as % ATM

81% of ATM for 3y fwd 1y10y

	1y	2y	5y	10y	30y
1m	162%	106%	88%	86%	79%
3m	150%	100%	87%	86%	77%
6m	112%	91%	85%	84%	78%
1y	73%	80%	80%	81%	76%
2y	82%	84%	80%	80%	77%
5y	84%	84%	82%	83%	77%
10y	89%	90%	89%	86%	80%

Source: BofA Global Research

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Exhibit 46: 3m Z-Score 3y Fwd vol % ATM

-0.5 Z-Score for 3y fwd 1y10y

	1y	2y	5y	10y	30y
1m	-0.3	1.2	0.5	-0.3	-0.2
3m	0.7	1.7	0.6	-0.2	-0.2
6m	0.8	0.8	0.1	-0.3	-0.2
1y	1.3	0.0	-0.2	-0.5	-0.3
2y	-0.1	0.3	0.2	-0.1	0.5
5y	0.5	0.1	0.2	0.7	0.9
10y	-0.1	-0.1	0.4	0.4	1.0

Source: BofA Global Research

BofA GLOBAL RESEARCH

Notes

Exhibit 8: We classify the moves on the 2s10s or 5s30s curve every day in either one of these: bear flattening & bull steepening (where the 2y or 5y leg leads) or bear steepening & bull flattening (where the 10y or 30y leg leads). We sum each one of those columns over the last 2 or 3 months and divide by the absolute value of the curve moves to get a % index for each of the 4 different curve dynamics. We sum up the bear flattening + bull steepening indices into a new index - when this index = 0 the entire dynamic of the 2s10s or 5s30s curve is driven by the longer leg (10y or 30y leg respectively - corresponds to periods of forward guidance for example).

Exhibit 13/17/19: We calculate the principal components of the vol grid (the Eigen vectors of the covariance matrix) and take only the first 2/3 that represent around 90% of the variance in the data. We transpose the PCA transformation to recover vols from only these 2/3 components and obtain models for the vols. We calculate the residual of these models to the original series, and the Z-Score of these residuals.

Exhibit 14/18/20: Instead of taking the first 2/3 principal components of the vol grid and apply the transpose of the PCA transformation to them, we first regress each of these vol PCs on the PCs of rates and apply the transpose of the vol PCA transformation to these models for the vol PCs. This way we remove the directionality between vol and rates from the vol dynamic, and obtain a purer Z-Score RV signal on vol.

Exhibit 21/24: In a payer/receiver ladder one buys the ATM strike and then you sell $ATM+/-x$ and $ATM+/-2x$. The position starts losing money when the forwards move past $ATM+/-3x$, which we call the downside breakeven on the payer/receiver ladder.

We calculate the x (gap between strikes) daily such that the premium one must pay for the payer/receiver ladder is zero (any vol structure that has unlimited downside can always be structured to be costless). These breakeven widths are therefore costless downside breakeven widths. When payer/receiver skew richens, this width increases - one needs to sell higher strikes $ATM+/(x+\delta)$ and $ATM+/-2(x+\delta)$ to pay for the ATM strike bought. By looking at how these costless downside breakeven widths change over time one can measure how payer/receiver skew has richen/cheapen over time.

Exhibit 23/26: Skew is directional with forwards and with the level of vol. We regress the costless downside breakeven widths (for receivers and payers) on the forwards and ATM vol and look at the residuals of that regression to get a purer skew RV signal.

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