

Japan Rates Watch

JP Vol – Focus on the July MPM

Macro backdrop and policy expectations

All eyes are on the 30-31 July MPM. While a rare unscheduled revision to GDP data shows an even weaker picture of Japan's economy in 2H23-1Q24 (see [1Q GDP revised down further due to construction data corrections](#), from 1 Jul '24), Japanese companies continue to face severe labor shortages and this, together with the recent resurgence in upstream import costs, is driving their strong stance towards price hikes (see [Price pressures picking up again](#), from 1 Jul '24). Thus, we still pencil in an additional policy rate hike to 0.25% at the July MPM, though the consensus is at the October MPM.

The detailed plan for reducing BoJ's purchases of JGBs is also the market's focus at the July MPM. According to a 25-27 June QUICK survey of 124 domestic JGB investors, the median view is that the BoJ will reduce its monthly JGB purchases from ¥5.7tn to ¥4tn a year out. We expect the BoJ to publish more aggressive reduction. We currently think the BoJ could reduce its monthly JGB purchases to around ¥3.3tn over the next year. We would expect it to scale back buying mainly of 1-3yr, 3-5yr, and 5-10yr issues, given its high JGB purchases as a percentage of issuance.

Therefore, we are more bearish on the JGBs than the consensus. We expect the 10yr JGB yield to rise to 1.25% at end-2024, while the market sees the year-end 10yr JGB yield at 1.1%. However, the Japanese life insurers' weak appetite for superlong JGBs would keep the 10s30s JGB curve steeper. The 10s30s spread is unlikely to start shrinking without the MoF's cut in superlong JGB issuance.

Recent vol dynamic

Implied vols have pushed higher since early April (Exhibit 1 & Exhibit 9). While levels continue to be broadly lower year to date (Exhibit 7), the recent moves are reflected in richness of vol on Z-Scores across the grid (Exhibit 4 & Exhibit 18), particularly on the left side.

Indeed, the grid continues to awaken gradually on the BoJ policy shift. The directionality of 1y10y vol with forwards continues to be low, helping the left side to catch up slowly to the right side (Exhibit 10), even as policy expectations reprice only gradually (c.+10-20bp shift in expectations over the last quarter – see Exhibit 13 & Exhibit 14). The vol term structure flattened further over the last week (Exhibit 11).

Payers trade over receivers broadly across the grid (Exhibit 27). However, the recent dynamic has driven some cheapness on Z-Scores for payer/receiver ratios (Exhibit 28). Payer skew looks cheap on Z-Scores when the recent directionality with ATM and forwards is considered (Exhibit 26), while receiver skew looks rich on Z-Scores (Exhibit 25).

Cheap vol on the left vs right up to 1y expiries (unusual ahead of CBs policy shifts. – Exhibit 3) drives give-ups to forwards in conditional bull-flatteners and bear-steepeners (which usually position for curve moves driven by shifting fundamentals), and pick-ups in bull-steepeners and bear-flatteners (BoJ driven moves that generally drive left side vol).

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Refer to important disclosures on page 12 to 14. Analyst Certification on page 11. 12712184

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ATM – At the money

BoJ – Bank of Japan

CB – Central Bank

DM – Developed Markets

IR – Interest Rates

ITM – In the money

LLC – Lower left corner

LRC – Lower right corner

MPM – Monetary Policy Meeting

NIRP – Negative IR policy

OIS – Overnight Index Swap

OTM – Out of the money

PC – principal component

QE – Quantitative Easing

ULC – Upper left corner

URC – Upper right corner

YCC – Yield Curve Control

For a list of recent recommendations please see our [Global Rates Weekly](#).

Levels for indication purposes only as of Friday's 8th July '24.

Exhibit 1: Changes in the JP vol grid since the early-April lows

Outperformance of ULC on BoJ policy tightening expectations

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	13.2	8.8	7.7	4.0	3.5	3.9	3.3
3M	12.0	10.2	9.9	5.2	4.6	5.3	5.3
6M	10.7	11.0	11.5	8.2	7.7	6.6	7.8
1Y	9.6	9.9	9.5	7.5	6.7	6.5	7.0
2Y	10.4	10.7	9.6	8.3	7.6	6.9	7.8
3Y	8.9	8.2	8.0	7.0	6.9	6.5	6.3
4Y	7.8	7.0	6.8	6.2	6.4	6.2	6.0
5Y	6.6	5.9	5.4	6.2	6.1	6.2	5.9
10Y	5.3	5.3	5.4	4.9	4.9	5.2	4.7
15Y	6.5	6.6	6.2	5.7	5.6	6.3	5.2
30Y	5.0	5.6	5.9	5.5	6.1	6.4	5.4

Source: BofA Global Research

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Exhibit 2: Low directionality of 1y10y vol with fwds ...

... helping the left side catchup to the right side of the grid



Source: BofA Global Research; Bloomberg

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Vol outlook & trade recommendations

The market has repriced the policy trajectory very gradually: 3m OIS forwards to c.1.1-1.15% over 5y, and c.1.8-1.85% over 10y (see Exhibit 13). These levels are c.10-20bp higher over the last quarter. For vols, this repricing continues to be reflected in only a very gradual awakening of the grid.

However, hawkish surprises at the July MPM, like a July hike (our baseline view vs. consensus centered around Oct MPM meeting) and/or with a more significant reduction of the pace of purchased over the next year (also our baseline view) may speedup the awakening process and increase the directionality of vol with the forwards.

In our global vol year ahead (see [Global Rates Vol in '24](#), from 21 Nov '23) we argued that we expected 1y10y vol levels fair in the c.60-70bp range over '24 and 1y1y vol around the midpoint of that range (with a bias towards the lower end in 1H24, and the upper end in 2H24). Broadly, these are c.10-15 normals higher from current levels. Hawkish surprised at the July MPM may serve as a catalyst for the grid to normalize to levels closer to these expectations.

Flow-wise, we have seen more interest to buy OTM payers and payer spreads in the gamma sector expiring both before and after the July BoJ meeting, supported by some hawkish rhetoric from the BoJ. In the vega sector, we have seen intermittent demand to buy ATM straddles.

We continue to favor:

- Costless 6m5y payer ladders (atm/atm+15bp/atm+30bp, indicative strikes), with main risk a selloff beyond the breakeven on the position (c.45bp underperformance vs the forwards at current levels) with potentially unlimited downside.
- Proxies for 2s10s bear steepeners expressed by buying 6m10y payer spread (atm/atm+50bp) financed by selling 6m2y atm payers (same delta as the atm 6m10y leg – currently +2bp). The structure works as a steepener proxy (at inception, the structure is short vol and marginally long the market). Because it is short the high strike payer, however, it is not only exposed to bear flattening moves with potentially unlimited downside (as it is the case with a conventional conditional bear steepening trade), but it is also exposed to bear steepening scenarios where 10y rates underperform by more than 50bp beyond the forwards.

Levels and recent moves

Vol supported on the week for short expiries on the right, while 3-6m expiries pushed slightly lower (Exhibit 5). For the year, however, we continue to see the right side leading the underperformance on the Japanese vol grid & the ULC marginally supported by BoJ policy expectations (see Exhibit 7 - vs a US grid where the left side repriced broadly lower on Fed easing expectations – Exhibit 10). However, 3m Z-Scores show vol levels broadly rich across the grid (Exhibit 4), as vols grinded slightly higher since early April (Exhibit 9). The vol term structure (1m10y vs 1y10y vol spread) flattened further last week as gamma outperformed intermediates (Exhibit 11). Policy expectations repriced only gradually over the last quarter (Exhibit 13 & Exhibit 14).

Exhibit 3: ATM Normal Volatility Grid

52.1bp for 1y10y volatility

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	34.3	36.0	38.0	42.6	44.5	48.2	49.5
3M	40.9	42.1	43.9	46.2	47.8	50.3	52.5
6M	45.1	47.8	49.4	50.4	51.8	53.0	54.6
1Y	48.8	50.4	50.9	51.2	51.5	52.1	52.7
2Y	53.4	54.1	53.4	52.1	51.3	50.9	51.7
3Y	53.0	52.5	52.0	50.9	50.0	50.0	49.7
4Y	52.7	51.9	50.9	49.6	48.8	48.7	48.6
5Y	52.3	51.7	50.1	49.2	48.0	48.0	47.8
10Y	49.1	48.7	48.1	47.0	46.1	46.4	46.0
30Y	44.9	45.2	45.2	44.6	44.3	44.5	43.7

Source: BofA Global Research

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Exhibit 4: ATM Volatility Grid - 3m Z-Scores

Grid rich on 3m Z-Scores

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	2.5	2.3	2.2	2.0	1.6	1.4	0.8
3M	2.1	1.7	1.8	1.6	0.6	0.6	0.7
6M	1.6	1.5	1.6	1.6	1.4	1.4	1.8
1Y	2.0	2.2	2.3	1.7	1.5	1.7	1.8
2Y	2.3	2.6	2.4	2.1	1.9	1.9	2.1
3Y	2.6	2.4	2.2	2.0	2.1	2.0	2.0
4Y	2.2	2.3	2.2	2.1	2.0	2.2	2.0
5Y	2.0	2.0	1.7	2.0	2.2	2.4	2.0
10Y	2.2	2.2	2.0	1.7	1.8	2.1	2.0
30Y	2.1	2.1	2.0	1.6	1.9	1.9	2.0

Source: R BofA Global Research

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Exhibit 5: ATM Normal Volatility Grid - CoW

Intermediates on the left outperforming over the last week

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-1.1	-1.1	-0.7	1.3	0.4	0.4	0.8
3M	-0.2	-0.1	-0.1	-0.4	-2.4	-2.2	-1.4
6M	-0.3	0.1	0.5	1.1	0.7	0.4	0.5
1Y	1.0	1.6	1.7	0.7	0.9	0.4	0.6
2Y	2.7	3.2	2.8	1.9	1.2	1.0	1.0
3Y	2.3	2.2	2.4	1.7	1.2	1.1	0.9
4Y	2.1	2.0	1.8	1.3	1.2	1.2	0.9
5Y	1.8	1.8	1.2	1.2	1.2	1.3	0.8
10Y	0.5	0.7	0.6	0.5	0.5	0.7	0.4
30Y	0.6	0.7	0.6	0.4	0.4	0.5	0.5

Source: BofA Global Research

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Exhibit 6: ATM Straddle Premiums (indicative only)

3.9% straddle premiums for 1y10y

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	0.08%	0.17%	0.3%	0.5%	0.7%	1.1%	2.8%
3M	0.16%	0.34%	0.5%	0.9%	1.3%	1.9%	4.9%
6M	0.26%	0.54%	0.8%	1.4%	2.0%	2.8%	7.2%
1Y	0.39%	0.80%	1.2%	2.0%	2.8%	3.9%	9.6%
2Y	0.6%	1.2%	1.8%	2.8%	3.8%	5.3%	13.2%
3Y	0.7%	1.4%	2.1%	3.4%	4.5%	6.3%	15.3%
4Y	0.8%	1.6%	2.3%	3.7%	5.0%	7.0%	17.0%
5Y	0.9%	1.8%	2.5%	4.1%	5.5%	7.6%	18.4%
10Y	1.1%	2.2%	3.2%	5.0%	6.8%	9.4%	22.9%
30Y	1.1%	2.2%	3.3%	5.3%	7.3%	10.1%	25.2%

Source: BofA Global Research

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Exhibit 7: Changes in the JP vol grid year-to-date

Outperformance of ULC on BoJ policy tightening expectations, but underperformance broadly elsewhere particularly in the URC...

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	4.1	-8.2	-13.4	-18.0	-17.8	-15.3	-13.6
3M	2.2	-3.6	-6.8	-13.0	-12.5	-12.0	-9.2
6M	2.7	0.0	-2.1	-8.5	-7.8	-9.3	-7.9
1Y	-0.9	-2.6	-3.3	-5.2	-5.9	-6.8	-7.1
2Y	-0.4	0.1	-0.5	-2.3	-3.1	-4.4	-4.5
3Y	-2.9	-3.0	-2.4	-3.2	-2.9	-2.6	-4.0
4Y	-4.5	-4.0	-4.1	-2.7	-1.9	-1.9	-1.7
5Y	-4.2	-4.6	-5.2	-2.6	-1.6	-0.8	-1.0
10Y	-4.6	-3.8	-2.3	-0.9	0.7	1.0	0.7
15Y	-0.7	1.0	1.4	1.3	2.0	2.8	2.7
30Y	-0.7	0.3	1.2	2.0	2.6	3.2	3.8

Source: BofA Global Research

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Exhibit 8: Changes in the US vol grid year-to-date

... while on the US grid ULC repriced materially lower on Fed easing expectations, even if the URC and longer expiries stayed supported

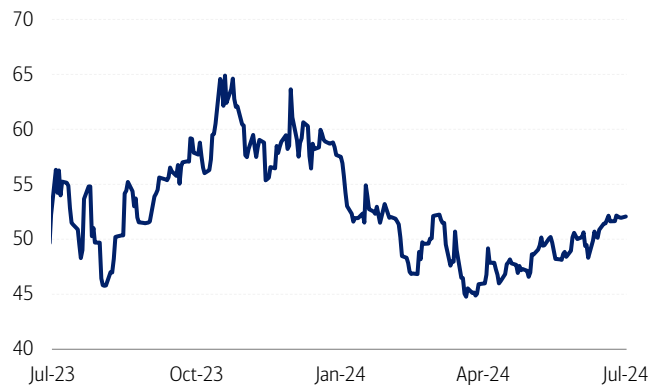
	1y	2y	3y	5y	7y	10y	30y
1m	-32.8	-27.6	-27.9	-21.7	-17.7	-14.5	-4.2
3m	-31.5	-27.1	-23.9	-21.2	-18.2	-16.1	-6.0
6m	-26.4	-18.6	-17.0	-13.9	-11.3	-9.0	-0.1
1y	-14.8	-10.9	-12.2	-7.0	-4.8	-2.9	3.7
2y	-3.9	-3.2	-3.7	-2.4	-0.9	0.5	6.2
3y	-1.3	-1.6	-1.9	0.2	1.9	3.4	8.5
4y	0.3	0.3	0.4	2.7	3.7	5.0	9.8
5y	1.2	1.8	2.2	3.7	4.5	5.9	10.7
10y	6.7	6.2	7.1	8.4	8.5	6.7	7.1
15y	8.1	8.0	8.6	8.6	8.8	8.1	8.6
30y	7.8	7.9	7.7	7.7	7.5	7.8	7.7

Source: BofA Global Research

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Exhibit 9: 1y10y volatility

Current level 52bp, grinding higher since early April



Source: BofA Global Research; Bloomberg

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Exhibit 10: 3m10y vs. 3m2y Normal Volatility

Right side underperforming vs left since mid-Jan

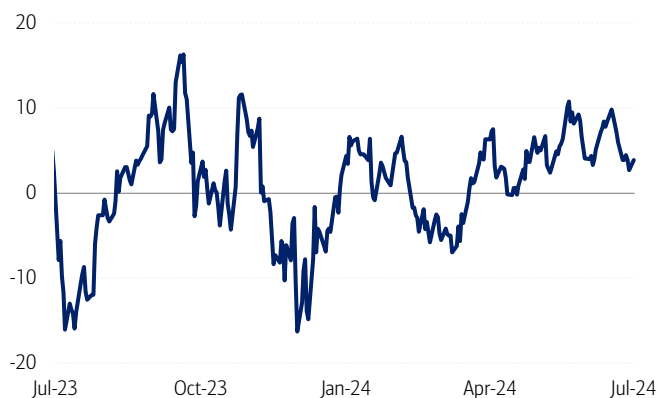


Source: BofA Global Research; Bloomberg

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Exhibit 11: 1y10y vs. 1m10y Normal Volatility

Vol term structure flattened slightly over the last week

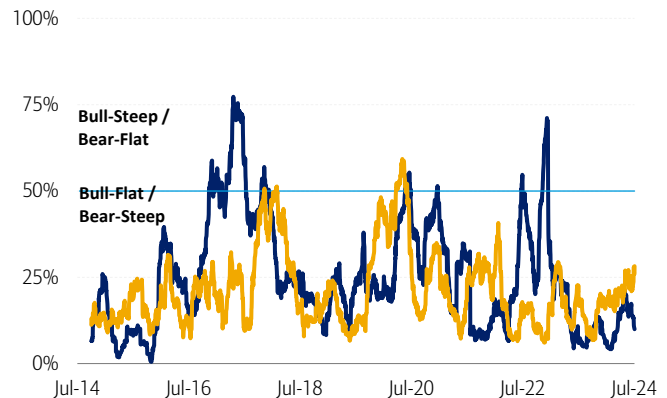


Source: BofA Global Research; Bloomberg

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Exhibit 12: 2s10s (blue) and 5s30s (orange) curve directionality

Frontend far from levels that reflect un-anchoring, belly starting to move...

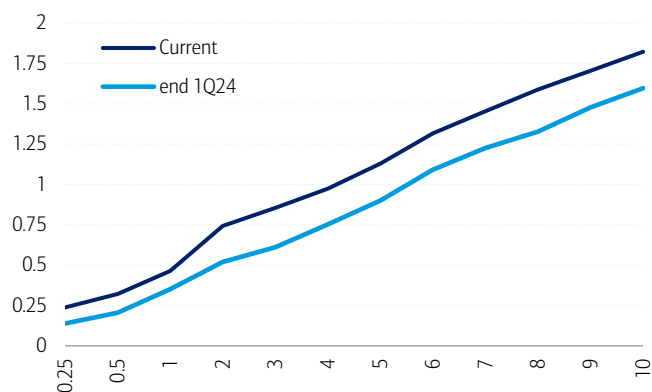


Source: BofA Global research

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Exhibit 13: Gradual repricing of BoJ policy trajectory in 3m OIS fwds

Market pricing a very gradual increase of policy rates to c.1.1-1.15% over the next 5y, and c.1.8-1.85% over the next 10y (+10-20bp over the last quarter)

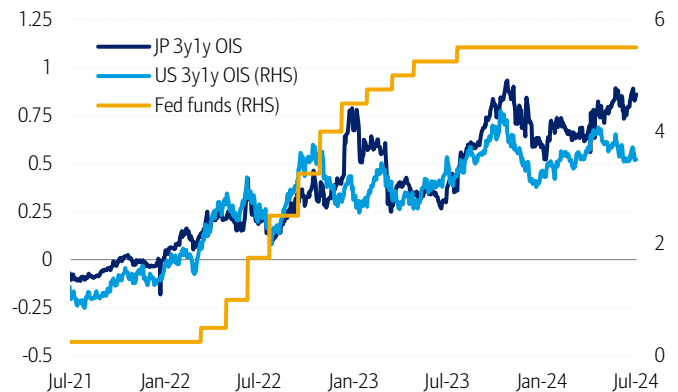


Source: BofA Global Research

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Exhibit 14: JP vs US 3y1y OIS rates

US 3y1y OIS rates converged c.2% before the first hike, and 2.75% before the second hike of the cycle. JP 3y1y OIS anchored sub-1%



Source: BofA Global Research; Bloomberg

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Volatility grid relative value

Grid looks fair/cheap for short gamma in the belly, fair/rich for intermediates (Exhibit 15 & Exhibit 17). However, on Z-Scores the grid looks broadly rich when we consider the directionality of ATM vol levels with the forwards (Exhibit 16 & Exhibit 18).

PCA Z-SCORES

Exhibit 15: 3m Z-Scores w/ PCA framework

Grid fair/cheap for short gamma in the belly, fair/rich for intermediates on the left side

	1y	2y	3y	5y	7y	10y	30y
3m	0.0	-0.7	-0.4	0.2	-1.9	-3.3	0.7
6m	-2.7	-3.1	-2.2	1.0	0.0	-0.1	1.7
1y	0.5	1.2	1.5	0.6	-0.3	-0.2	0.8
2y	2.9	3.7	3.1	1.2	0.1	0.6	0.9
5y	1.9	0.9	-0.4	0.0	0.9	1.5	0.1
10y	0.3	1.0	-0.1	-0.9	-0.7	0.3	-0.6

Source: BofA Global Research

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Exhibit 17: 6m Z-Scores w/ PCA framework

Grid fair/cheap for short gamma in the belly extending out to intermediates

	1y	2y	3y	5y	7y	10y	30y
3m	1.1	-0.2	0.2	0.9	-2.1	-1.3	0.9
6m	-0.9	-3.1	-2.4	-0.5	-0.9	-0.3	0.8
1y	0.0	0.7	0.9	-1.1	-1.9	-0.4	-0.9
2y	1.3	2.2	2.0	0.1	-1.2	0.8	1.1
5y	0.0	0.7	-0.1	-0.1	0.3	0.9	0.2
10y	0.0	0.5	1.0	0.0	0.0	0.7	0.4

Source: BofA Global Research

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Exhibit 19: 1y Z-Scores w/ PCA framework

Grid fair/cheap for short gamma in the belly, fair rich for intermediates

	1y	2y	3y	5y	7y	10y	30y
3m	2.1	0.5	-0.7	-1.5	-1.4	0.9	-0.3
6m	0.2	1.0	1.3	-0.9	-0.5	1.9	0.3
1y	-0.1	0.6	0.7	0.0	-0.4	1.8	0.3
2y	0.8	1.9	1.6	1.2	-0.2	0.1	0.2
5y	-1.5	-0.5	-2.3	-0.3	-1.1	-0.3	-0.2
10y	-1.3	-1.0	-0.9	-0.7	-0.4	0.3	0.3

Source: BofA Global Research

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Exhibit 16: 3m Z-Scores w/ PCA framework w/o rates directionality

Grid looks broadly rich when the directionality of vol with rates is considered, particularly on the left

	1y	2y	3y	5y	7y	10y	30y
3m	2.2	1.8	1.6	1.0	0.0	0.2	0.8
6m	1.3	1.2	1.3	1.2	0.8	0.9	1.5
1y	1.9	2.1	2.3	1.3	1.0	1.3	1.4
2y	2.6	3.1	2.8	2.1	1.6	1.6	1.9
5y	2.5	2.7	1.9	2.1	2.2	2.4	1.9
10y	1.9	2.1	1.9	1.5	1.7	2.1	2.1

Source: BofA Global Research

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Exhibit 18: 6m Z-Scores w/ PCA framework w/o rates directionality

Grid looks broadly rich when the directionality of vol with rates is considered, particularly on the left

	1y	2y	3y	5y	7y	10y	30y
3m	1.9	1.4	1.2	0.6	0.2	0.3	0.6
6m	1.4	1.4	1.4	1.1	1.0	1.1	1.6
1y	2.1	2.3	2.2	1.4	1.2	1.4	1.3
2y	2.7	3.0	2.6	2.0	1.7	1.7	1.9
5y	1.7	1.9	1.4	1.6	1.8	2.1	1.8
10y	1.5	1.8	1.9	1.6	1.9	2.3	1.9

Source: BofA Global Research

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Exhibit 20: 1y Z-Scores w/ PCA framework w/o rates directionality

Grid looks broadly rich when the directionality of vol with rates is considered, particularly on the left

	1y	2y	3y	5y	7y	10y	30y
3m	1.3	0.6	0.2	-0.2	-0.2	0.1	-0.1
6m	1.0	1.0	0.9	0.2	0.3	0.5	0.3
1y	1.0	1.2	1.1	0.6	0.5	0.7	0.5
2y	1.3	1.6	1.4	1.1	0.8	0.7	0.6
5y	0.5	0.6	0.2	0.8	0.4	0.8	0.7
10y	0.0	0.1	0.3	0.5	0.7	1.1	1.0

Source: BofA Global Research

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Skew relative value

Receiver skew trades under payer skew broadly across the grid (Exhibit 19 & Exhibit 23 and Exhibit 26), but looks cheap on Z-Scores (Exhibit 28). Payer skew looks cheap on Z-Scores (Exhibit 22), particularly when directionality with ATM and forwards is considered (Exhibit 24). Receiver skew looks rich on Z-Scores (Exhibit 25).

Exhibit 21: Skew 25% delta

Rich receiver skew for intermediates and longer expiries on the right

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	-1.9	-1.9	-1.9	-1.9	-1.6	-1.3	-0.7
3M	-3.8	-3.7	-3.6	-3.3	-2.9	-2.3	-1.4
6M	-5.9	-5.5	-5.3	-4.7	-4.1	-3.2	-2.1
1Y	-7.2	-6.8	-6.3	-5.4	-4.6	-3.8	-2.5
2Y	-9.4	-8.8	-8.0	-6.7	-5.8	-4.8	-3.2
5Y	-9.5	-9.0	-8.3	-7.1	-6.3	-5.5	-3.8
10Y	-7.7	-7.4	-7.0	-6.2	-5.8	-5.5	-3.9
30Y	-5.5	-5.4	-5.1	-4.6	-4.4	-4.1	-3.5

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 22: Skew 75% delta

Cheap payer skew broadly on the grid

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	2.3	2.4	2.4	2.2	2.0	1.7	1.1
3M	4.7	4.6	4.4	4.2	3.9	3.3	2.4
6M	6.7	6.8	6.5	5.8	5.1	4.2	3.1
1Y	8.9	8.2	7.6	6.5	5.8	4.8	3.6
2Y	11.9	11.0	9.9	8.3	7.3	6.3	5.0
5Y	13.2	12.2	10.9	9.3	8.3	7.6	6.1
10Y	12.1	11.6	10.9	9.9	9.1	8.5	6.9
30Y	13.9	13.7	13.4	12.9	12.4	12.1	10.5

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 23: Breakeven Widths for Costless Receiver Ladders

47bp breakeven width for 1y10y receiver ladders

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	9	10	11	12	13	14	15
3M	18	19	20	21	22	24	26
6M	27	29	30	31	33	35	37
1Y	39	41	43	44	45	47	50
2Y	58	60	61	61	62	63	67
5Y	88	88	87	89	88	90	95
10Y	120	120	120	120	120	122	127

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 24: Breakeven Widths for Costless Payer Ladders

64bp breakeven width for 1y10y payer ladders

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	12	13	14	15	15	16	16
3M	27	27	28	29	29	30	30
6M	45	47	47	46	45	45	44
1Y	74	73	71	68	65	64	61
2Y	130	123	116	105	100	94	90
5Y	221	208	189	171	159	153	140
10Y	289	279	266	247	233	224	204

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 25: 3m Z-Score Receiver Skew (w/o fwds & ATM direction)

Receivers fair/rich, with richness more evident on the right

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

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 26: 3m Z-Score Payer Skew (w/o direction w/ fwds & ATM)

Payers broadly fair/cheap on the grid

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	0.9	1.0	1.0	0.6	0.4	0.5	0.7
3M	-0.4	-0.1	-0.4	-1.1	-0.5	-0.3	0.3
6M	-0.4	-0.6	-0.8	-0.8	-0.8	-0.4	0.6
1Y	0.1	-0.4	-0.5	-0.8	-0.5	-0.5	0.3
2Y	-0.8	-1.4	-1.2	-1.3	-1.2	-1.1	-0.2
5Y	-1.8	-2.0	-2.0	-1.5	-1.2	-0.3	-0.5
10Y	-0.1	-0.2	-0.8	-2.0	-1.5	0.2	-0.8

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 27: Ratio of Payer/Receiver BE widths for Costless Ladders

Ratios of breakeven widths > 100% across the grid, particularly LLC

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	135%	131%	128%	123%	118%	113%	107%
3M	147%	145%	140%	135%	129%	123%	115%
6M	169%	162%	156%	147%	137%	130%	119%
1Y	189%	176%	167%	154%	146%	136%	123%
2Y	223%	206%	192%	172%	162%	149%	134%
5Y	251%	235%	216%	192%	181%	170%	148%
10Y	241%	232%	221%	206%	195%	184%	160%

Source: BofA Global Research

BoFA GLOBAL RESEARCH

Exhibit 28: 3m Z-Score Ratio of Payer/Receiver Skew

Z-Scores show payer skew broadly cheap vs receivers

	1Y	2Y	3Y	5Y	7Y	10Y	30Y
1M	2.1	0.7	-0.3	-1.6	-1.9	-1.9	-2.0
3M	-1.9	-1.7	-2.9	-2.3	-3.2	-2.6	-2.3
6M	-3.0	-3.2	-3.1	-3.2	-3.3	-2.4	-2.0
1Y	-2.3	-3.0	-2.9	-3.0	-2.6	-2.8	-2.6
2Y	-2.3	-2.6	-2.9	-2.9	-2.8	-3.5	-2.4
5Y	-2.5	-2.9	-2.8	-3.0	-2.8	-2.3	-2.3
10Y	-1.8	-2.2	-2.2	-2.7	-2.3	-1.7	-2.1

Source: BofA Global Research

BoFA GLOBAL RESEARCH



Conditional curve trades

Rich vol for short expiries on the right vs left side drives give-ups to forwards on costless conditional bull-flatteners and bear-steepeners (which usually position for curve moves driven by shifting fundamentals), and pick-ups in bull-steepeners and bear-flatteners (BoJ driven moves).

Exhibit 29: 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	-1.7	-3.2	-4.4	-1.7	-2.4	-0.9
6M	-1.3	-2.8	-3.8	-1.3	-2.2	-0.9
1Y	-0.5	-1.3	-1.7	-0.7	-1.1	-0.5
1.5Y	1.3	1.1	0.3	-0.1	-1.1	-0.9
2Y	1.9	3.0	2.4	1.3	0.5	-0.9

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 30: 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	-4.2	-9.7	-13.6	-4.8	-8.1	-2.8
6M	-3.2	-7.3	-10.4	-3.6	-6.5	-2.4
1Y	-2.1	-4.4	-6.3	-2.2	-4.0	-1.7
1.5Y	0.3	-1.1	-3.6	-1.7	-4.0	-2.4
2Y	1.1	1.5	-0.7	0.3	-1.9	-2.2

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 31: 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	1.7	3.2	4.4	1.7	2.4	0.9
6M	1.3	2.8	3.8	1.3	2.2	0.9
1Y	0.5	1.3	1.7	0.7	1.1	0.5
1.5Y	-1.3	-1.1	-0.3	0.1	1.1	0.9
2Y	-1.9	-3.0	-2.4	-1.3	-0.5	0.9

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 32: 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	4.2	9.7	13.6	4.8	8.1	2.8
6M	3.2	7.3	10.4	3.6	6.5	2.4
1Y	2.1	4.4	6.3	2.2	4.0	1.7
1.5Y	-0.3	1.1	3.6	1.7	4.0	2.4
2Y	-1.1	-1.5	0.7	-0.3	1.9	2.2

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 33: 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	2.1	3.8	4.8	1.9	2.8	0.9
6M	1.9	3.4	4.4	1.7	2.6	1.1
1Y	0.7	1.5	2.1	0.9	1.3	0.5
1.5Y	-1.7	-1.5	-0.3	0.3	1.5	1.1
2Y	-2.6	-4.0	-2.8	-1.7	-0.5	1.1

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 34: 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	2.6	4.8	5.2	2.1	2.6	0.5
6M	1.3	2.1	2.4	0.7	1.1	0.5
1Y	-0.7	-1.3	-1.5	-0.5	-0.9	-0.3
1.5Y	-4.4	-5.6	-5.0	-1.5	-0.9	0.3
2Y	-5.6	-8.9	-8.3	-3.6	-3.4	0.1

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 35: 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	-2.1	-3.8	-4.8	-1.9	-2.8	-0.9
6M	-1.9	-3.4	-4.4	-1.7	-2.6	-1.1
1Y	-0.7	-1.5	-2.1	-0.9	-1.3	-0.5
1.5Y	1.7	1.5	0.3	-0.3	-1.5	-1.1
2Y	2.6	4.0	2.8	1.7	0.5	-1.1

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 36: 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	-2.6	-4.8	-5.2	-2.1	-2.6	-0.5
6M	-1.3	-2.1	-2.4	-0.7	-1.1	-0.5
1Y	0.7	1.3	1.5	0.5	0.9	0.3
1.5Y	4.4	5.6	5.0	1.5	0.9	-0.3
2Y	5.6	8.9	8.3	3.6	3.4	-0.1

Source: BofA Global Research

BofA GLOBAL RESEARCH

Forward volatility

6m and 1y forward vols trade rich to ATM vol (>100%) only on the ULC and cheap elsewhere (Exhibit 38 & Exhibit 41). On Z-Scores, however, we see fair/rich levels on the belly and right side for intermediate and longer dates expiries, cheap on the ULC (Exhibit 39 & Exhibit 42).

Exhibit 37: 6m Forward Volatility

48.6bp for 6m fwd 1y10y

	1y	2y	5y	10y	30y
1m	48.5	46.3	49.2	49.7	48.5
3m	47.5	45.9	48.7	49.3	48.2
6m	49.3	50.4	50.6	50.7	50.7
1y	47.6	50.3	48.5	48.6	50.1
2y	50.0	50.7	48.9	48.1	48.9
5y	46.5	46.4	44.8	44.5	45.7
10y	42.8	42.8	42.0	42.2	43.7

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 38: 6m Fwd vol as % ATM

93% of ATM for 6m fwd 1y10y

	1y	2y	5y	10y	30y
1m	141%	129%	115%	103%	98%
3m	116%	109%	105%	98%	92%
6m	109%	105%	100%	96%	93%
1y	98%	100%	95%	93%	95%
2y	94%	94%	94%	94%	94%
5y	89%	90%	91%	93%	96%
10y	87%	88%	89%	91%	95%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 39: 3m Z-Score 6m Fwd vol % ATM

1.9 Z-Score for 6m fwd 1y10y

	1y	2y	5y	10y	30y
1m	-1.9	-1.7	-0.9	-0.6	-0.6
3m	-1.2	-0.9	0.1	1.0	-0.7
6m	-0.8	-0.1	0.7	1.3	0.0
1y	0.9	1.3	2.0	1.9	1.5
2y	-0.3	-0.2	1.5	1.9	0.6
5y	2.0	2.2	2.3	2.0	1.3
10y	1.6	1.8	1.6	1.3	1.4

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 40: 1y Forward Volatility

49.2bp for 1y fwd 1y10y

	1y	2y	5y	10y	30y
1m	49.2	51.8	46.9	46.4	48.8
3m	51.0	53.5	48.3	47.9	50.2
6m	50.6	53.3	48.4	48.1	50.5
1y	52.7	54.5	51.5	49.2	50.8
2y	50.7	50.3	48.6	47.7	47.9
5y	46.3	46.7	44.8	44.3	45.5
10y	42.8	42.8	42.0	42.2	43.4

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 41: 1y Fwd vol as % ATM

94% of ATM for 1y fwd 1y10y

	1y	2y	5y	10y	30y
1m	143%	144%	110%	96%	99%
3m	125%	127%	104%	95%	96%
6m	112%	112%	96%	91%	92%
1y	108%	108%	101%	94%	97%
2y	95%	93%	93%	94%	93%
5y	88%	90%	91%	92%	95%
10y	87%	88%	89%	91%	94%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 42: 3m Z-Score 1y Fwd vol % ATM

1.9 Z-Score for 1y fwd 1y10y

	1y	2y	5y	10y	30y
1m	-2.2	-1.6	-0.8	-0.8	0.0
3m	-1.5	-0.1	2.2	2.2	1.8
6m	-0.5	0.6	2.0	1.9	1.6
1y	0.8	1.9	2.8	1.9	1.9
2y	-0.4	-1.1	1.4	1.9	0.5
5y	1.9	2.2	2.0	1.7	1.4
10y	1.6	1.8	1.4	1.4	1.5

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 43: 2y Forward Volatility

49.0bp for 2y fwd 1y10y

	1y	2y	5y	10y	30y
1m	50.1	49.2	49.5	49.3	46.2
3m	50.2	49.6	49.6	49.2	46.3
6m	50.1	50.0	49.9	49.5	46.6
1y	47.3	49.4	49.4	49.0	46.4
2y	50.7	49.7	47.8	46.9	45.6
5y	46.0	46.8	44.6	43.8	44.0
10y	43.0	43.1	42.0	41.9	42.9

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 44: 2y Fwd vol as % ATM

94% of ATM for 2y fwd 1y10y

	1y	2y	5y	10y	30y
1m	146%	137%	116%	102%	93%
3m	123%	118%	107%	98%	88%
6m	111%	105%	99%	93%	85%
1y	97%	98%	97%	94%	88%
2y	95%	92%	92%	92%	88%
5y	88%	90%	91%	91%	92%
10y	88%	88%	89%	90%	93%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 45: 3m Z-Score 2y Fwd vol % ATM

1.7 Z-Score for 2y fwd 1y10y

	1y	2y	5y	10y	30y
1m	-2.2	-2.2	-1.1	-0.3	-0.4
3m	-1.9	-1.6	1.2	2.3	0.4
6m	-1.4	-1.3	0.5	1.7	0.0
1y	-1.9	-1.9	0.6	1.7	-0.1
2y	-1.4	-1.6	-0.1	1.5	-0.8
5y	1.0	1.5	1.5	0.9	0.1
10y	1.3	1.4	0.6	0.9	0.0

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 46: 3y Forward Volatility

46.9bp for 3y fwd 1y10y

	1y	2y	5y	10y	30y
1m	55.0	53.2	49.6	47.9	46.8
3m	54.5	52.1	48.8	47.1	46.1
6m	54.5	52.5	49.2	47.5	46.5
1y	51.9	51.3	48.6	46.9	46.2
2y	51.3	51.8	49.0	46.5	45.4
5y	47.8	49.3	44.6	44.3	43.6
10y	43.1	43.5	42.4	42.5	42.9

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 47: 3y Fwd vol as % ATM

90% of ATM for 3y fwd 1y10y

	1y	2y	5y	10y	30y
1m	160%	148%	116%	99%	94%
3m	133%	124%	106%	94%	88%
6m	121%	110%	98%	90%	85%
1y	106%	102%	95%	90%	88%
2y	96%	96%	94%	91%	88%
5y	91%	95%	91%	92%	91%
10y	88%	89%	90%	92%	93%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 48: 3m Z-Score 3y Fwd vol % ATM

0.8 Z-Score for 3y fwd 1y10y

	1y	2y	5y	10y	30y
1m	-2.1	-1.7	-1.5	-0.3	0.1
3m	-1.9	-1.3	-0.5	2.0	0.8
6m	-1.1	-0.9	-0.6	1.1	0.5
1y	-0.6	-1.4	-0.8	0.8	0.5
2y	-1.5	-1.3	-1.0	1.1	-0.3
5y	-0.2	0.2	0.6	0.6	0.5
10y	1.4	1.6	0.8	1.4	0.8

Source: BofA Global Research

BofA GLOBAL RESEARCH



Ratios implied/delivered

Ratios of implied to delivered vol show rich implieds across the grid, but more significantly on the left side (Exhibit 48 & Exhibit 50). However, on 3m Z-Scores, we see implieds broadly fair/cheap to delivereds (Exhibit 51 & Exhibit 52).

Exhibit 49: Implied vs. Delivered (21d) Ratio

Ratios of Implied to 21d deliv. >100% across, richer on the left

	1y	2y	3y	5y	7y	10y	30y
1m	162%	129%	123%	123%	122%	128%	126%
3m	177%	142%	138%	131%	130%	134%	133%
6m	162%	146%	144%	138%	137%	138%	137%
1y	142%	140%	138%	133%	132%	132%	130%
2y	141%	140%	135%	129%	126%	125%	126%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 50: Implied vs. Delivered (63d) Ratio

Ratios of Implied to 63d deliv. >100 across, richer on the left

	1y	2y	3y	5y	7y	10y	30y
1m	186%	151%	143%	136%	127%	129%	126%
3m	197%	165%	157%	142%	134%	133%	133%
6m	186%	170%	164%	148%	141%	137%	137%
1y	168%	163%	155%	141%	134%	131%	131%
2y	160%	154%	145%	131%	124%	123%	125%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 51: 3m Z-Scores for Implied vs. Delivered (21d) Ratio

Z-Scores of ratios of implied/21d deliv. fair/cheap on the left

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

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 52: 3m Z-Scores for Implied vs. Delivered (63d) Ratio

Z-Scores for ratios of implied/63d deliv. fair/cheap in the belly

	1y	2y	3y	5y	7y	10y	30y
1m	0.8	-0.1	-0.3	-0.6	-0.7	-0.4	-0.2
3m	0.5	-0.5	-0.7	-1.3	-1.4	-1.3	-0.6
6m	-0.7	-0.8	-0.7	-1.0	-1.0	-0.9	-0.2
1y	-1.0	-0.8	-0.8	-1.0	-0.9	-0.8	-0.2
2y	-0.6	-0.4	-0.5	-0.6	-0.6	-0.5	0.2

Source: BofA Global Research

BofA GLOBAL RESEARCH

Notes

Exhibit 12: 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 15/17/19: 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 16/18/20: 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 23/24 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 25/26: 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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