Liquid Insight

Volatility market suddenly attracts attention

Bank of America Merrill Lynch

08 August 2019

Rates and Currencies Research
Global

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Key takeaways

- Principal component analysis, which compresses data, is an effective means of grasping rate volatility with many variables.
- Prices reflect hedging against the BoJ cutting interest rates more negative, as well as investor demand for duration.
- While we agree with investor demand for duration, we do not expect the BoJ to cut interest rates now, but its risk has risen.

By Shuichi Ohsaki

Chart of the day: Interest rate swaption volatility surface

Tenors of the underlying interest rate swaps (columns); option maturities (rows)

Norm. Vol	1Y	2Y	3Y	4Y	5Y	7Y	10Y	12Y	15Y	20Y
1M	14.8	15.4	16.0	16.7	17.4	18.5	19.7	21.3	23.5	27.9
3M	13.7	14.1	14.7	15.2	16.0	17.2	18.5	20.0	22.1	26.1
6M	13.7	13.9	14.2	14.8	15.4	16.6	17.9	19.3	21.2	25.4
9M	13.8	13.9	14.1	14.6	15.1	16.4	17.8	19.2	21.0	25.1
1Y	14.0	14.0	14.1	14.4	14.8	16.3	17.8	19.2	21.0	25.0
18M	13.8	14.3	14.4	14.3	15.2	17.3	18.7	19.9	21.5	25.9
2Y	14.7	14.8	14.9	15.3	15.8	17.3	18.9	20.0	21.6	25.5
3Y	15.3	15.5	16.0	16.5	17.2	18.4	20.3	21.2	22.5	26.2
4Y	16.1	16.5	17.1	17.8	18.6	19.6	21.4	22.2	23.5	26.8
5Y	17.1	17.6	18.2	19.0	19.9	20.8	22.6	23.4	24.6	27.5
10Y	23.5	23.8	24.1	24.5	25.0	25.7	27.3	27.8	28.5	30.2
15Y	27.0	27.1	27.3	27.5	27.7	28.2	29.6	30.0	30.8	32.1
20Y	29.2	29.2	29.3	29.4	29.6	30.1	31.0	31.5	32.3	33.3

Source: BofA Merrill Lynch Global Research

Volatility market suddenly attracts attention

Under the Bank of Japan (BoJ)'s powerful monetary easing policy, the yen rates market has been characterized by low yields and low volatility for a considerable time. Against this background, Nippon Life Insurance made clear in its FY18 earnings materials that it held receiver swaptions of ¥500bn notional (maybe long tenor). On the other hand, with numerous central banks taking a more dovish stance, some thought the BoJ might push interest rates further into negative territory, and some are also hedging with short tenor swaptions. While the yen rates market is becoming less of a talking point, the interest rate swaption market is suddenly attracting attention. We use principal component analysis (PCA) and other means to survey yen rate volatility and check on recent supply-demand conditions.

Refer to important disclosures on page 7 to 8.
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Yen rates volatility

Principal component analysis and the volatility surface

When surveying the interest rate swaption market, one bothersome issue is the large number of variables. In yield curve analysis, the object of analysis is one-dimensional curve movements representing the yields on each tenor. In analyzing interest rate swaption volatility, we have to analyze at least two-dimensional volatility surface with tenors of the underlying interest rate swaps and option maturities. Including volatility for each strike further, we have to deal with a three-dimensional volatility cube. However, the volatilities at each point do not move independently, but are linked to one another as they move. When trying to grasp those movements, it can be effective to concentrate information in a small number of variables and then carry out the analysis. We will survey volatility through principal component analysis (PCA). The objects of this analysis are 13 option maturity points (1M, 3M, 6M, 9M, 1Y, 18M, 2Y, 3Y, 4Y, 5Y, 10Y, 15Y, and 20Y) and 10 tenor points (1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 12Y, 15Y, and 20Y), for total 130 (= 13 x 10) points surface of ATM normal volatilities (Chart of the day). Two years of data are used in this analysis.

Top components

The top three principal components can be roughly interpreted as shown in Table 1. These three principal components can explain over 90% of the movements of the 130 variables.

Table 1: Top three principal components and their explanatory power

		Higher score	Explanatory power	Cumulative explanatory power
PC1	Volatility level	Volatility rises	57.4%	57.4%
PC2	Slope in option maturity direction	Short (long) maturity volatility rises (declines) Upper (lower) surface is rich (cheap)	25.8%	83.2%
PC3	Slope in tenor direction	Short (long) tenor volatility rises (declines) Left side (right side) of surface is rich (cheap)	8.9%	92.1%

Source: BofA Merrill Lynch Global Research

- 1st principal component (PC1)

  This component expresses the level of volatility. A higher PC1 score means volatility is higher over the entire surface. This explains 57.4% of the volatility surface's movement.

- 2nd principal component (PC2)

  This component expresses volatility moves arising from differences in option maturities. A higher PC2 score means volatility is higher for options with shorter maturities and lower for options with longer maturities. This shows the volatility surface's slope in the vertical direction. Explanatory power is 25.8%.

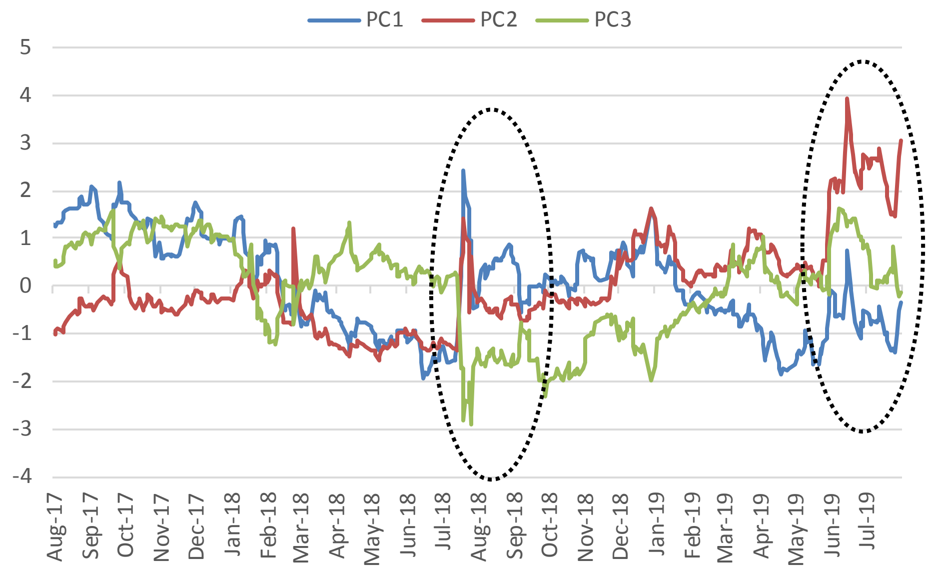
- 3rd principal component (PC3)

  This component expresses volatility moves arising from differences in tenors. A higher PC3 score means volatility is higher for short tenors and lower for long tenors. This shows the volatility surface's slope in the horizontal direction. Explanatory power is 8.9%.

PC scores

Chart 1 shows PC1 to PC3 scores. Looking at two examples, we will consider the relationship between principal component scores and moves in the volatility market.

Chart 1: Principal component scores on the volatility surface



Source: BofA Merrill Lynch Global Research

Note: PC1 shows volatility level, PC2 shows slope in option maturity direction, and PC3 shows slope in tenor direction.

- July 2018

  At its late-July meeting, the BoJ was expected to make adjustments that would encourage steepening of the curve to lessen the side effects of its accommodative policy. In fact, the BoJ did fine tune yield curve control (YCC) (see BoJ review). Reflecting an increase in speculation that volatility would rise in the near future, PC1 and PC2 scores rose. Due to speculation that the curve would steepen, volatility rose in long-tenor sectors and the PC3 score declined.

- June 2019

  As the US-China trade war worsened and the economic outlook became more uncertain, numerous central banks took a more dovish stance. Some market participants expected the BoJ to push short rates further into negative territory in the near future. In response to hedging against such a development, volatility rose on short-maturity and short-tenor points, and PC2 and PC3 scores rose. Although the PC1 score also rose, its ascent was limited. It might be because market participants, unsure whether the BoJ would enact easing policies, hedged against a decline of short-term yields. After that, with the flattening of the curve, the PC3 score declined to about zero (its past average).

This month the US announced it would invoke its fourth round of sanction tariffs against China and designated China as a currency manipulator, fanning concern about US-China conflict. PC1 and PC2 scores are rising again, while the PC3 score remains around zero. Table 2 shows relative values (RV) calculated from fair values based on PC1 movements. Volatility is higher in the upper left (shorter maturity, shorter tail) and upper right (shorter maturity, longer tail) of the table. This could be explained as a result of hedging against the BoJ pushing short rates further into negative territory, as well as demand for superlong-term bonds from life insurers and other investors. The duration of assets held by life insurers has shortened, and demand for duration is probably rising. In particular, that demand tends to strengthen when yields decline (Bond investment by lifers). The curve flattened and the PC3 score declined after an upturn, and this is not unrelated to investors' demand for longer durations. On the other hand, we do not expect the BoJ to cut rates for now. If our view is correct, the richness in short-tenor swaptions should correct, possibly allowing long-tenor swaptions to outperform. But we have to say that the risk of a BoJ rate cut has risen after escalation of the US-China trade war. Volatilities with tenors around 10yr are cheaper, which may be because the YCC long-term yield target is about 0% for the 10yr JGB. However, whether the BoJ can stop 10yr yield declines has attracted attention (Yield decline driven by external environment vs. resistance from BoJ).

Table 2: RV of volatility surface based on PCA (higher volatility in upper left/right)

PC1	1Y	2Y	3Y	4Y	5Y	7Y	10Y	12Y	15Y	20Y
1M	7.06	7.01	6.92	6.87	6.95	6.49	5.83	6.09	6.49	7.66
3M	5.28	5.16	5.10	5.02	5.06	4.46	3.50	3.76	4.14	4.97
6M	4.63	4.42	4.20	4.19	4.08	3.25	1.94	2.18	2.52	3.45
9M	4.30	3.88	3.60	3.49	3.28	2.37	1.09	1.29	1.57	2.56
1Y	3.96	3.44	3.02	2.73	2.39	1.65	0.32	0.56	0.88	1.84
18M	3.25	2.78	2.35	2.02	1.69	0.92	-0.37	-0.13	0.18	1.17
2Y	2.48	2.07	1.63	1.25	0.94	0.14	-1.12	-0.88	-0.57	0.42
3Y	0.87	0.69	0.57	0.35	0.19	-0.55	-1.49	-1.36	-1.17	-0.29
4Y	-0.37	-0.44	-0.43	-0.41	-0.41	-1.18	-1.83	-1.70	-1.53	-0.74
5Y	-1.38	-1.30	-1.35	-1.19	-1.09	-1.57	-1.98	-1.81	-1.58	-0.89
10Y	-2.33	-2.30	-2.32	-2.34	-2.30	-2.32	-1.99	-1.94	-1.85	-1.51
15Y	-2.67	-2.67	-2.69	-2.73	-2.81	-2.90	-2.50	-2.38	-2.19	-1.98
20Y	-3.33	-3.27	-3.32	-3.31	-3.23	-3.12	-3.07	-2.87	-2.58	-2.46

Source: BofA Merrill Lynch Global Research

Note: Vertical axis shows option maturity, horizontal axis shows tenor of interest rate swap.

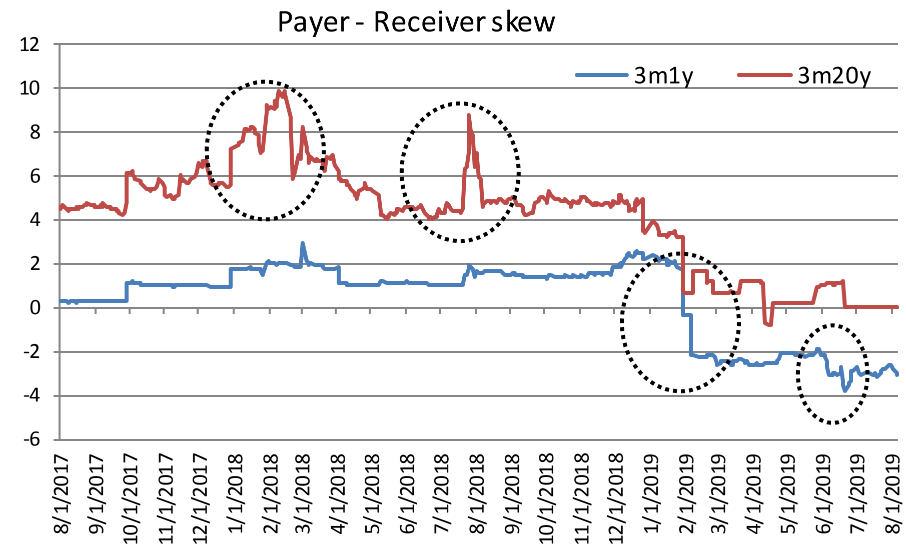
Volatility skew

We have surveyed volatility moves and RV. Still lacking, however, is information on how much the market expects yields to rise or fall. For this reason, it would be good to carry out an analysis including volatility for each strike (volatility cube), but at this point let us take a separate look at volatility skew. Chart 2 shows volatility differences between OTM payer and OTM receiver. This is the same concept as the risk reversal often seen in the currency option market. When the value rises (declines), it can be taken as a sign that investors lean toward expectations of a yield rise (decline).

First let us look at the long-tenor 3M20Y volatility skew. Beginning around the end of December 2017, the 3M20Y payer swaption was noticeably rich. With the concentration of the BoJ's superlong-term JGB purchase operations in the latter half of this month, some market participants took the view that the BoJ would reduce its purchases. Although the BoJ passed up the opportunity to reduce purchases in December, it did reduce purchases of JGBs with remaining maturities over 10yr on 9 January 2018, and the emergence of steepening expectations probably influenced this result (Surprise timing of BoJ's purchasing cutback met with surprise reaction). This was reflected in the PC3 score's decline, but the PC1 score rose only marginally, and PC2 score did not change noticeably (Chart 1). Next, the payer swaption became richer when YCC was fine tuned in July 2018 too, as shown above. This is consistent with increased expectations of a superlong yield upturn.

In contrast, the 3M1Y receiver swaption got richer from late January into February 2019. This was around the time the Fed clearly took a more dovish line due to the increasingly unclear outlook for the global economy. Although the PC1 score, indicating volatility level, did not rise greatly, some market participants constructed speculative hedge positions against the possibility the BoJ would push short-rates deeper into negative territory at the January Monetary Policy Meeting. In June, we see that the receiver swaption got richer.

Chart 2: Volatility skew (OTM payer – OTM receiver)



Source: BofA Merrill Lynch Global Research

Note: Volatility difference = 25delta

Notable Rates and FX Research

- Global Rates, FX & EM 2019 Year Ahead, 18 Nov 2018
- The unknown unknowns just got known, **Global Liquid Markets Weekly**, 5 Aug 2019
- When monetary policy fails, **Global FX Weekly**, 1 Aug 2019
- Divine comedy: inferno, **Global Rates Weekly**, 2 Aug 2019
- Risk off, **Liquid Cross Border Flows**, 5 Aug 2019

Rates, FX & EM trades for 2019

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Global FX Weekly: When monetary policy fails, 1 Aug 2019

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