Tenor Adjustments for a Basis Swap

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1. Introduction

Interest rate swaps (IRS) are powerful tools to transfer the cash flows of assets and liabilities to fix from floating and vice versa. They are also used for transferring the cash flow from one tenor to another, i.e if we have a cash flow at 3 months and we want to convert this cash flow to monthly one, we can use the basis swap to get this done. The valuation methodology for IRS is very well documented in the literature but the value a basis swap we just mentioned is seldom mentioned. The challenges in valuation of a basis swap arise due the presence of credit/liquidity risk to the party which pays the monthly cash flows and receives quarterly payments.

2. Tenor adjustments Methodology for a Basis Swap

Suppose today we are having a USD swap for say 5 years. The swap is Float vs Float, where we pay 3 monthly and receive 1 monthly.

Now the USD base curve is constructed by zero rates (cash rates) for maturity less than 1 year and swap rates (with 3 month exchange) for maturities more than 1 year. We will construct a zero curve by bootstrapping this curve.

In a world where there is "no" credit/liquidity risk

Our payment projections today t_0 will be like this:

1. Using the ZC calculate the 3 months forward rates.
2. The Cash flow at t_n will be equal to (ForwardRate(t_{n-1}/4)*Notional Value of the Swap)

Our receivable projections today t_0 will be like this:

1. Using the ZC calculate the 1 months forward rates.
2. The Cash flow at t_n will be equal to (ForwardRate(t_{n-1}/12)*Notional Value of the Swap)

All the cash flows will be discounted by today's ZC (original) and the value on both the sides will be equal.

In a world where there "is" credit/liquidity risk

The monthly payer will expect sum premium because of holding credit/liquidity risk. For this Market quotes tenor basis adjustment to price credit/liquidity risk.

Our payment projections today t_0 will be like this:

1. Using the ZC calculate the 3 months forward rates.
2. The Cash flow at t_n will be equal to (ForwardRate(t_{n-1}/4)*Notional Value of the Swap)

Our receivable projections today t_0 will be like this:

1. To the par curve add the spreads to the tenors as given by the Market.
2. Extract the ZC from the new par curve
3. Using the new ZC curve calculate the 1 months forward rates.

4. The Cash flow at t_n will be equal to (ForwardRate(t_{n-1}/12)*Notional Value of the Swap)

All the cash flows of the both the sides will be discounted by todays ZC (original). The value difference will show the premium associated with the credit/liquidity risk.

Below is a typical example of USD IRS tenor adjustment. The benchmark rates in USD are 3 months rates. So the premiums are based on them. Incase for some other currency the benchmark rates are for some other tenors then the premiums will be based on them.

ID	NUSD_1M3M	NUSD_3M6M
By Date	Value	Value
1y	-21.55	20.80
2y	-18.58	18.70
3y	-16.27	16.50
4y	-14.39	14.90
5y	-13.01	14.00
6y		13.30
7y	-11.01	13.00
8y		12.70
9y		12.50
10y	-8.13	12.30
12y		12.10
15y		11.80
20y		11.60
25y		11.50
30y		11.40
Term		

Date: 05/15/2012

Suppose today is 05/15/2012, then

1) **Suppose we pay 1 monthly and receive 3 monthly**, to project "our" cash-flows the par curve will be adjusted by the tenors shown in red circle. The spreads of the tenors which are not given and also for the shorter maturities will be interpolated. The methodology of interpolated will be decided by the judgment of the management. NO adjustment will be made to the curve to project the receivable cash flows

2) **Suppose we pay 6 monthly and receive 3 monthly**, to project "our" cash-flows the par curve will be adjusted by the tenors shown in green circle. The spreads of the tenors which are not given and also for the shorter maturities will be interpolated. The methodology of interpolated will be decided by the judgment of the management. NO adjustment will be made to the curve to project the receivable cash flows.

3) **Suppose we pay 6 monthly and receive 1 monthly**, to project
   a. **Payer cash-flow:** We will add the spreads in green circle to the par curve similar to step 2.
   b. **Receiver cash-**flow: We will add the spreads in red circle to the par curve similar to the step 1.
   c. We will discount the cash flows of both the legs by today's ZC (original). The difference will represent the credit/liquidity risk premium.

3. Why this tenor spread so important?

Courtesy Bloomberg

If you see the spreads in 1m3m USD spread, they were almost .25 bps before 2008 primarily because of liquidity concerns. But during the credit crunch/liquidity crises (2008) the spreads reached up to 41 bps which include credit risk associated with the counterparty. The episodes of Bear Sterns and Lehman have generated an obvious fear among the financial institutions regarding their receivables.

4. Conclusion

We describe and discuss the valuation of basis swap. The challenge arises due the presence of credit/liquidity risk to the party which pays coupons in advance and receives the coupons after some time. It is obvious for that party to expect some premium for carrying the credit/liquidity risk against its counterparty. We present the basic methodology which is followed by the market in general to price that market risk.

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