IRS, FRA, Currency swap. FX. Forward swap. IAR. Off-market. Arrears. Basis. CMS. Corridor. Diff. MTM

IRS and currency swap

In an interest rate swap (IRS) cash flows are denominated in the same currency. An interest swap does not involve an exchange of principal. The two parties arrange to make periodic exchanges of cash flows based on a common national principal and two separate interest rates, one that remains fixed and one that is reset (floating rate). All settlements are made on a net basis.

In a currency swap (cross-currency swap) the cash flows are expressed in different monetary units. The principal amounts are usually traded at the inception and maturity of a currency swap.

Terms of the swap transaction

1. notional principal,
2. floating rate and reference dates,
3. fixed rate,
4. settlement dates,
5. collateral,
6. currencies.

Long and Short Position

The two parties to the transaction are referred to as the pay-fixed and receive-fixed.
The fixed-rate payer is said to have "bought" the swap or taken the long position. The fixed-rate receiver is said to have "sold", or taken the short position. The floating rate is treated as the "commodity" that the two parties are trading.

Payments

Fixed-rate payments are usually calculated using "actual/365" convention. The day-count convention for the swap floating rate-payments is usually "actual/360". Under these conditions the formulas for the settlement calculations are following:

(1) $$OS_t = s * \frac{p_t}{365} * K$$

(2) $$OZ_t = LIBOR_{t-1} * \frac{p_t}{360} * K$$

where
OS_t - fixed rate payment,
OZ_t - floating-rate payment,
s - swap fixed rate, SFR,
$LIBOR_{t-1}$ – floating rate LIBOR at date t-1,
p_t – number of days in period t,
t - period,
K - notional principal, NP.

Nonplain vanilla swap designs

1. forward swap
2. IAR
3. off-market
4. arrears
5. floating-floating
6. CMS
7. corridor
8. diff
9. MTM
10. equity swap
11. commodity swap

Swap as a derivative instrument

Swap can be interpreted as a pair of capital market transactions (buying bonds and selling bonds), a sequence of Forward Rate Agreement contracts, a sequence of Eurodollar futures and as a pair of options. The interpretation as a combination of bonds is useful in calculation its MTM value. It is also useful to calculate swap's duration.

Problem 1. IRS

A dealer quates the following swap fixed rates

Maturity	Treasury Yield	Bid Swap Spread (bps)	Ask Swap Spread (bps)	Effective Fixed Swap Rate
2	9,76%	26	29	10,02% - 10,05%
3	9,92%	28	31	10,20% - 10,23%
4	10,10%	30	33	10,40% - 10,43%
5	10,41%	27	31	10,68% - 10,72%
7	10,64%	36	40	11,00% - 11,04%
10	10,82%	38	42	11,20% - 11,24%
15	11,09%	58	63	11,67% - 11,72%

The dealer arranges IRS with a counterparty X with the following terms

Origination date:	2000-01-15
Maturity date:	2005-01-15
Notional principal:	10 000 000
Fixed-rate payer	Counterparty X
Swap fixed rate:	10,72%
Convention:	365
Fixed-rate receiver:	Dealer
Floating rate:	6M WIBOR
Convention:	360
Settlement dates:	January 15th and July 15th of each year
WIBOR determination:	Determined in advance, paid in arrears

The dealer arranges IRS with a counterparty Y with the following terms

|	
Origination date:	2000-01-15
Maturity date:	2005-01-15
Notional principal:	10 000 000
Fixed-rate payer	Dealer
Swap fixed rate:	10,68%
Convention:	365
Fixed-rate receiver:	Counterparty Y
Floating rate:	6M WIBOR
Convention:	360
Settlement dates:	January 15th and July 15th of each year
WIBOR determination:	Determined in advance, paid in arrears

Required
(a) Draw a box-and-arrow diagram from a dealer's point of view.
(b) Calculate the swap cash flows assuming the 6M WIBOR path shown in the
   following table.

Settlement Date	WIBOR
2000-01-15	10,400%
2000-07-15	10,600%
2001-01-15	9,100%
2001-07-15	8,100%
2002-01-15	7,600%
2002-07-15	9,100%
2003-01-15	10,100%
2003-07-15	10,500%
2004-01-15	10,600%
2004-07-15	8,400%
2005-01-15	10,200%

(c) Calculate the swap dealer's profit on each settlement date.
   Calculate the swap dealer's profit assuming 90/360 conventions is used

Solution

(a)

Counterparty X	← 6M WIBOR ←	Dealer	← 6M WIBOR ←	Counterparty Y
	→ 10,72% →		→ 10,68% →	
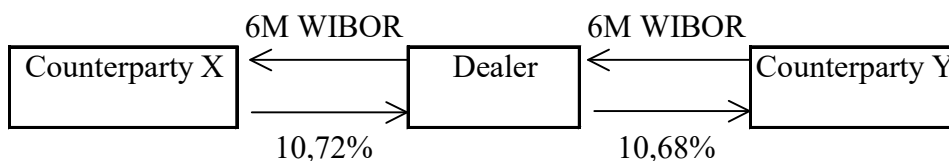
(b)

Settlement Date	Number of Days	6M WIBOR	Floating Rate Receipt	Fixed Rate Payment	Counterparty X Net Receipt (Payment)
2000-01-15	-	10,400%	-	-	-
2000-07-15	182,00	10,600%	525 778	534 532	-8 754
2001-01-15	184,00	9,100%	541 778	540 405	1 372
2001-07-15	181,00	8,100%	457 528	531 595	-74 067
2002-01-15	184,00	7,600%	414 000	540 405	-126 405
2002-07-15	181,00	9,100%	382 111	531 595	-149 483
2003-01-15	184,00	10,100%	465 111	540 405	-75 294
2003-07-15	181,00	10,500%	507 806	531 595	-23 789
2004-01-15	184,00	10,600%	536 667	540 405	-3 739
2004-07-15	182,00	8,400%	535 889	534 532	1 357
2005-01-15	184,00	10,200%	429 333	540 405	-111 072
			4 796 000	5 365 874	-569 874

Settlement Date	Number of Days	6M WIBOR	Fixed Rate Receipt	Floating Rate Payment	Counterparty Y Net Receipt (Payment)
2000-01-15	-	10,400%	-	-	-
2000-07-15	182,00	10,600%	532 537	525 778	6 759
2001-01-15	184,00	9,100%	538 389	541 778	-3 389
2001-07-15	181,00	8,100%	529 611	457 528	72 083
2002-01-15	184,00	7,600%	538 389	414 000	124 389
2002-07-15	181,00	9,100%	529 611	382 111	147 500
2003-01-15	184,00	10,100%	538 389	465 111	73 278
2003-07-15	181,00	10,500%	529 611	507 806	21 805
2004-01-15	184,00	10,600%	538 389	536 667	1 722
2004-07-15	182,00	8,400%	532 537	535 889	-3 352
2005-01-15	184,00	10,200%	538 389	429 333	109 056
			5 345 852	4 796 000	549 852

(c)
The dealer's cash flows are as follows

Settlement Date	Receipt	Payment	Net Receipt
2000-01-15	-	-	-
2000-07-15	534 532	532 537	1 995
2001-01-15	540 405	538 389	2 016
2001-07-15	531 595	529 611	1 984
2002-01-15	540 405	538 389	2 016
2002-07-15	531 595	529 611	1 984
2003-01-15	540 405	538 389	2 016
2003-07-15	531 595	529 611	1 984
2004-01-15	540 405	538 389	2 016
2004-07-15	534 532	532 537	1 995
2005-01-15	540 405	538 389	2 016
	5 365 874	5 345 852	20 022

If the 180/360 convention was used for both interest rates, the dealer's profit would be fixed and equal to
(10,72%-10,68%) * 180/360 * 10 000 000 = 2 000.

## Problem 2. FRA

The actual bid-offer quates on FRA are following

Period	Bid	Offer
3 x 6	4,93%	4,97%
6 x 9	4,84%	4,88%
9 x 12	4,86%	4,90%
12 x 15	5,07%	5,11%
15 x 18	5,03%	5,07%
18 x 21	5,05%	5,09%
21 x 24	5,11%	5,15%

Required

(a) Draw a box-and-arrow diagram for a 3x6 FRA.

(b) Suppose that the dealer buys 3x6 FRA from Company Y. Notional principal is
$1 000 000. The 3M WiBOR is 5,0% on the rate determination date.
Calculate the net payment.

(c) Calculate the net in advance payment.

Solution

(a)
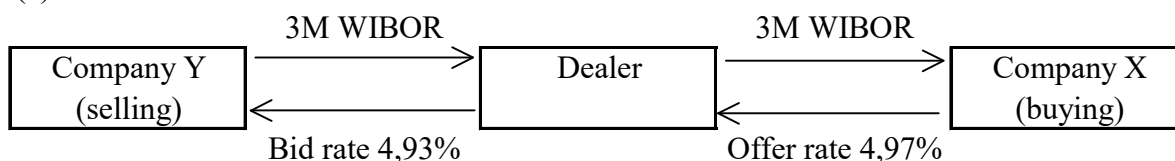
(b)
The net payment in month 6 woould be (5,00%-Bid rate 4,93%) / 4 * 1 000 000 =185,2.

(c)
If settled in advance, the payment in month 3 would be
185,2 / (1+5,00% / 4) = 182,9.