

Interest Rate, Basis and Cross Currency Swaps

Swaps

101



Interest Rate Swaps are the most well-known instrument for hedging medium and long term interest rate risk. This module covers not only their uses for both asset and liability managers but also looks at the various factors that influence their price. While already under an interest rate swap contract, if your view on rates were to change owing to yield curve shifts there are three different ways to terminate an Interest Rate Swaps.

The Swaps market is an OTC market. We will see how to read swap quotes off a monitor and learn about why swaps are quoted as spreads over treasuries. We will also see what drives these swap spreads up or down.

Cross currency Swaps are exchanges of interest rate payments in 2 differing currencies.



Basis Swaps are means to hedge basis risk. Basis risk stems out of a time or currency mismatch on interest payments receivable and interest payments payable. A time mismatch is hedged using a tenor basis swap, while a currency mismatch is hedged using a cross currency basis swaps.

By using a combination of these swaps, we can completely alter the debt composition for a client.



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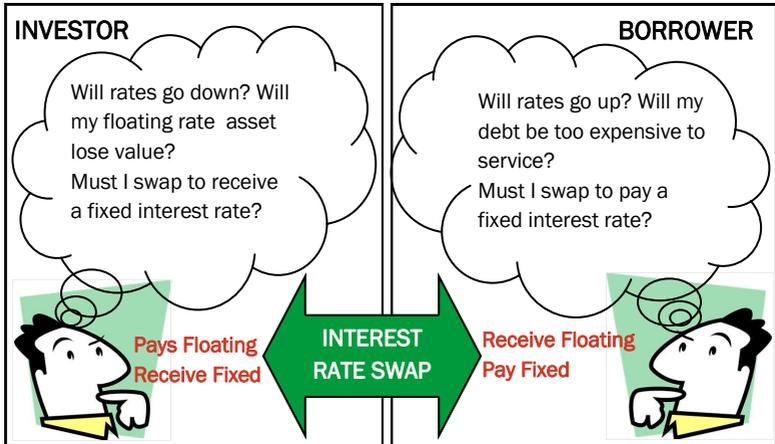
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Points of interest

- **Interest Rate Swaps are most well known for hedging medium and long term risk**
- **The notional scheme, indices, maturity and days basis on both legs are all variables.**
- **Financial Crises, Bond issuance and supply and demand are the drivers of swap spread**
- **Limits are imposed on the amount of risk a swaps trader can hold to any particular segment of the yield curve**

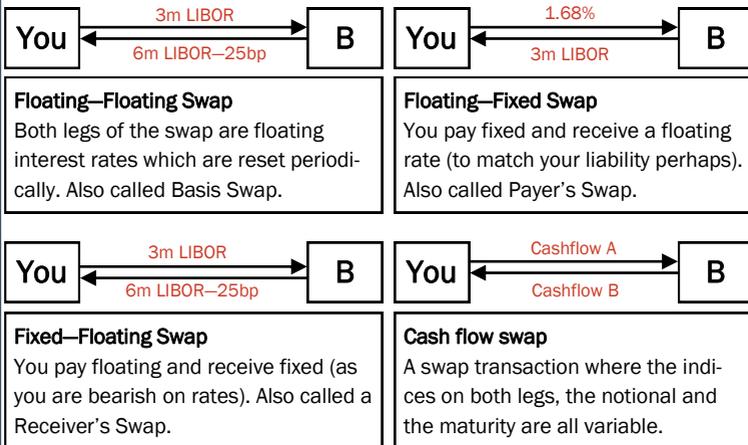
Interest Rate Swaps

Interest Rate swaps describe the replacement of one set of interest rate cash flows for another. It is a very flexible method to control exposure to interest rate movements, whether to reduce risk or increase it.



There are no exchanges of principal in an interest rate swap. Because all the cash flows are denominated in the same currency, any principal exchanges would simply cancel each other out.

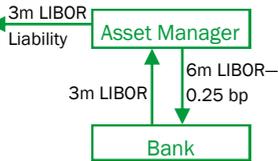
Four Types of Interest Rate Swaps



Uses of Interest Rate Swaps

Basis Swap

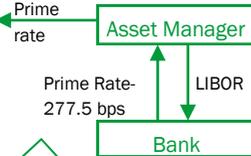
Moving the frequency of a floating rate swap



An asset manager owns a quarterly pay asset with which he pays down a quarterly liability tagged to 3m LIBOR. He has since traded his asset which now pays him semi annually. He'd like to match the frequency of his liability and his asset and hence opts in for a basis swap as shown

Basis Swap

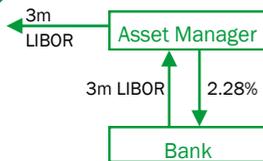
Changing from one basis to another



A US Corporate borrows at the Prime Rate from its domestic banks but invests in LIBOR-based assets can eliminate the risk of Prime Rate rising more quickly than LIBOR by entering into a swap to match the asset and the liability.

IR Swap

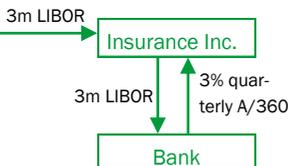
Changing from a floating rate to a fixed rate of interest



A fund manager has financed himself with 5 year floating rate funding the interest on which is payable quarterly and tagged to 3m LIBOR. He however has a bullish outlook on 3m LIBOR forward rates and believes the curve is too flat at the moment. He'd hence prefer to pay a fixed rate of interest instead. He achieves this by doing a Vanilla Interest Rate Swap.

IR Swap

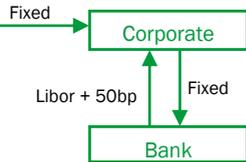
Creating Synthetic Fixed Rate Assets



Insurance companies and pension funds favour fixed rate medium- to long-term assets because of their predictability of income. They offer a useful source of funding to both Corporates and Financial Institutions. Interest Rate swaps enables the investors to synthetically create fixed rate assets from floating rate investments.

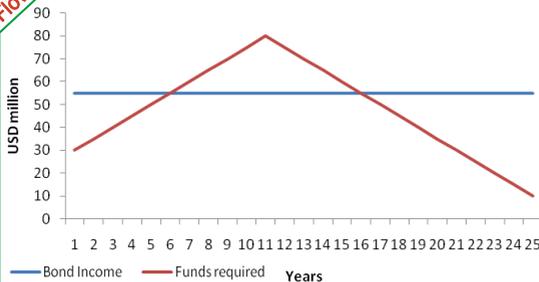
Interest Rate, Basis and Cross Currency Swaps

Investors benefiting from rising rates



Fixed-income assets decline in value and price as rates increase. An interest rate swap enables fixed-rate exposures to be swapped to a floating basis so that the advantages of a rising interest rate environment may be captured. This would be equivalent to synthetically creating a floating rate note out of an earlier fixed rate investment by combining it with a swap.

Reconfiguring a cash flow profile to match off asset and liability notional



The unwanted interest it placed back in the market in the early years. Were rates low, there is a high reinvestment risk. However the fund is protected from a credit crunch if they aren't able to fund themselves from the capital markets in the underinvested years.

The swap with this notional scheme is called a **'Rollercoaster'**

Imagine a pension fund where a certain demographic of employees shall draw down on their earned pensions heavily during the mid years. The investment to fund this liability stream is a fixed pay bond portfolio. The cash flow profile required by the employees hence neither matches their income flows nor the amortization profile of their bond portfolio. The bond interest receivables maybe swapped to create a more efficient portfolio as shown.

This cash flow swap is structured as follows—

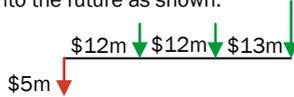
- Evaluate the coupon on the fixed leg which is the fixed rate receivable from the bond portfolio
- Suitably reinvest the excess cash flows in the early years using a variable notional schedule by opting for a lower notional in the early years
- A higher notional in the middle years suitably increases the interest received to provide the excess funds as required.

Interest Rate, Basis and Cross Currency Swaps

IR Swap

Paying fixed rate to hedge project appraisal discount rates

Consider a project in Belgium with an upfront investment and cash flows (in millions) into the future as shown.



The project is being funded at a funding cost of LIBOR+50bp. Net Present Value of the project computed by discounting at the funding cost for different values of LIBOR is as below—

1y LIBOR	LIBOR+50bp	NPV
1%	1.5%	\$30,900,000
1.5%	2.0%	\$30,550,000
2%	2.5%	\$30,200,000

Clearly fluctuations in a floating interest rate affect the valuation of a project that is funded at that rate of interest. Rising rates reduces the book value of a project, which might affect access to subsequent rounds of funding.

Hence, swapping into fixed funding rates might be of interest.

IR Swap

Hedging contingent financial risks in M&A transactions (notably options)

You are a large global coffee house chain looking to acquire a local brand in your newest country of operation in one year's time. You plan to do a leveraged buy out and shall raise \$5 million in debt capital by issuing debt of 5 year maturity to fund an asset purchase of the target company. You anticipate rising rates over a 5 year term but are not too confident of your view. What could you do?



Secure funding today, and purchase a forward starting swap



If you are confident of your bullish view on rates, raise floating rate debt today but purchase a payer's swap that begins in one year's time that will help you pay a lower fixed rate as opposed to a higher floating rate.

Buy a Payer's swaption maturing in one year

You aren't entirely confident of your view on rates. If rates were to fall you would like to fund yourself at these lower rates. Hence buy an option to enter into a swap where you will pay fixed on your \$5m notional over the next 5 years.

IR Swap

Use in the sale or disposal of financial assets or even institutions, especially where bond portfolios are involved



Imagine that you are looking to buy a bond portfolio off an international asset manager. The portfolio comprises of 100 floating rate pay bonds and is currently valued at \$100m at the point when the deal is made. Once the deal is signed you have assumed the title and the interest rate risk of the bond portfolio.

Assuming the portfolio has a duration of 6.2, a 1bp rise in rates would reduce the value of the bond portfolio by $PVBP = 6.2 * 0.0001 * \$100m = \$62,000$. Had rates risen by 1 bp, the bond is now worth only \$99,938,000.

Hence as a hedge it is wise to get into an offsetting position on a swap, which gains in value by the same amount when rates rises by 1bp (i.e. the swap has a $PV01 = \$62,000$). A swap that will gain in value when rates rise is a payer's swap (i.e. pay fixed and receive floating).



Hence swaps positions are used for hedging interest rate risk.

IR Swap

Protection of covenants common to loan or bond requirements

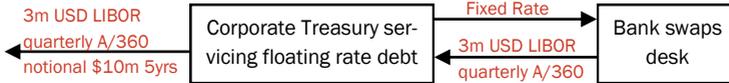
A lending institution like a commercial bank may require borrowers to adhere by certain covenants regarding interest coverage such as maintaining an interest coverage ratio of atleast 1.6.

$$\text{Interest Coverage Ratio} = \frac{\text{Earnings Before Interest and Taxes}}{\text{Interest Payments}}$$

This means that that the lending institution expects the company to make atleast 1.6 dollars in operating profit for every dollar of interest payable over an interest period. Were the borrower exposed to floating rate interest payments, a rise in rates will reduce the interest coverage ratio. In order to help the borrower uphold his commitment to adhering by this covenant, the bank (the lender) may request / require the borrower to buy a swap that alters his interest payments to a fixed rate thereby capping his interest payments. Alternatively the bank may require the client to buy an interest rate cap that helps cap their interest rate risk.

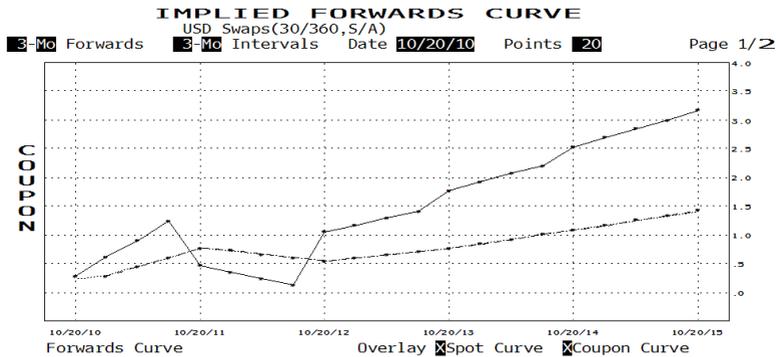


Pricing Interest Rate Swaps



Pricing a swap is the process of evaluating the equivalent fixed coupon rate that must be paid against a floating rate on a certain notional such that the 2 cash flow streams have the same present value today!

$$PV(\text{Fixed Rate Cash flow stream}) = PV(\text{Floating Rate Cashflow Stream})$$



We had introduced you to forward curves in the Rates 102 module. A Forward curve shows the estimate of the floating rate at a future date (E.g. the estimate of 3m USD Libor 3 months from now). Interest payments on the floating leg will be received as per the forward rates indicated. As we know the swap is dealt on an agreed notional and maturity and the days basis on the fixed and floating legs are agreed at the date of the initiation of the swaps contract. Assume the forward curve as shown to the right. It can be interpreted as shown.

3 month USD LIBOR will be reset to 0.52370% on 19th October 2011 (i.e. one year from now).

In actuality the rates may or may not be reset to this level. This is just the market's current expectation on 3m lending rates 1 year into the future. These expectations shall be used to make assumptions about the cash flows on the floating leg into the future and hence used to price the swap. If rates are higher 1 year forward, the floating rate receiver realizes gains from buying the swap.

Reset Date	Reset Rate
10/19/2010	0.28906
01/19/2011	0.36939
04/19/2011	0.41512
07/19/2011	0.45698
10/19/2011	0.52370
01/19/2012	0.60974
04/19/2012	0.70706
07/19/2012	0.82455
10/18/2012	0.95430
01/18/2013	1.10379
04/18/2013	1.25964
07/18/2013	1.43734
10/17/2013	1.64692
01/17/2014	1.86639
04/16/2014	2.00744
07/17/2014	2.14730
10/17/2014	2.45744
01/19/2015	2.61017
04/17/2015	2.75931
07/17/2015	2.90693

Interest Rate, Basis and Cross Currency Swaps

Let's start pricing this swap. The details on the 2 legs are as shown below—

90) Actions		91) Swaps & Options		92) Str. Notes		93) Mkt Data		94) Help		95) Feedback	
Deal	Counterparty	SWAP	CNTRPARTY	Ticker /	SWAP	Series	Deal ID	21) Detail			
31) Load	32) Save	34) Send		35) VCON		36) Ticketing		37) Add to Portfolio			
Leg 1	Receive Fixed			Leg ID		Leg 2	Pay Float				
Notional	10MM			Notional	10MM	Notional	10MM	Leg ID			
Currency	USD			Currency	USD	Currency	USD	Index	US0003M		
Effective	10/21/2010			Effective	10/21/2010	Effective	10/21/2010	Latest Index	0.28906		
Maturity	10/21/2015			Maturity	10/21/2015	Maturity	10/21/2015	Tenor	3 Month		
Pay Freq	SemiAnnual			Pay Freq	Quarterly	Pay Freq	Quarterly	Leverage	1.00000		
				Unwind Cpn	1.371000			Spread	0.00 bp		
								Day Count	ACT/360		
MV	10,000,000.00			MV	-10,000,000.00			Accrued	0.00		
Premium	100.00			Premium	-100.00			DV01	-255.37		
Market				Market							
Discnt Curve	23 Bid			Discnt Curve	23 Bid						
				Fwd Curve	23 Bid						
Curve Date	10/19/2010										
Valuation											
Par Cpn		1.370249	Calculate	Leg1: Coupon							
Principal		0.00	Unwind Annuity		-0.000751						
Accrued		0.00	Unwind PV		-366.10	DV01			4.873.43		
Market Value		0.00	Premium		0.00000	Gamma (1bp)			2.76		

The Fixed Leg

The particulars of the fixed rate leg of the swap. The Day Count is set to Act/365 and the pay frequency is set to semi annual. This means the fixed rate payer will make semi annual payments.

The Swap Price = 1.370249%

This is the equivalent fixed rate of interest upon the USD 10m notional that one must pay semi annually in exchange for receiving 3m LIBOR interest payments paid quarterly over the next 5 years such that the value of these two cash flow streams is the same today. A more detailed look at how we derive this number is provided later.

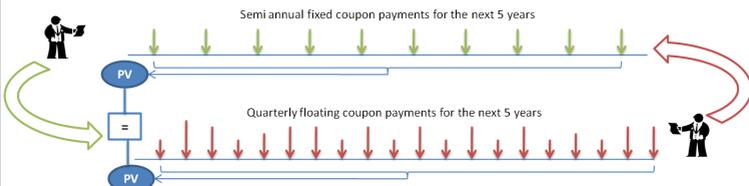
The Floating Leg

The particulars of the floating rate leg. The index is set to 3m USD LIBOR and the reset and pay frequency are quarterly. The Day's basis is A/360. Maturity is set at 5 years from now.

The Premium

The value that must be exchanged upfront were the fixed and floating cash flow streams exchanged today. In this case we want the premium to be zero as we'd like the PV of the fixed leg to be equal to the PV of the floating leg.

"Loosely, it is possible to think of a swap as the exchange interest payments of a floating rate note for a fixed rate note"



Interest Rate, Basis and Cross Currency Swaps

Shown below is a cash flow schedule, i.e. a table showing the cash flows to an investment into periods in the future and their discounted values in the present. Let's take a closer look—

Semi Annual Fixed Rate Interest Receivable (A/365 basis)

= notional x fixed rate x (act days in interest period / 365)
 = 10,000,000 x 0.01370249 x 185/365
 = 69,450.99

Quarterly Floating Rate Interest Payments (happens in arrears)

= notional x 3m forward rate on the reset date (7/19/11) x (Act days in interest period/360)
 = 10,000,000 x 0.0045698 x (92/360)
 = 11678.49

Pay Date	Payments(Fcv)	Payments(Pay)	Net Payments	Discount	Pv
01/21/11	0.00	-7,387.09	-7,387.09	0.999262	-7,381.64
04/21/11	68,324.76	-9,234.84	59,089.92	0.998340	58,991.82
07/21/11	0.00	-10,493.25	-10,493.25	0.997293	-10,464.85
10/21/11	68,700.17	-11,678.49	57,021.68	0.996130	56,801.01
01/23/12	0.00	-13,674.27	-13,674.27	0.994770	-13,602.75
04/23/12	69,450.99	-15,412.88	54,038.11	0.993239	53,672.76
07/23/12	0.00	-17,872.78	-17,872.78	0.991467	-17,720.27
10/22/12	68,324.76	-20,842.74	47,482.02	0.989405	46,978.93
01/22/13	0.00	-24,387.76	-24,387.76	0.986998	-24,070.67
04/22/13	68,324.76	-27,594.83	40,729.92	0.984282	40,089.71
07/22/13	0.00	-31,840.87	-31,840.87	0.981157	-31,240.91
10/21/13	68,324.76	-36,332.72	31,992.03	0.977606	31,275.59
01/21/14	0.00	-42,087.94	-42,087.94	0.973508	-40,972.96
04/22/14	68,700.17	-47,178.18	21,521.99	0.968937	20,853.45
07/21/14	0.00	-50,185.93	-50,185.93	0.964099	-48,384.18
10/21/14	68,324.76	-54,875.45	13,449.31	0.958837	12,895.69
01/21/15	0.00	-62,801.12	-62,801.12	0.952853	-59,840.26
04/21/15	68,324.76	-65,254.23	3,070.53	0.946675	2,906.79
07/21/15	0.00	-69,749.25	-69,749.25	0.940118	-65,572.93
10/21/15	10,068,700.17	-10,074,288.71	-5,588.14	0.933186	-5,214.77

Discount Factors

These are derived from the spot USD LIBOR Curve. Cash flows 6 months into the future are discounted using the 6 month spot rate. If the 6 month spot rate is 0.332414% the discount factor is computed as—

$$DF = \frac{1}{(1 + 0.00332414 * \frac{90}{360})^2} = 0.998340$$

Only net interest payments are exchanged

= 68,700.17 – 47,178.18 = 21,521.99

“The sum of the PVs must be zero for the swap to be priced correctly. The swap price is the fixed rate of interest that makes the PV of the net payments zero”

Where do spot rates come from?

Spot rates are bootstrapped from the par yield curve, and are used to construct estimates of the forward rates. Refer the Rates 102—Yield Curves and Yield Spreads booklet to know more!

A View on Interest Rate volatilities!



What if the counterparties both have a varying interpretation of the curve from the market?

What happens in a dysfunctional market where lending activity is suspended and liquidity has frozen and curves aren't behaving rationally?

What happens if the counterparties to the swap who deal over the counter have a view on the forward curve that differs highly from the market or are trying to price up a swap well into the future where the market has no expectation of rates?

Confused? Essentially...

Essentially the motive to do an interest rate swap in the first place is a differing view on interest rate volatilities from the market over a prolonged period of time! Any model for pricing interest rate swaps must hence allow to tweak yield curves as per differing expectations.

The swap is against LIBOR flat

This means that there is no spread added on top of LIBOR. Counterparties will sometimes ask you to pay them a floating rate + a spread as they are trying to match out a liability.

Zero Rates and Discount Factors

Zero rates are the published LIBOR rates, the forward curve is derived from the zero curve in the case of LIBOR based transactions. Discount factors are derived from the zero rates.

Term	Market Rate	Shift	Shifted Rate	Zero Rate	Discount
0/N	0.22688	+0.00	0.22688	0.22688	
T/N	0.25000	+0.00	0.25000	0.25000	
1 v1k	0.25150	+0.00	0.25150	0.25150	0.9999951
2 v1k	0.25169	+0.00	0.25169	0.25169	0.9999902
1 H0	0.25625	+0.00	0.25625	0.25625	0.999772
2 H0	0.27172	+0.00	0.27172	0.27172	0.999540
3 H0	0.28906	+0.00	0.28906	0.28906	0.999262
EDZ0	0.34500	+0.00	0.34500	0.31851	0.998719
EDH1	0.39900	+0.00	0.39900	0.35261	0.997713
EDH1	0.43700	+0.00	0.43700	0.37987	0.996527
EDU1	0.49600	+0.00	0.49600	0.40600	0.995279
EDZ1	0.57900	+0.00	0.57900	0.43773	0.993825
EDH2	0.66600	+0.00	0.66600	0.47394	0.992155

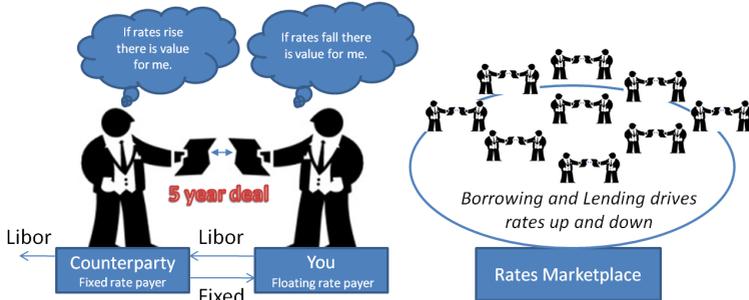
Valuation

Par Cpn	1.370249	Calculate	Premium
Principal	0.00	Unwind Annuity	-0.000751
Accrued	0.00	Unwind PV	-366.10
Market Value	0.00	Premium	4.873.43
			Gamma (1bp)
			2.76

Navigation: 1) Main 4) Curves 5) Cashflow 7) Leg Detail 10) Reset Rates 11) Risk 13) Scenario 14) Charts 15) CVA

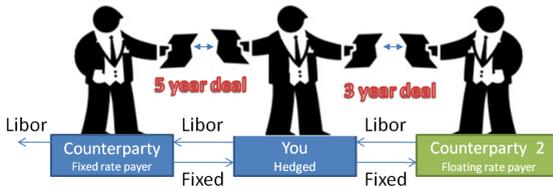
Terminating a Swap

Once you've struck the swap deal we had discussed with a counter party you are in this position—



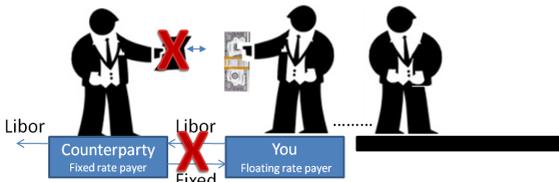
Two years have passed and you've got your view wrong, Rates are rising steeply and you are having trouble servicing the floating rate payments. You would like to get out of this swap deal and cut your losses. How can you do this?

Do an Offsetting Swap



Pros	Cons
<ul style="list-style-type: none"> No cash payment required upfront. If the market is under pricing the offsetting position unwinding the swap in this manner is cheaper. 	<ul style="list-style-type: none"> You still hold 2 different credit risks on your books. If either party defaults, you will need liquidity to keep up your end of the deal.

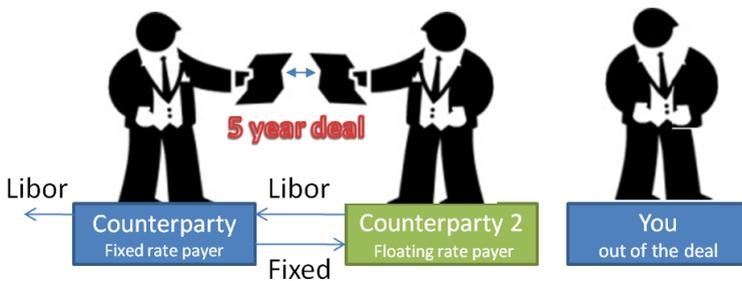
Cash Settlement



Interest Rate, Basis and Cross Currency

Pros	Cons
<ul style="list-style-type: none"> You have voided your earlier position and do not hold the credit risk any longer 	<ul style="list-style-type: none"> You will need cash to pay to terminate the swap in this manner

Novate the swap



Pros	Cons
<ul style="list-style-type: none"> You have walked away from the swap by assigning it to another counterparty who are willing to accept this risk. You do not require excess liquidity either. 	<ul style="list-style-type: none"> There is time taken to find another counterparty willing to assume this risk and completing the relevant documentation. The market may have moved further against you in this while.

When it's time to terminate the swap, each party will value the swap using their own interpretation of the market forward curve. This is shown later.

However in essence, the way the swap is valued into its term is by computing the present value of the future cash flows on floating leg and the fixed leg and computing the difference between the two.

If the rates had risen since initiation of the swap,
 The future payouts to the floating rate receiver is higher,
 The present value of these future payouts is hence higher too,
 There is hence a positive value to the floating rate receiver.

Calculating the Termination Value of a Swap

When it's time to terminate the swap, that means it's time to open out your earlier deal ticket and revalue your position, to see if the rising and falling rates in the market place to see if your position has gained or lost value since. Here's how to go about it—

1) Keep the rate on the fixed leg constant

This is the fixed swap rate you were locked into receiving at the initiation of the swap.

Deal	Counterparty	SWAP_CNTRPARTY		Ticker / SWAP	Series	Deal ID	
Market Data	Curve #	23	Bid	USD Swaps(30/360.5/A)	Swap Contract	Reset Fixing	US00003H 0.28906 %
Cash Rates	ACT/360	Swap Rates		30I/360 (\$)	Rate Source	Custom Curve	
Interpolation	Piecewise Linear (Simple)	Shift		5.00 bp		98) Refresh	99) Export to Excel

Term	Market Rate	Shift	Shifted Rate	Zero Rate	Discount
0/N	0.22625	+5.00	0.27625	0.27625	
T/N	0.14000	+5.00	0.19000	0.19000	
1 Wk	0.25150	+5.00	0.30150	0.30150	0.999941
2 Wk	0.25169	+5.00	0.30169	0.30169	0.999883
1 MO	0.25625	+5.00	0.30625	0.30625	0.999728
2 MO	0.27172	+5.00	0.32172	0.32172	0.999455
3 MO	0.28906	+5.00	0.33906	0.33906	0.999134
ED20	0.37000	+5.00	0.42000	0.38460	0.998454
EDH1	0.42900	+5.00	0.47900	0.42471	0.997246
EDM1	0.46700	+5.00	0.51700	0.45478	0.995845
EDU1	0.51600	+5.00	0.56600	0.48004	0.994422
EDZ1	0.57900	+30.00	0.87900	0.55228	0.992217
EDH2	0.65600	+5.00	0.70600	0.57757	0.990450

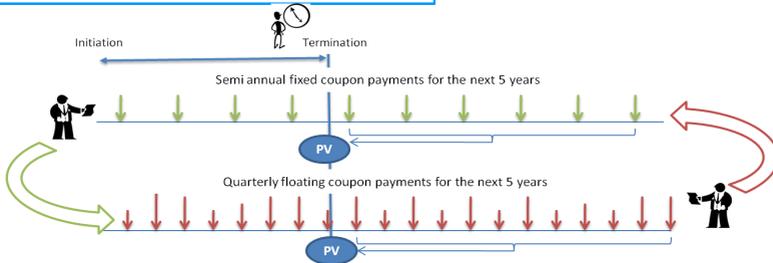
Par Cpn	1.408229	Calculate	Premium	
Principal	-24,329.96	Unwind Annuity	-0.082112	
Accrued	0.00	Unwind PV	20,077.42	PV01 4,859.13
Market Value	-24,329.96	Premium	-0.24330	3wanna (1bp) 2.75

2) Shift the yield curve based on market movements

You know what's happened in the marketplace since the initiation of the deal, tweak the curves to reflect the market's current expectations on rates into the future. Cash flows receivable into the future will now be discounted at these new rates. Assume there has been a 5bp parallel shift in yield curve, and an additional 25bp rise in the EDZ1 rate since initiation. (The 1 year forward rate is computed as a weighted average of the yields on 4 different Euro\$ futures contracts EDH1 thro EDZ1)

3) Compute the premium

The premium is your gain or loss and is the market value of the net position expressed in percentage. It is computed as the difference in the present value between the fixed rate and floating rate interest payments into the future, discounted using the current yield curve. The rise in rates means a gain in 24.33 basis points to the floating rate receiver.



Swap Market Conventions

Swap Quotations

All swap quotes assume that the LIBOR leg / the floating leg of the swap has no margin attached. It is quoted as 'LIBOR flat'. It is the fixed side of the swap that changes and the dealer will show the salesman a two-way price. The price may be quoted as an all-in fixed rate or as a spread.

Receiving fixed on a swap is much like going long a bond. (The position loses value were rates to rise). Hence swap monitors show swap spreads alongside comparable treasuries.

The Swap Rate in semi annual bond basis
The Mid market bond yield + the swap spread.

The Swap Rate in Ann Money Market Basis
The Mid market bond yield + the swap spread.

<HELP> for explanation. Curren**SSRC**

BLOOMBERG Swapsource - US Dollar P 1/2

Mty	Desc	Source	Market	BIA Yld	Mid	Swap Spreads	Semi 30/360	Ann ACT/360		
2Y	T 0 ½ 12	BBT	100-00 ³ / 100-00 ³	.363 / .363	0.363	15.00 - 19.00	0.113	-0.553	0.506	-0.445
3Y	T 0 ½ 13	BBT	99-28 / 99-28	.543 / .543	0.543	20.50 - 24.50	0.748	-0.788	0.738	-0.778
4Y					0.859	19.75 - 23.75	1.057	-1.097	1.044	-1.084
5Y	T 1 ¼ 15	BBT	100-11 / 100-11	1.175 / 1.175	1.175	23.75 - 27.75	1.413	-1.453	1.398	-1.437
6Y					1.523	22.25 - 26.25	1.745	-1.785	1.727	-1.767
7Y	T 1 ¾ 17	BBT	100-01 / 100-01	1.870 / 1.870	1.870	15.75 - 19.75	2.028	-2.068	2.008	-2.048
8Y					2.099	16.50 - 20.50	2.264	-2.304	2.244	-2.284
9Y					2.329	12.50 - 16.50	2.454	-2.494	2.433	-2.473
10Y	T 2 ½ 20	BBT	100-19 / 100-17	2.556 / 2.561	2.558	6.25 - 10.25	2.621	-2.661	2.599	-2.639
11Y					2.558	19.25 - 23.25	2.750	-2.790	2.728	-2.768
12Y					2.558	31.25 - 35.25	2.871	-2.911	2.849	-2.889
13Y					2.558	41.50 - 45.50	2.973	-3.013	2.952	-2.992
14Y					2.558	50.25 - 54.25	3.061	-3.101	3.039	-3.079
15Y					2.894	23.50 - 27.50	3.129	-3.169	3.107	-3.147
20Y					3.251	0.00 - 0.00	3.231	-3.231	3.210	-3.210
30Y	T 3 ¾ 40	BBT	99-16 ⁴ / 99-16 ⁴	3.903 / 3.903	3.903	-38.00 - -34.00	3.523	-3.583	3.502	-3.542

11-14 year bonds; 10-year treasury mid; Others are interpolated

Swap Spread Pricing Source: **PRBB** - **Prebon Yamane US** 3 Month LIBOR **0.28844**

Australia 61 3 977 8500 Brazil 11 35 1 3048 4500 Europe 44 20 3330 7200 Germany 49 01 9204 1210 Hong Kong 852 2377 0000 Japan 81 3 3501 8500 Singapore 65 6212 1000 U.S. 1 212 518 2000 Copyright 2010 Bloomberg Finance L.P. SN 873201 0460-148-0 28-Oct-2010 07:13:28

Maturity of the swap we're considering

The comparable on the run treasury issue atop which the swap spread is added. Coupon = 0.5% and Maturity in

The market price of the treasury bond quoted in 32nds. Price in this case would be 99 + 28/32 or 99.875

The price expressed as a yield instead. PV = -99.875 FV = 100 PMT* = 0.25 N = 6 CPT I/Y I/y = 0.2715% YTM = 0.543%

The Swap spread in basis points. (Two way price). The bid is where the dealer pays fixed

Interest Rate, Basis and Cross Currency Swaps

World Swap Matrix								
Maturity	5yr	Display	Rate	Yield	ACT/365 S/A	Market	Mid	Spread vs
Display	Name	Current	Change	Update	Yield	Change		
		Rate	on day	Time	12 Month	6 Month		
1) America								
4)	US\$ 5yr S/A	1.4392	0.35	9:09	-142.71	-131.03		
5)	US\$ 5yr Ann	1.4398	0.31	9:09	-142.78	-131.17		
6)	CAD 5yr	1.9800	0.60	8:28	-92.05	-129.45		
7)	MXP 5yr	5.9948	0.10	0:42	-185.31	-111.24		
2) Europe/Africa								
8)	GBP 5yr	2.0270	4.20	9:10	-128.90	-101.30		
9)	EUR 5yr	2.1369	1.83	9:10	-67.83	-22.09		
10)	CHF 5yr	1.2127	1.79	9:08	-55.85	-35.78		
11)	SEK 5yr	2.6350	-6.23	9:09	-30.58	10.73		
12)	DKK 5yr	2.4067	2.96	9:10	-85.49	-31.33		
13)	ZAR 5yr	6.9468	1.78	9:06	-193.98	-79.67		
3) Asia/Pacific								
14)	JPY 5yr	0.4850	0.38	9:07	-43.20	-21.75		
15)	HK\$ 5yr	1.4025	5.02	8:12	-112.54	-103.49		
16)	AUD 5yr	5.6053	-0.47	8:58	-53.97	-29.47		
17)	NZD 5yr	4.3600	1.00	6:31	-146.00	-91.50		
18)	KRW 5yr	3.5910	0.00	9:09	-111.64	-56.54		
19)	SGD 5yr	1.5425	4.00	9:08	-98.75	-60.25		

The screen above shows the fixed swap rate for a 5 year maturity against floating rates in different countries. This shows how country risk affects the lending rates in these countries, and as a result the fixed swap rate is higher too.

Swap Terminology



Receiver: If a client were receiving fixed, he is called a receiver. This position is equivalent to going long a bond i.e. the client's swap position will go down in value were rates to rise because he is foregoing the opportunity to receive at higher rates available in the market and his locked-in cash flows are being discounted at higher rates

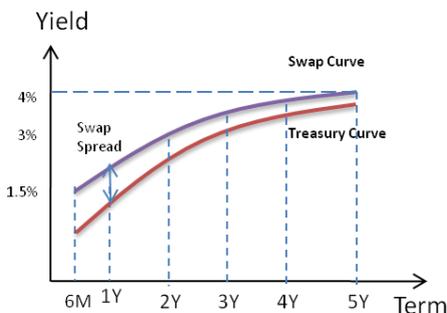
Payer: If the client were paying fixed, he is called a payer and the swap position is called a "long payer's swap position". His position is equal to being short a bond. If rates rise, his position gains in value as he receives a higher floating rate of interest on his assets, but services his debt at a lower fixed rate which was locked in at the time of swap initiation.

Axe: When a trader has a particular position on his books—(e.g. he wishes to pay fixed for a three year maturity because he has a short term bullish view on rates), he is said to have an axe. Traders will have a portfolio of swaps and hedging instruments in their portfolio and will be looking to increase or decrease particular parts of their exposure. Typically they will split their exposure into time buckets, being aware of how much profit or loss they stand to make as each part of the yield curve moves.

Swap Spreads

What does the swap spread signify?

We saw that swap price (the fixed rate) was quoted as a spread over the government bond yields. The risk on the floating leg is LIBOR risk and represents interbank risk. Hence we can interpret the swap spread as the spread that must be added over treasuries to account for interbank risk. This is shown below—



Spreads determine the yield demanded by investors over the treasury rate to be compensated for different classes of risk.

In order to know more about spreads and how they are computed refer the Rates 102—Yield Curves and Yield Spreads Booklet.

What are the factors affecting the swap-spread?

Any factor contributing to increasing interbank risk will increase swap spreads. For example,

(a) **Financial Crises:** When there is a financial crisis and faith in the banking sector falls in the marketplace, swap spreads will widen out. (increase).

(b) **Supply and Demand:** Consider a positive yield curve scenario (as shown above), and the current 5 year swap rate is 4% (a weighted average). A treasurer servicing his debt has a bullish outlook on rates and has opted in for a fixed pay swap for a 5 year term. If the current 3 month floating rate is 1.5%, in the early years of a swap (when the floating rate is less than the swap rate) the treasurer must pay at higher than the floating rate. An example would be paying an extra 2.5% for the first interest period. This poses a dilemma to treasurers and demand for swaps may fall if there is insufficient liquidity in short term funds due to greater cost of carry for treasurers in the short term. This fall in demand will make the swaps cheaper i.e. decrease/tighten the swap spreads.



Interest Rate, Basis and Cross Currency Swaps

(c) **Bond Issuance:** When issuance of fixed rate bonds increases, issuers expect to receive fixed to cover their fixed rate liabilities and facilitate this by doing a swap with a swap house. As more banks begin to pay fixed on swaps, they'll pay a lower fixed rate causing swap spreads to tighten in.

Credit Valuation Adjustment

When the relationship manager requests a quote for a swap deal from a trader, the trader (being connected to the marketplace at all times) will quote the salesman a mid market fixed rate. A sales team then adds on a spread over the mid market rate to offer a price to a client. This spread added is called a "**Credit Valuation Adjustment**" and reflects the credit quality of the client. This is determined from proprietary credit models.



Swap Sensitivity to Interest Rates

A portfolio manager issued a bond, and later bought a swap to hedge some of his interest rate risk. He however has to monitor his hedge periodically and must know the value change in his swap position for every basis point change move in interest rates.

The interest rate risk measures for a swap are estimated by estimating the exposures for the fixed and floating leg individually and computing the difference. Interest rate sensitivity of the fixed leg is always higher than the floating leg. (As we have seen in Rates 103, the point of issuing floating rate debt is to minimize interest rate risk for the investor!)

	Fixed Leg	LIBOR Leg	Net position
PV01	US\$4684.06	-US\$502.57	US\$4181.49
Modified	4.68 years	-0.5 years	4.18 years

(Refer the Rates 103 to know more about PV01 and Modified Duration)

Time Buckets

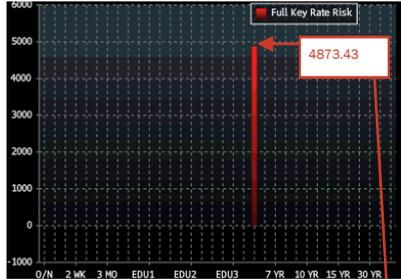
In reality, a bond trader (or the portfolio manager above) knows his interest rate exposure to a greater granularity. He classifies his risk into time buckets, by quantifying his net profit and loss for a 1 basis point change in rates at



different parts of the yield curve.

How do time buckets work?

The Screen below shows the vanilla interest rate swap we had priced up earlier. The image to the right shows the quantification of risk in the various time buckets (in dollar terms). We can notice that the majority of the risk on this deal is in the 5 year time bucket. Why is this so?



<p>Leg 1</p> <p>Notional: 10MM</p> <p>Currency: USD</p> <p>Effective: 10/21/2010</p> <p>Maturity: 10/21/2015</p> <p>Pay Freq: SemiAnnual</p>	<p>Receive Fixed</p>	<p>Leg ID</p> <p>Coupon: 1.370249 %</p> <p>Calc Basis: Money Mkt</p> <p>Day Count: ACT/365</p> <p>Unwind Cpn: 1.371000 %</p>	<p>Leg 2</p> <p>Notional: 10MM</p> <p>Currency: USD</p> <p>Effective: 10/21/2010</p> <p>Maturity: 10/21/2015</p> <p>Reset Freq: Quarterly</p> <p>Pay Freq: Quarterly</p>	<p>Pay Float</p>	<p>Leg ID</p> <p>Index: USD0003M</p> <p>Latest Index: 0.28906</p> <p>Tenor: 3 Month</p> <p>Leverage: 1.00000</p> <p>Spread: 0.02 bps</p> <p>Day Count: ACT/360</p>
<p>HV: 10,000,000.00</p> <p>Premium: 100.00</p>	<p>Accrued: 0.00</p> <p>DV01: 5,128.79</p>	<p>...</p>	<p>HV: -10,000,000.00</p> <p>Premium: -100.00</p>	<p>Accrued: 0.00</p> <p>DV01: -255.37</p>	<p>...</p>
<p>Market Dscnt Curve: 23 Bid</p> <p>Curve Date: 10/19/2010</p> <p>Valuation: 10/24/2010</p>	<p>USD Swaps(30/360,S/A)</p>	<p>Dscnt Curve: 23 Bid</p> <p>Fwd Curve: 23 Bid</p>	<p>USD Swaps(30/360,S/A)</p> <p>USD Swaps(30/360,S/A)</p>	<p>Leg1: Coupon</p> <p>Principal: 0.00</p> <p>Accrued: 0.00</p> <p>Market Value: 0.00</p>	<p>DV01: -366.10</p> <p>Gamma (1bp): 2.76</p>

DV01 on the fixed leg

Change in the value of the fixed rate bond for a 0.01% parallel yield curve shift. This would mean that the fixed rate locked in would now be discounted at higher spot yields for a 5 year period and the receiver swap would make a loss of USD 5128.79

DV01 on the floating leg

Change in the value of the floating rate interest payments for a 0.01% parallel yield curve shift. In this case only the floating interest payments in 3 months would differ as the floating rate would be reset for subsequent payments to match the required yield.

Hence such a swap has exposure to the floating rate for the 3 month until the next roll date, and an exposure on the fixed rate for the next 5 years.

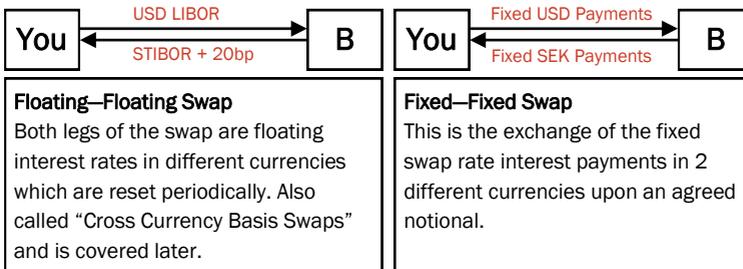
When holding a portfolio of swaps—

The risk management department of the bank or financial institution may impose limits as to how much a trader can be exposed to any one part of the yield curve i.e. what is the maximum present dollar value change of the portfolio for a one basis point rise in the rate for a specific term!

Cross Currency Swaps

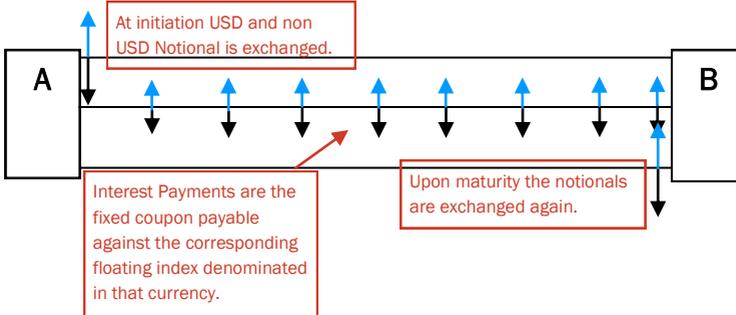
Cross currency swaps work a little differently and can be thought of in this manner. One party lends USD to the other while the other simultaneously makes a loan in the other currency. The notional principal amount is agreed today in either currency and translated to the other using the spot rate. The interest rates payable on these currencies over the period of the swap are variable.

Two Types of Cross Currency Swaps



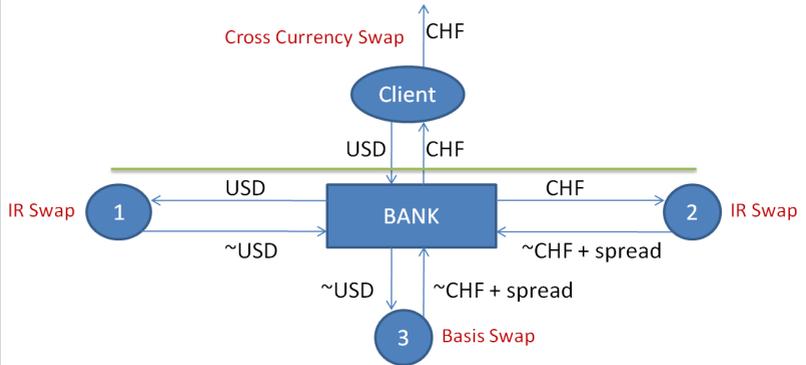
A Fixed-Fixed Cross Currency Swap Example

In a fixed-fixed cross currency swap works as below–



Consider a fixed-fixed cross currency swap, where fixed USD payments are exchanged for fixed CHF payments for a 5 year term beginning today. We'll elucidate the pricing using the Bloomberg pricing model and also show how to price this swap using a no-arbitrage relation, involving the corresponding interest rate swaps of equal maturity in each currency and the basis swap between the two floating interest rates.

Interest Rate, Basis and Cross Currency Swaps



If there were to be no arbitrage, the fixed coupon on the CHF leg of the fixed-fixed cross currency swap, must be equal to the fixed coupon on the IR swap #2. We can derive this as follows—

a) STEP 1:

The client pays typically pays the fixed coupon against current USD yield curve. This

Leg 1	Receive Fixed	Leg ID	Notional	Pay Float	US 6mth Libor
Notional	10MM	Coupon	1.496499 %	10MM	Leg ID
Currency	USD	Calc Basis	Money Mkt	USD	Index
Effective	11/03/2010	Day Count	ACT/360	Effective	11/03/2010
Maturity	11/03/2015	Unwind Cpn	1.442000 %	Maturity	11/03/2015
Pay Freq	SemiAnnual			Reset Freq	SemiAnnual
				Pay Freq	SemiAnnual
Market					
Disnt Curve	23 Bid			Disnt Curve	23 Bid
				Fwd Curve	51 Bid
					Pay US 6mth Libor
Curve Date	11/01/2010				
Valuation		Valuation	11/03/2010		
Par Cpn	1.496499	Calculate	Leg1: Coupon		
Principal	0.00	Unwind Annuity	0.054499	BR01	US 6mth Libor
Accrued	0.00	Unwind Pv	26,930.36	DV01	4,941.44
Market Value	0.00	Premium	0.00000	Gamma (1bp)	4,871.31
					2.75

The Fixed Coupon against 6 month USD LIBOR on a semi annual Act/360 basis is 1.496499%

can be determined from the swap curve, or by pricing the IR Swap #1

b) STEP 2:

Determine the Basis Swap spread on swap #3 by averaging several dealer quotes or alternatively by pricing the basis swap (This is covered later)

Interest Rate, Basis and Cross Currency Swaps

Leg 1	Receive Fixed	Leg ID	Leg 2	Pay Fixed	Leg ID
Notional	10MM	Coupon	Notional	9,839,614.29	Coupon
Currency	USD	1.496499 %	Currency	CHF	0.740102 %
Effective	11/03/2010	Calc Basis Money Mkt	Effective	11/03/2010	Calc Basis Money Mkt
Maturity	11/03/2015	Day Count ACT/360	Maturity	11/03/2015	Day Count ACT/360
Pay Freq	SemiAnnual		Pay Freq	SemiAnnual	
HV	10,036,085.16	Accrued	0.00	HV	-10,036,085.16
Premium	100.36	DV01	5,136.79	Premium	-100.36
					Accrued 0.00
					DV01 -4,921.73
Market					
Dscent Curve	23 Bid	USD Swaps(30/360,S/A	Dscent Curve	93 Bid Pay	CHF Basis Swaps
Curve Date	11/01/2010	Valuation	11/03/2010	Currency	USD
Valuation				FX Rate	1.016300
Principal	0.00			BR01 CHF Basis Swa	-4,990.45
Accrued	0.00	Calculate	Leg2: Coupon	DV01	215.06
Market Value	0.00	Premium	0.00000	Gamma (1bp)	-0.16

Sure enough, the swap rate in the market is approximately equal. A fixed-fixed cross currency swap pricing model prices this swap at 0.740102%. The price is different from our estimate by 0.23208bp.

If a trader wishes to capitalize on this arbitrage opportunity, he might have to sell the swap to the market at this rate i.e. 0.740102%, and buy the constituent IR swaps and basis swaps at the lower coupon rate i.e. 0.737782%.

Cash flow Profile:

The cash flows that will be exchanged under this fixed-fixed cross currency swap are as shown—

Pay Date	Payments(Rcv)	Payments(Pay)	Fwd FX	Net Payments	Discount	PV
05/03/11	75,240.64	-37,254.71	1.01750	37,985.93	0.998408	37,925.46
11/03/11	76,487.73	-37,950.44	1.01960	38,537.28	0.996327	38,395.73
05/03/12	75,656.34	-37,599.21	1.02127	38,057.13	0.993622	37,814.38
11/05/12	77,319.12	-38,503.80	1.02335	38,815.32	0.989910	38,423.66
05/03/13	74,409.26	-37,124.82	1.02528	37,284.43	0.985016	36,725.76
11/04/13	76,903.42	-38,483.15	1.02833	38,420.27	0.978087	37,578.37
05/05/14	75,656.34	-38,042.34	1.03330	37,614.00	0.968738	36,438.11
11/03/14	75,656.34	-38,266.36	1.03939	37,389.98	0.957670	35,807.26
05/04/15	75,656.34	-38,562.71	1.04744	37,093.63	0.944405	35,031.42
11/03/15	10,076,072.03	-10,435,493.32	1.05658	-359,421.29	0.929662	-334,140.16

Receivable (USD)
10,000,000*
0.01496499*
(181/360)

The forward CHF/
USD rate*

75,656.34—
37,599.21

The Discount
Factors are
derived from
the fwd USD
Libor curve
(refer rates
102)

37,985.93*
0.998408

Payable (in USD)
 $9,839,614.29 * 0.00740102 * (182/360) * 1.02127$

Interest Rate, Basis and Cross Currency Swaps

The net present value at initiation of a swap is zero. However, as time goes by and the FX forward curve changes, gains and losses are realized by either party. Note that if accounting of Profit and Loss is done in USD, its present value will be derived by discounting future cash flows receivable using the USD LIBOR curve, and hence cross currency swaps also have some embedded interest rate risk on the accounting currency. Note that the notional that will be exchanged upon maturity is the same as the principal amount exchanged upon initiation as determined by the spot FX rate. Currency swaps are terminated much like IR swaps.

A Floating-Floating Cross Currency Swap

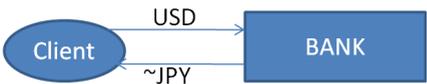
This is also called a cross currency basis swap and is discussed under the section on basis risk and basis swaps later.



This however qualifies as a cross currency swap too. Like a cross currency swap, principal is exchanged both at initiation and at maturity.

A Fixed-Floating Cross Currency Swap

This is the third kind of cross currency swap. Interest payments one leg are fixed rate payments on the agreed notional in one currency, while the payments on the other leg are floating rate interest payments on the agreed notional on the other currency. An example of

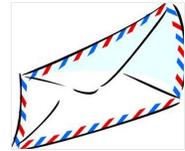


a swap between fixed rate dollars and floating rate yen is shown in the exercises section towards the end of the booklet.

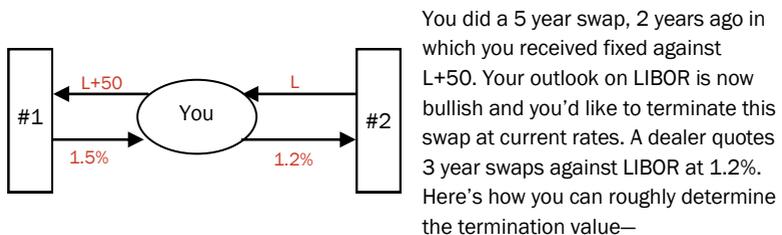
Snippet Box

Back of the Envelope

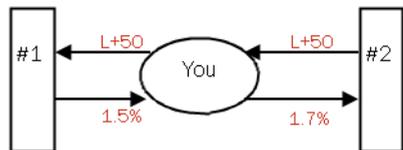
Imagine you are a relationship banker, you spend a majority of your time meeting and interfacing to clients and do not have the luxury of using discount factors to price up swaps while on the move. Here is an easy way to price up interest rate swaps and cross currency swaps on the back of an envelope to get an approximate measure of the termination value on the back of an envelope.



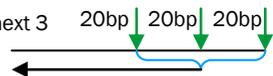
Quick and Dirty method for IR Swap Termination



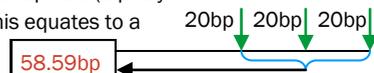
- A) Equate the floating legs on the receiver and payer swap and transfer all benefit onto the fixed leg. If swaps against LIBOR flat currently price at 1.2%, swaps against L+50 price at 1.7%



- B) You will make a loss of 20bp a year for the next 3 years.



- C) Discounted at the current 3 year swap rate (a proxy used in the place of spot rates) this equates to a loss of 58.59bp upfront.



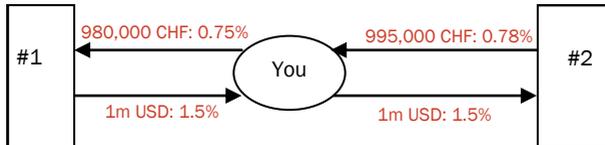
- D) On a notional of \$10m, that translates to an upfront loss of \$58,590. This is the amount you can pay upfront to the counterparty of the earlier swap in order to unwind it.

PMT = 20
N = 3
FV=0
I/Y = 1.2%
PV=? Ans. PV = -58.59bp

Interest Rate, Basis and Cross Currency Swaps

Quick and Dirty method for Cross Currency Swap Termination

This is marginally more complex as there are two sets of interest rates, two currencies and an upfront notional exchange determined by the spot rates. However there is still a quick and dirty way to price cross currency swaps into maturity to approximate their termination values—

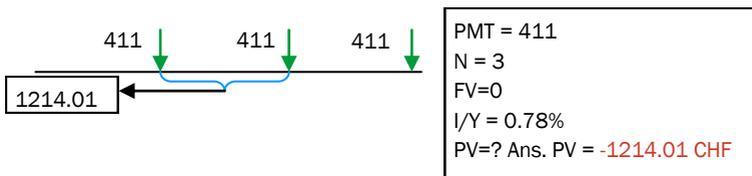


You did a 5 year fixed-fixed cross currency swap, 2 years ago in which you paid CHF against receiving USD upon a notional of USD 1m. The spot USD/CHF rate was 0.98 and the 5 year USD swap rates against LIBOR flat are 1.5%. The Swiss Franc is now weakening against the dollar and your counterparty would prefer to now receive dollars and pay down the weaker currency. The spot rate is now 0.995 and the CHF coupon against fixed USD 1.5% payments for a 3 year maturity is quoted at 0.78%. Compute your Profit / Loss.

Answer:

You will make a profit here as you will make CHF payments on a lower notional amount but receive CHF payments on a higher notional determined by the current spot rate!

The amount you will receive each year for the next three years is—
 $0.0078 * 995,000 - 0.0075 * 980,000 = \text{CHF } 411$



Translating this at the present spot rate into dollars receivable we will make a profit of **USD 1220.1105**.

This is approximately the amount the counterparty will have to pay us in order to unwind the earlier swap.

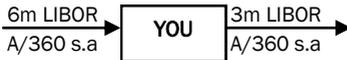
Basis Risk

Consider the following situations—

A: TENOR BASIS RISK

You are the treasurer of a global corporate and have raised floating rate funding and are servicing your debt on 3m LIBOR flat every quarter A/360 basis. In order to hedge your risk you bought a floating rate note yourself. However this floating rate note pays 6m LIBOR semi annually on a 30/360 basis.

This is how your position looks—



The risk you face here is that you make your interest payments one quarter and the issuer of the floating rate note you have purchased defaults. You hence have a small interim credit exposure. Further, since you receive floating coupon less frequently, you may only reinvest it less frequently.

This risk is called “Tenor Basis Risk” and sometimes called “Single currency Basis Risk”.

B: CROSS CURRENCY BASIS RISK

You are the treasurer of a global corporate headquartered in Chicago. Your revenues and your accounting is done in USD, and you also have an investment in a downstream company which pays you revenues linked to USD LIBOR. You are incidentally funding a project and are unable to raise debt in USD at the prevailing market conditions. You instead decide to raise funds in the Japanese Bond Markets. Since you have floating rate receivables you raise floating rate debt.

This is how your position looks—



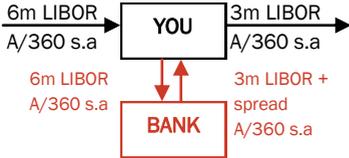
The risk you face here is that the JPY LIBOR index rises much steeper than the USD LIBOR index. This would mean you would have a net liability if the nature of the American and Japanese rates markets not to revert soon. This is called “Cross Currency Basis Risk”.

Hedging Basis Risk

This is additional opportunity for banks by virtue of them being highly connected to the debt capital markets.



Tenor Basis Swap



A tenor basis swap is one where 2 floating rate interest payments in the same currency are exchanged. For the two cash flow streams to have the same present value today a spread is generally added to the lower term floating rate.

The terms to be decided at the initiation of a basis swap (apart from the floaters of course) are the maturity, the notional principal amount and the price (spread).

Common tenor basis swaps are 1s/3s, 6s/12s, 1s/6s.
The example shown above is a 3s/6s basis swap and the spread is added to the 3 month

Basis swaps are mainly used by commercial banks to match the risks between their borrowing and lending activities. The Basis swap market is a purely OTC market.

7:46 USD BASIS SWAPS

TERM	1 MONTH VS 3 MONTH			3 MONTH VS 6 MONTH			Time
	Spot	IMM	1W	Spot	IMM	1W	
6 MO	3.70	6.10	3.90	12.00	11.20	11.80	7:05
1 YR	5.80	7.10	5.90	11.40	10.90	11.30	7:00
2 YR	7.40	8.00	7.40	10.60	10.30	10.50	7:05
3 YR	7.50	7.80	7.50	9.90	9.70	9.90	6:59
4 YR	7.30	7.50	7.30	9.60	9.40	9.50	6:00
5 YR	7.10	7.20	7.10	9.30	9.20	9.30	6:00
6 YR	6.80	6.90	6.80	9.10	9.00	9.10	6:00
7 YR	6.50	6.60	6.50	9.00	8.90	9.00	6:59
8 YR	6.20	6.30	6.20	8.90	8.80	8.90	6:59
9 YR	5.90	6.00	5.90	8.80	8.70	8.80	6:59
10 YR	5.60	5.70	5.60	8.70	8.60	8.70	6:00
12 YR	5.10	5.10	5.10	8.50	8.50	8.50	7:00
15 YR	4.40	4.40	4.40	8.40	8.30	8.40	6:00
20 YR	3.60	3.70	3.60	8.20	8.10	8.20	6:59
25 YR	3.20	3.20	3.20	8.00	8.00	8.00	6:00
30 YR	2.90	2.90	2.90	7.90	7.90	7.90	6:00



MID MARKET QUOTES

The 1s/3s basis swap spread for a 2 year tenor is 7.4 bp. i.e.

The pricing for this is shown later.

The 3s/6s basis swap spread for a 6 month tenor is 12.00 bp. i.e.

The dealer may quote a margin over the mid market rate.

Interest Rate, Basis and Cross Currency Swaps

Leg 1	Receive Float	Leg ID	10MM	Leg 2	Pay Float	US 1mth Libor
Notional	USD	Index	US0003M	Notional	USD	Leg ID
Effective	10/21/2010	Latest Index	0.28906	Effective	10/21/2010	Index
Maturity	10/21/2012	Tenor	3 Month	Maturity	10/21/2012	Tenor
Reset Freq	Quarterly	Leverage	1.00000	Reset Freq	Monthly	Leverage
Pay Freq	Quarterly	Spread	0.00 bp	Pay Freq	Quarterly	Spread
		Day Count	ACT/360			7.41 bp
MV	10,000,000.00	Accrued	0.00	MV	-10,000,000.00	Accrued
Premium	100.00	DV01	255.37	Premium	-100.00	DV01
						-255.59
Market				Market		
Dscnt Curve	23 Bid	USD Swaps(30/360,S/A)		Dscnt Curve	23 Bid	USD Swaps(30/360,S/A)
Fwd Curve	23 Bid	USD Swaps(30/360,S/A)		Fwd Curve	50 Bid Pay	US 1mth Libor
Curve Date	10/19/2010	Valuation	10/21/2010			
Valuation						
Principal	0.00	Calculate		Leg2: Spread	DV01	-0.22
Accrued	0.00	Premium			0.00000	Gamma (1bp)
Market Value						0.00

The positive spread goes on the shorter tenor index. If a dealer quotes you USD 1s/3s 2 year at 7.00/7.90, then you will have to

- pay 3m LIBOR + 7.9bp to receive 6m LIBOR flat (or)
- Pay 6m LIBOR flat to receive 3m LIBOR + 7.0bp

The spread would go on the 3m LIBOR leg in this case.

Also note that the payment frequencies are different. Hence it is possible to receive a coupon under the basis swap around the date your interest payments are due to perfectly hedge any interest rate exposure.

Leg 1	Receive Float	Leg ID	10MM	Leg 2	Pay Float	US 6mth Libor
Notional	USD	Index	US0003M	Notional	USD	Leg ID
Effective	10/21/2010	Latest Index	0.28906	Effective	10/21/2010	Index
Maturity	04/21/2011	Tenor	3 Month	Maturity	04/21/2011	Tenor
Reset Freq	Quarterly	Leverage	1.00000	Reset Freq	SemiAnnual	Leverage
Pay Freq	Quarterly	Spread	12.03 bp	Pay Freq	Quarterly	Spread
		Day Count	ACT/360			0.00 bp
MV	10,006,076.15	Accrued	0.00	MV	-10,006,076.15	Accrued
Premium	100.06	DV01	255.60	Premium	-100.06	DV01
						-505.20
Market				Market		
Dscnt Curve	23 Bid	USD Swaps(30/360,S/A)		Dscnt Curve	23 Bid	USD Swaps(30/360,S/A)
Fwd Curve	23 Bid	USD Swaps(30/360,S/A)		Fwd Curve	51 Bid Pay	US 6mth Libor
Curve Date	10/19/2010	Valuation	10/21/2010			
Valuation						
Principal	0.00	Calculate		Leg1: Spread	DV01	-249.61
Accrued	0.00	Premium			0.00000	Gamma (1bp)
Market Value						-0.02

Basis Swap Spread

Technically the basis swap spread must be zero, if the long term lending rates are the geometric average of current and future short term rates. However, banks are reluctant to lend to each other on the interbank market for periods greater than 1 week and expect large premiums to do so. Hence the large premiums on LIBOR fixings greater than a week led to a widening out of basis swap spreads post 2008.

Interest Rate, Basis and Cross Currency Swaps

Hence it is possible to look at the basis swap spread as a compensation demanded by the banks for taking on the credit risk in the interbank market at the expense of liquidity.

Cross Currency Basis Swap

The Cross currency Basis Swap like its name suggests is a cross currency swap and a basis swap, i.e. floating rate payments in 2 different currencies are exchanged.

(A) Much like a Cross Currency Swap the principal amounts exchanged at initiation and maturity are determined by the FX Spot rate today.

(B) Like a Basis Swap the payments on each leg are based on the value of the floating rate index in subject.

The price is computed as the spread over the floating rate and is added onto the "non USD leg" of the swap.

The pricing is as shown below—

Leg 1	Receive Float	US 6mth Libor	Leg 2	Pay Float	JPY Basis Swaps
Notional	10MM	Leg ID	804,505,229.28	Leg ID	JY0006M
Currency	USD	Index	US0006M	Index	0.39750
Effective	11/03/2010	Latest Index	0.44860	Effective	11/03/2010
Maturity	11/03/2015	Tenor	6 Month	Maturity	11/03/2015
Reset Freq	SemiAnnual	Leverage	1.00000	Reset Freq	SemiAnnual
Pay Freq	SemiAnnual	Spread	0.00 bp	Pay Freq	SemiAnnual
		Day Count	ACT/360		
			...		
MV	25,938.32	Accrued	0.00	MV	-25,938.32
Premium	0.26	DV01	-239.71	Premium	0.26
Market					
Dscont Curve	23 Bid	USD Swaps(30/360,S A)	Dscont Curve	97 Bid	JPY Basis Swaps
Fwd Curve	51 Bid	US 6mth Libor	Fwd Curve	13 Bid	Japanese Yen
Curve Date	11/01/2010	Valuation	11/03/2010	Currency	USD
Valuation				FX Rate	0.012430
Principal	0.00			BF01	US 6mth Libor
Accrued	0.00	Calculate	Leg2: Spread	DV01	-4,944.04
Market Value	0.00	Premium	0.00000	Gamma (bp)	-245.79
					0.06

The JPY notional that will be exchanged against the USD 10,000,000 principal at initiation and at maturity.

The Spread on 6m JPY LIBOR is -53.39bp

The spot FX rate used to translate the principal amount today.

Interest Rate, Basis and Cross Currency Swaps

Reset Date	Reset Rate	Reset Date	Reset Rate
11/02/2010	0.39750	11/02/2010	0.44860
05/04/2011	0.33955	05/04/2011	0.48137
11/02/2011	0.36120	11/02/2011	0.62482
05/03/2012	0.35628	05/03/2012	0.72473
11/01/2012	0.40661	11/01/2012	1.05013
05/02/2013	0.42352	05/02/2013	1.43069
11/01/2013	0.49972	11/01/2013	2.02738
05/02/2014	0.53292	05/02/2014	2.38879
10/31/2014	0.66208	10/31/2014	2.73723
05/05/2015	0.71546	05/05/2015	3.08253

The days basis on both legs are A/360.

6m JPY Forward Curve

6m USD Forward Curve

Cash Flow Profile

Pay Date	Payments (Rcv)	Payments (Pay)	Fwd FX	Net Payments	Discount	PV
11/04/10	-10,000,000.00	10,000,039.31	0.01243	39.31	0.999993	39.31
05/06/11	22,806.12	6,944.85	0.01245	29,750.97	0.998378	29,702.71
11/04/11	24,335.70	9,875.51	0.01249	34,211.21	0.996314	34,085.11
05/08/12	32,282.55	9,002.23	0.01254	41,284.79	0.993517	41,017.15
11/05/12	36,437.93	6,652.23	0.01260	45,490.16	0.989866	45,029.16
05/07/13	53,381.38	6,599.85	0.01268	59,981.23	0.984821	59,070.70
11/05/13	72,329.15	5,737.77	0.01278	78,066.92	0.977957	76,346.11
05/07/14	103,058.64	1,805.23	0.01291	104,863.87	0.968648	101,576.20
11/04/14	120,103.13	52.12	0.01306	120,155.25	0.957799	115,084.52
05/07/15	139,902.91	-6,981.80	0.01325	132,921.11	0.944309	125,518.54
11/04/15	10,154,982.98	-10,829,945.91	0.01345	-674,962.93	0.929636	-627,469.50

10,000,000*

0.0048137*

182/360

804,505,229.28*

0.01243005

The Forward JPY/USD FX Rates

These are derived from the Fwd USD LIBOR curve (refer Rates 102)

Net Payment Discounted to present value in USD.

804,505,229.28*(0.0040661-0.005339)

*183/360*0.01286

53,381.38 + 6599.85

We can see how the various payments are derived from the annotations above. The notional exchanged at maturity is same as the notional exchanged at initiation and is determined using the spot FX rate at initiation.

Also note that the basis swap can also be priced using the no arbitrage relation like the one we had derived for Fixed-Fixed Cross Currency Swap.

Conversion Factors



Here's a Question: Would the following two swaps amount to the same?

(A) Receiving JPY LIBOR - 53.39 vs paying USD LIBOR

(B) Receiving JPY LIBOR vs USD LIBOR + 53.39

Answer: NO. If we transfer the spread onto the USD leg, The present value of JPY LIBOR payments would equate to the present value of USD + 51.69bp payments. In other words 1 JPY basis point is not equal to 1 USD basis point.

Interest Rate, Basis and Cross Currency Swaps

Why is this so? Think of this -



You are the Bank. You fund yourself at Turkish Lira Libor (TRY) or Yen Libor (JPY) flat. You lend to your client in either currency with a credit margin of 100 bps.

You can get 18% for 10 yr Turkish rates, 1.5% for Yen rates.
What cash flow stream would you rather have?

Answer: Take the 100 yen basis points! The cash flow stream with the higher present value is what you want. Take a look—

 Currency = TRY PMT = 100 N = 10 FV = 0 I/Y = 18% PV = 449bp	 Currency = JPY PMT = 100 N = 10 FV = 0 I/Y = 1.5% PV = 922bp	Conversion Factor = 922/449 = 2.21 For the same value credit margin, charge at Yen Libor + 100 bps or TRY Libor + 221 bps.
---------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------

Going back to USD and JPY

Why is it better to receive ¥(LIBOR)+100 than \$(LIBOR)+100 in a cross currency swap?

PV of a 100 USD bp receivable in 1 year at spot rate of 2.64% = 97.43bp

PV of a 100 JPY bp receivable in 1 year at spot rate of 0.10% = 99.90bp

Hence 1 year conversion factor = 99.90/97.43 = 1.0254 JPY bp / USD

Years	US		Japan		Conversion Factors
	SPOT	PV	SPOT	PV	
1	2.64%	97.43	0.10%	99.90	1.0254
2	3.66%	189.53	0.14%	199.58	1.0530
3	4.26%	276.15	0.21%	298.74	1.0818
4	4.66%	357.41	0.34%	396.62	1.1097
5	4.95%	433.55	0.50%	492.59	1.1362
7	5.33%	571.78	0.86%	676.53	1.1832
10	5.64%	748.73	1.34%	930.08	1.2422
15	5.93%	975.68	1.79%	1,305.35	1.3379
20	6.05%	1142.35	2.03%	1,630.42	1.4273
30	6.09%	1363.33	2.25%	2,164.53	1.5877

Interest Rate, Basis and Cross Currency Swaps

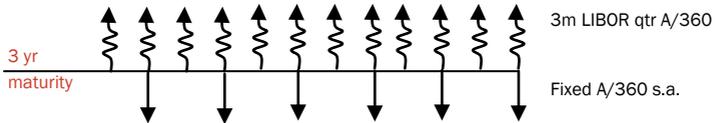
The table in the earlier page shows a list of conversion factors for each term into the future. For example 1 USD bp receivable 2 years into the future would be equivalent to receiving 1.053 JPY bp into the future.

Snippet Box

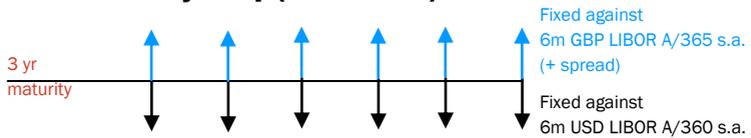
Voila!

In Summary

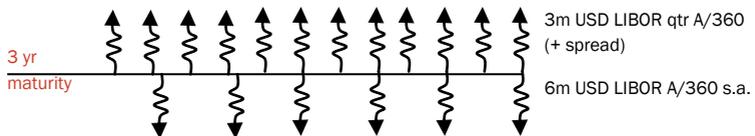
Vanilla Fixed-Floating Interest Rate Swap



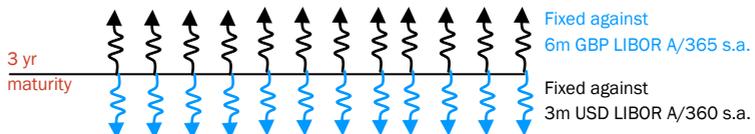
Cross Currency Swap (Fixed-Fixed)



Tenor Basis Swap



Cross Currency Basis Swap



Try for yourself: An Opportunity Spotting Exercise



We saw several uses for interest rate swaps. With the knowledge of this how can we follow deals that happen in the bank's other businesses and follow them down the supply chain to bring in swap business?

Look at the following client scenarios and suggest potential swap deals that would be appropriate for the client.

A. Debt Origination Deal

American Company raises JPY Debt from Japanese debt investors which they service on JPY LIBOR in JPY. Their Revenues are however in USD.

B. Commercial Lending

You are part of a team to arrange a large syndicated loan for your client, a global consumer goods company. Under the loan agreement the client is expected to adhere to several covenants imposing control over the liquidity of his balance sheet, the solvency of his fixed asset base, the amount reinvested into the firm, financial leverage, and the dollar value of operating profit per dollar of interest payable.

C. Bond Trade

Your bank was the book runner of a \$5bn bond issue for a Swedish Furniture Giant, and did the Bond issue as a bought deal, whilst also agreeing to maintain liquidity in the issue over the initial 3 months of trading. You are holding \$10m of these bonds on one of your books and the bond has a duration of 13.2. The bond pays a fixed 5% coupon semi annual bond basis. How can you hedge your position in the swap market using the following instruments. The bond has 4 years to maturity—

Swap	Type	Duration	Cpty	Notional (of upto)	Maturity	Starting	Index
A	Payer	7	C1	\$9m	4y	Today	6m USD LIBOR
B	Receiver	3	C2	\$5m	4y	Today	6m USD LIBOR
C	Payer	9.2	C3	\$2m	2y	Today	6m USD LIBOR
D	Payer	10.2	C4	\$3m	5y	2y fwd	6m USD LIBOR
E	Receiver	4	C3	\$10m	4y	2y fwd	6m USD LIBOR

* Payer—you will pay fixed under the swap

Interest Rate, Basis and Cross Currency

D. Commodity Basis Risk

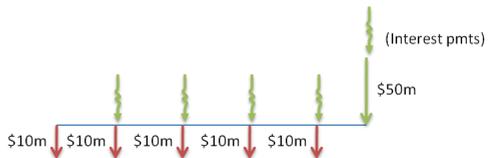
You are a Norwegian oil company. You will buy a cargo of “Malaysian Tapis Crude” from a Malaysian oil company each month, for the next 6 months at the month’s average price. Since you are exposed to rising prices of Tapis crude, and since this grade of crude doesn’t have a paper market you sell a series of WTI futures on NYMEX as a hedge. A month has passed and you realize that the correlation between WTI prices and Tapis prices has reversed, however Tapis price and Brent Crude price are still nearly perfectly positively correlated.



E. Project Finance

The project finance division of your bank is financing a telecom company for a project over a five year term. They will extend to the client a sum of USD 10,000,000 each year for the next five years for a claim on project revenues over the 5 year period at a cost of 1 year USD LIBOR+50bp payable annual Act/365. The project revenues can be used to amortize principal on the loans over the period. The project finance desk calls in for a suggestion on how their clients funding cost may be capped by the use of swaps. Suggest how this may be done using—

- A) A vanilla interest rate swap
- B) Amortizing swap
- C) Forward starting swap
- D) Payers’ Swaption



F. Putting it all together

Your client, an insurance company has raised floating JPY debt but prefer to pay fixed USD as their assets are long term fixed rate assets. They call you to swap these two cash flow streams for a 5 year term and have asked you to quote them a premium in JPY basis points. What are all the constituent swap deals you will have to execute in the background to structure this swap for your client?



Suggested Answers

Hope you were able to think of potential swap deals that might be of interest to your client. Here are some suggested answers—

Debt Origination Deal	Swaps Desk
<p>American Company raises JPY Debt from Japanese debt investors which they service on JPY LIBOR in JPY. Their Revenues are however in USD.</p>	<p>1 Do a Cross Currency Swap: Your payables are in JPY but your receivables are in USD. Let us help you mitigate your currency risk!</p> <p>2 Do a Basis Swap: You are now paying interest on debt against JPY LIBOR but in USD. If you believe that Japanese interest rates are rising though you would like to still pay floating on your debt, we can swap you into USD LIBOR perhaps?</p> <p>3 Do an Interest Rate Swap: Do you believe that the yield curve is flatter than it should be? That mean the fixed swap rate is low as well. Would you like to swap into paying fixed?</p>

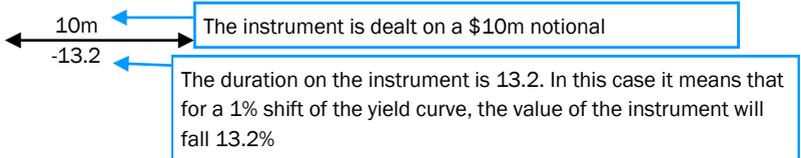
Commercial Lending	Swaps Desk
<p>Under the loan agreement the client is expected to adhere to covenants regarding the dollar value of operating profit to be maintained per dollar of interest payable i.e. An interest coverage ratio = EBIT/interest payments</p>	<p>1 Do an Interest Rate Swap: Your interest coverage ratio must not fall below 4? Limit your interest payments in the medium to long term! On what index do you service the loan? What is your outlook on the said index?</p> <p>2 Do a Cross Currency Swap: Are your revenues and your loan interest payments on different currencies. What are your outlook on the two currencies? Give us your currency translation risk!</p> <p>3 This is also a cross selling opportunity! When are your cash inflows receivable? Do they match and net off your payables? Would you like us to help you re-structure your assets / liabilities? Our bank also offers advisory services on these.</p>

Interest Rate, Basis and Cross Currency Swaps

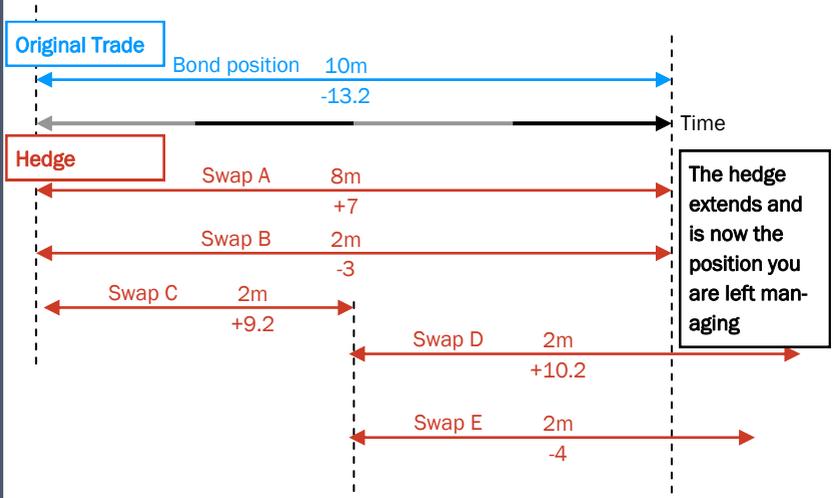
Bond Trade

The key here is to know your exact exposure and purchase positions in the swaps as a hedge to retain just enough interest rate exposure as we're comfortable with or alternatively build a perfect hedge to void our position. Here we will look to build a perfect hedge. Remember that a receiver (payer) swap position is equivalent to a long (short) bond position.

The conventions to read the picture below are -



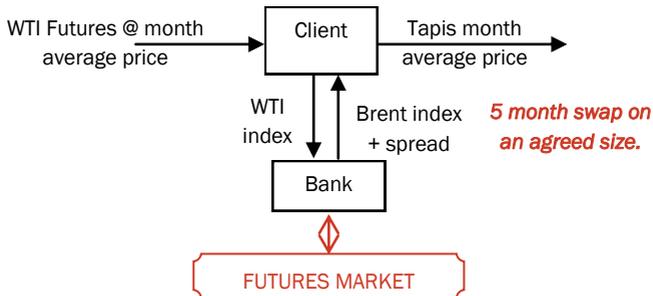
Here's a detailed look at exposures—



Commodity Basis Swap

This is an opportunity for banks too. Since banks are players on the paper markets and are connected to commodity exchanges, they can make markets in commodity futures contracts. A bank can provide a basis swap for a term of 5 months, and suitably hedge themselves on the other side using futures contracts. The spread is quoted on either leg to adjust for the difference in risk.

Interest Rate, Basis and Cross Currency Swaps



Project Finance

Swaps Desk

The project finance division of your bank is financing a telecom company for a project over a five year term. They will extend to the client a sum of **USD 10,000,000 each year for the next five years** for a claim on project revenues over the 5 year period at a cost of **1 year USD LI-BOR+50bp payable annual Act/365**. The project revenues can be used to **amortize principal on the loans over the period**. The project finance desk calls in for a suggestion on how their clients funding cost may be capped by the use of swaps.

- 1 **Do a Vanilla Interest Rate Swap:** Do you believe your funding cost is likely to be too high over the 5 year period? Do you believe the yield curve is too flat? Why don't you pay a fixed rate instead? Not entirely sure of your view? Would you purchase a cap on LI-BOR+50bp? Would you like a structured cap product?
- 2 **An Amortizing/Accreting Swap:** Do you have a planned principal amortization schedule based on your forecasted cash flows? If you do not, you are paying your interest on a greater notional each year, and hence you have a greater dollar duration. Would you like to reduce your interest payments by paying fixed on this amortizing / accreting notional scheme?
- 3 **A Forward Starting Swap:** You are comfortable making floating rate interest payments now, but have a differing expectation on rates beginning sometime in the future. Why don't you consider a forward starting swap? You can hereby lock in your swap rate today for a period beginning in the future.
- 4 **A Swaption:** Is it expensive for you to service the swap at the moment? You do not mind a loss of upto 5bp, but would like protection for rate fluctuations beyond 5bp? Have you considered purchasing a payers swaption for a small premium today?

Notes

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