ISMA

ISMA CENTRE - THE BUSINESS SCHOOL
OF THE FINANCIAL MARKETS

UNIVERSITY OF READING
ENGLAND

ISMA
CENTRE

IFID Certificate Programme

Rates Trading and Hedging

Interest Rate Options

Table of contents

1. Overview 3

2. Bond Options 4
   2.1. Market Prices 6

3. Eurocurrency Options 7
   3.1. Application 7

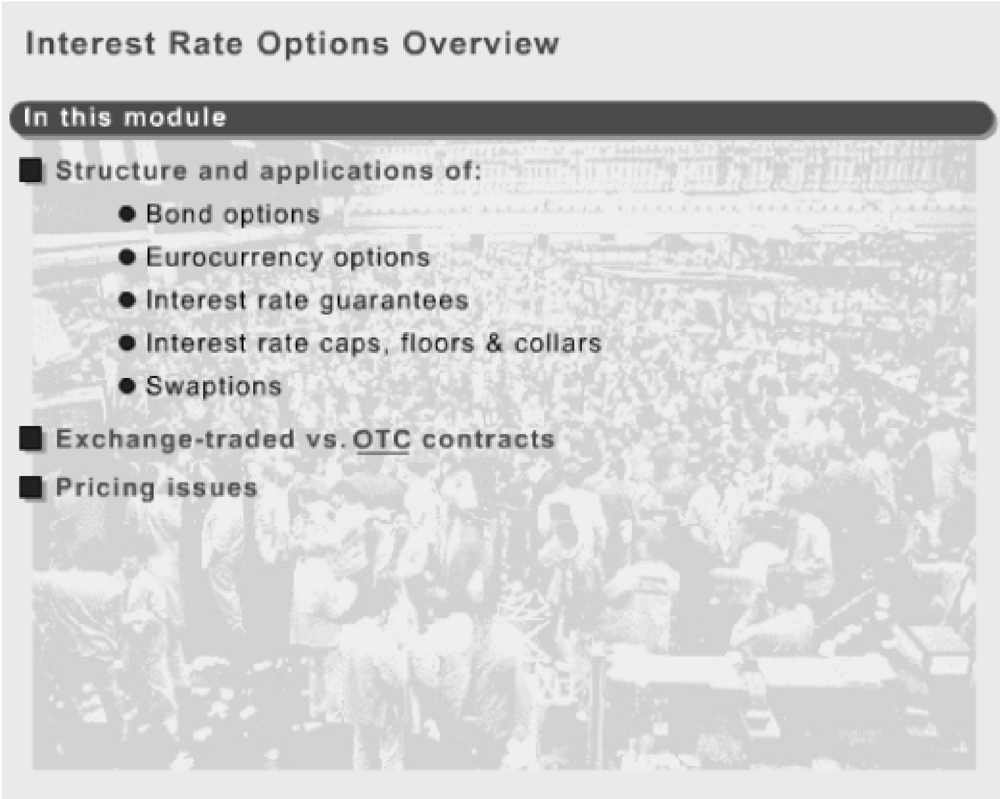
4. Interest Rate Guarantees 9

5. Caps, Floors & Collars 10
   5.1. Market Quotation 11

6. Swaptions 14
   6.1. Example - Hedging 14
   6.2. Other Applications 15
   6.3. Swaptions and Caps Compared 15
   6.4. Market Quotation 17

7. Exercise 20

1. Overview



In this module we describe the structure of various interest rate options products and examine some of their applications. We also compare the benefits and disadvantages of exchange-traded vs. OTC contracts.

Many of the products in this class are indexed on rates of interest which are more or less correlated with each other, and there has been a great deal of theoretical research into developing pricing models which take these correlations into account and are capable of pricing all the products consistently. In this module we explain the theoretical issues involved and some of the practical difficulties.

Learning Objectives

By the end of this module, you will be able to:

1. - Explain the limitations of standard models for the pricing of bond options
2. - Compare the relative merits of using yield volatility, as opposed to price volatility, in the valuation of bond options
3. - Describe the structure and typical applications of the following interest rate options:
    - Caps and floors
    - Swaptions
4. - Explain how:
    - A swaption may be viewed as an option on a strip of forward rates
    - An interest rate cap or floor may be viewed as a strip of options on forward rates
    - A swap may be viewed as a zero-cost interest rate collar

5. - Structure an advancing swap and a putable/extensible swap using vanilla swaps, forward swaps and swaptions

6. - Interpret typical broker quotations for standard caps, floors and swaptions

2. Bond Options

Below is the contract specification for the 30 year US Treasury bond options traded at the Chicago Board Options Exchange (CBOE), one of the most popular bond options.

Contract	CBOE US Treasury Bond Futures Option
Unit of trading	1 US Treasury Bond Futures
Expiry months	Front months plus March, June, September, December
Expiry day	10:00 AM Saturday following the Last Trading Day
Last trading day	Friday of the month preceding the last business day of the month prior to the contract Expiry Month by at least five business days.
Quotation	Percentage of face value (i.e. per $100 nominal)
Minimum price movement (Tick size)	1/64% of the futures contract size ($100,000)
Tick value	$\frac{1/64}{100} \times 100{,}000 = \text{USD } 15.625$
Regular trading hours	07:20 - 14:00 Chicago time

Note:

- **Futures option**: the option is on a T-bond futures contract, rather than on the underlying bonds (see Bond Futures - Definition). If the option is exercised the holder's position is changed into an equivalent futures position opened at the option's strike, and from then on it is marked to market accordingly.

- **Tick size & value**: premium prices are quoted to the nearest 1/64th of 1% of the underlying futures contract size. In most other futures and options markets (except on the UK Gilt contracts) the tick size is 0.01%.

  $$\textbf{Tick Value} = \frac{\textbf{Tick Size}}{\textbf{100}} \times \textbf{Contract Size}$$

Analytic systems
Examples of Reuters bond futures options analysis functions

Below are sample screens from two widely-used providers of market information and analytics.

These examples are for illustration purposes only and do not form part of the IFID Certificate syllabus.

Reuters bond futures

BUND FUT 6% MAR4 | 113.520 | 0.14 / 0.12% | DTB / EUR | Future Options List | Help

FGBL: | MAR4 | Exercise Style: AMER | 18 Dec03

ATM Chain Only | Own Volatility

4 Chains found

30 Cntrcts found

Calculation Info: Whaley

Call/Put Ratios	
Volume	7/8
Opn Int	5/6
OI Nch	0/1
Center	113.52
+/- % ATM	2.0%

Selected Options | Display Name:

To construct a strategy, click->

CALLS Totals: Avg IV 5.2% | Volume 2320 | OI/ Nch 58325 17

PUTS Totals: Avg IV 6.7% | Volume 2634 | OI/ Nch 69437 5034

Show All | ATMs Only

Last	Bid	Ask	IV Bid	IV Ask	IV Sprd b	Delta	Gamma	ExpDate	Strike	Last	Bid	Ask	IV Bid	IV Ask	IV Sprd b	Delta	Gamma
								20 Feb04	110	0.1400	0.1300		5.874%				
								20 Feb04	110.5			1.3500		13.838%		-0.3095	0.053503
								20 Feb04	111	0.2600							
								20 Feb04	111.5		0.3200	0.3600	5.487%	5.772%	29	-0.2244	0.108999
								20 Feb04	112		0.4400	0.4800	5.455%	5.706%	25	-0.2813	0.124191
								20 Feb04	112.5	0.6300	0.5900	0.6500	5.413%	5.757%	34	-0.3484	0.134877
								20 Feb04	113	0.7500							
1.0200								20 Feb04	113.5								
0.8000		1.0000		6.463%		0.4421	0.128223	20 Feb04	114								
								20 Feb04	114.5								
0.4300	0.4000	0.4400	5.063%	5.314%	25	0.2832	0.133757	20 Feb04	115								
	0.2800	0.3200	5.041%	5.329%	29	0.2219	0.117274	20 Feb04	115.5								
0.2200	0.1800	0.3000	4.932%	5.921%	99	0.1945	0.097677	20 Feb04	116								
0.1300	0.0300	0.1500	3.596%	5.274%	168	0.1222	0.080722	20 Feb04	116.5								
0.0900		0.0900		5.138%		0.0817	0.061733	20 Feb04	117								

Notes

- The screen shows calls and put prices for MAR 2004 Bund futures with various strikes within a 2% range of the underlying futures
- Using a Whaley model[1] for pricing American options, the system calculates the **implied volatilities** behind the observed bid and ask prices of these options, as well as the options' **deltas** and **gammas** (concepts that we shall discuss in more detail in module *Options Pricing and Risks – Implied Volatility*)

[1] The Barone-Adesi and Whaley pricing model, known as a pseudo-American model, is an analytical Black-Scholes type formula that gives excellent approximations to the results that you would obtain using a computational model such as the binomial.

2.1. Market Prices

Below is a typical set of prices for a selected series of strikes and expirations. For reference, we also show where the corresponding futures were trading at the time.

LIFFE Bund Futures Options Settlement

23 Feb 1999
(EUR 250,00 points of 100%)

	Calls		Puts	
Str.	**May**	**June**	**May**	**June**
... ...				
107.00	0.74	0.94	0.84	1.04
107.50	0.52	0.71	1.12	1.31
108.00	0.35	0.52	1.45	1.62
... ...				

*Futures Settlement MAR 107.61 JUN 107.04

In practice, most of the liquidity is concentrated in the near months and in the close-to-the-money strikes. Looking at these prices, as you would expect, you notice:

- For the calls, the higher the strike the lower the premium; for puts it is the opposite
- Premium prices for the far months are higher than for the near months: the longer the time to expiry the higher is the option's time value

Premium Calculation – Example

Trade:	Buy 23 June 107.50 Bund puts
Tick size:	0.01/100 x 250,000 = DEM 25.00
Premium price:	1.31% (or 131 ticks)
Last trading day:	Friday, 19 June
Expiry:	10:00 AM Saturday, 20 June

Premium payable = 131 x 25.00 x 23
= DEM 75,325.00

3. Eurocurrency Options

Below is the definition of one of the most liquid interest rate option contracts: the Eurodollar futures options traded in the International Monetary Market (IMM) at CME.

Contract	CME Eurodollar interest rate futures option
Unit of trading	One three months Eurodollar futures
Delivery months	March, June, September, December
Delivery day	Third Wednesday of Delivery Month
Last trading day	11:00 (London) two business days prior to Delivery Day
Quotation	100.00 minus rate of interest
Minimum price movement (Tick size)	0.01% (one basis point)
Tick value	USD 25.00
Trading hours	07.20 - 14.00 (Chicago)

Settlement

Like the underlying futures contract, the options are cash-settled on the expiry date against the **Exchange Delivery Settlement Price** (see Eurocurrency Futures - Definition).

EDSP = 100 - Three Month LIBOR

The options are American style and exercise before expiry means the options position is replaced with an equivalent futures position at the options' strike, and is marked to market in the normal way thereafter.

Market Prices

LIFFE Eurosterling Options Settlement[2] 3 March 1998 (GBP 500,000, points of 100%)				
	Calls		Puts	
Strike	**June**	**Sep**	**June**	**Sep**
9250	0.11	0.28	0.15	0.17
9275	0.04	0.15	0.33	0.29

3.1. Application

Like all options, the contract may be used for speculative or for hedging purposes.

Example – Hedging

Date: 10 March 1998

Scenario: In its latest Quarterly Inflation Report, the Bank of England said:
"It is more likely than not that a modest further rise in interest rates will be necessary at some point to hit the inflation target …"
You need to fund GBP 100 million at 3 month LIBOR in 3 months' time.

Strategy: Buy puts on the LIFFE short sterling futures

[2] Underlying market prices at the time:

- Futures Settlement: JUN = 92.58 and SEP = 92.75
- Cash 3 month LIBOR = 7.47%

? How many 3 months interest rate contracts should you buy?

Analysis
The number of contracts depends on the market risk on the underlying exposure to be hedged. The tick value on the sterling contract is £12.50, so roughly:

Basis point value of exposure = Basis point value of option hedge
100 million x 0.01% / 4 = Number of options x 12.50

Number of options = 2,500 / 12.50
= **200 contracts**

Premium payable = 200 x 15 x 12.50
= **GBP 37,500**

Expiry Analysis
The table below shows the net interest rate cost to the hedger under different EDSP scenarios at the expiry of the options.

EDSP	3 month LIBOR	Premium	Expiry Payoff	Net Interest Cost
9200	8.00	0.15	+0.50	7.65%
9225	7.75	0.15	+0.25	7.65%
9250	7.50	0.15	0.0	7.65%
9275	7.25	0.15	0.0	7.40%
9300	7.00	0.15	0.0	7.15%
9350	6.75	0.15	0.0	6.90%
9400	6.00	0.15	0.0	6.15%

Capped Cost (all-in)
= 7.50 + 0.15
= **7.65%**

Refining the futures hedge ratio

Strictly speaking the hedge in the example on the previous page should be risk-weighted using the basis point value (BPV) of the two instruments.

The technique of risk-weighting is similar to the one used in the construction of risk-weighted spread trades in the bond markets (see Bond Market Risk - Trading Applications). Assuming a 6 month LIBOR of 6.65%:

$$\text{Basis point value of underlying exposure} = \frac{0.01\% \times 100 \text{ million} \times 91 / 365}{(1 + 0.0665 \times 183 / 365)}$$

= GBP 2,412.71

The numerator in this formula is the future value of one basis point and the denominator is the discount factor applied to present-value that cash flow. Therefore the number of option contracts required:

= 2,412.71 / 12.50
= **193 contracts**, *not* 200 as previously calculated.

Product Disadvantages

Like all exchange-traded products, options on Eurocurrency futures may be inconvenient in terms of:

- Fixed contract sizes
- Fixed expiry months (hence possible basis risk)

Moreover, users of these options for hedging purposes typically have multi-period exposures to LIBOR, possibly stretching many years into the future. Typically, they need to buy **strips** of options, rather than just a single one, and in this situation they find it more convenient to use OTC interest rate **caps** or **floors**. We examine these products in the next section.

4. Interest Rate Guarantees

Interest Rate Guarantee (IRG): an option on a forward LIBOR

This is the single-period OTC equivalent of the Eurocurrency interest rate option.

Buying an IRG call = Buying a Eurocurrency interest rate put
Buying an IRG put = Buying a Eurocurrency interest rate call

Example - Hedging

Date: 10 March 1998
Scenario: You need to borrow GBP 20 million for 6 months starting in 3 months and you are worried about the prospects of rising interest rates. 6 month LIBOR is currently 7.40%

Strategy: Buy a **3 into 6 months 7.50% call** for GBP 20 million
(i.e. a 3 month option on a 3x9 month LIBOR)

Price: 0.30% per annum

The Underlying LIBOR:

Settlement date: (i.e. option expiry)	12 June 1998
Maturity date:	14 December (using next business day adjustment convention)
Contract period:	185 days
Contract rate:	7.50%

Premium payable : = 0.30% x 20 million x 185 / 365
= **GBP 30,410.96**

Capped cost (all-in): = 7.50 + 0.30
= **7.80%**

Settlement

Settlement on this IRG at expiry will be calculated as follows[3]:

- If the option expires ITM then the option buyer receives:

  $$\frac{(\text{LIBOR - Strike}) \times \text{Notional} \times 183/365}{(1 + \text{LIBOR} \times 183/365)}$$

  Where LIBOR is the rate fixing published by the British Bankers Association (BBA) for the settlement of such derivatives

- If the option expires OTM the option buyer pays nothing

5. Caps, Floors & Collars

Interest rate cap: a strip of IRG calls (**caplets)** all struck at the same rate
Interest rate floor: a strip of IRG puts (**floorlets**) all struck at the same rate

Cap buyers wish to profit from (or hedge against) a rise in interest rates; floor buyers wish to profit from (or hedge against) a fall in rates.

Example

Date: 10 March 1998
Scenario: You issued a 5 year GBP 100 million Floating Rate Note on which you pay 6 month LIBOR + 0.20%, and you are worried that UK interest rates may rise on a two-year view. Current 6 month LIBOR is 7.40%.

Strategy: Buy a 2 year 7.50% cap (3 caplets) for GBP 100 million

Price: 0.64% flat (i.e. 0.64% of contract size)

Analysis

The LIBOR on the note is now effectively capped at 7.50%. To this we must add:

- The 20 basis points spread on the note

- The premium cost of the cap. Amortised over 2 years at 7.50% (semi-annual) the 64 basis points flat are equivalent to some 35 basis points per annum.

All-in capped cost:
= 7.50 + 0.20 + 0.35
= **8.05%**

Interest Rate Collars

Cap price = Sum of prices of the individual caplets
Floor price = Sum of prices of individual floorlets

Caps or floors can be expensive, so cap buyers often reduce their net premium cost by selling floors – i.e. they buy **interest rate collars**. Similarly, floor buyers reduce their net premium costs by selling caps - i.e. they sell interest rate collars.

[3] This is in fact the same formula that is used to settle Forward Rate Agreements (FRAs) because the IRG is an option on an FRA. The only difference between the two is that here the buyer would not have to pay if LIBOR turns out to be less than the Strike, whereas on an equivalent FRA position the buyer would have to pay the difference. In other words, the IRG can only settle to the buyer's benefit whereas the FRA would cut both ways.

- Buying an interest rate collar: buying a cap and selling a floor
- Selling an interest rate collar: selling a cap and buying a floor

It is possible to set the cap rate and the floor rate in such a way that the cost of one exactly matches the revenue from the other - a **zero-cost collar**. You will have a chance to explore zero-cost collars in an exercise, later on.

5.1. Market Quotation

The table below shows typical broker prices for interest rates caps and floors.

1152 Euro Brokers int. LDN

CAPS/FLOORS ATM VOLS

	EUR	STG
1Y	25.0-28.0	17.5-20.0
2Y	25.0-26.5	21.5-23.0
3Y	23.5-25.0	22.0-23.5
4Y	21.3-22.8	22.0-23.5
5Y	19.8-21.3	21.8-23.0
7Y	16.5-18.0	20.3-21.8
10Y	14.0-15.5	18.5-20.0

Volatility Pricing

The market quotes prices in terms of **flat** implied volatilities (i.e. the same volatility for all caplets/floorlets). Most caps and floors are traded European-style and for this contract the convention has become to price each caplet (or floorlet) using the conventional Black model (see *Option Pricing - Analytic Models*). For example, for the 3 year ATM EUR cap on 6 month LIBOR in the figure above, the market maker:

- Offers the cap by pricing each of the 5 caplets at 25.0% implied
- Bids the cap by pricing each of the caplets at 23.5% implied

The bid-offer spread in volatility translates into a corresponding spread on the premium payable. When a counterparty hits or takes one of these prices, the two parties then enter the agreed volatility into their respective pricing models, along with all the other market variables, to calculate the premium payable. Of course, this practice only works if both parties use the same pricing model!

At this level of abstraction, volatility becomes a traded commodity like government bonds or barrels of crude oil. Option traders **buy volatility** when they believe it is too low and **sell volatility** when they believe it's too high. This market sees a great deal of volatility trades in the form of straddles and strangles (see *Options Strategies - Volatility Trading*).

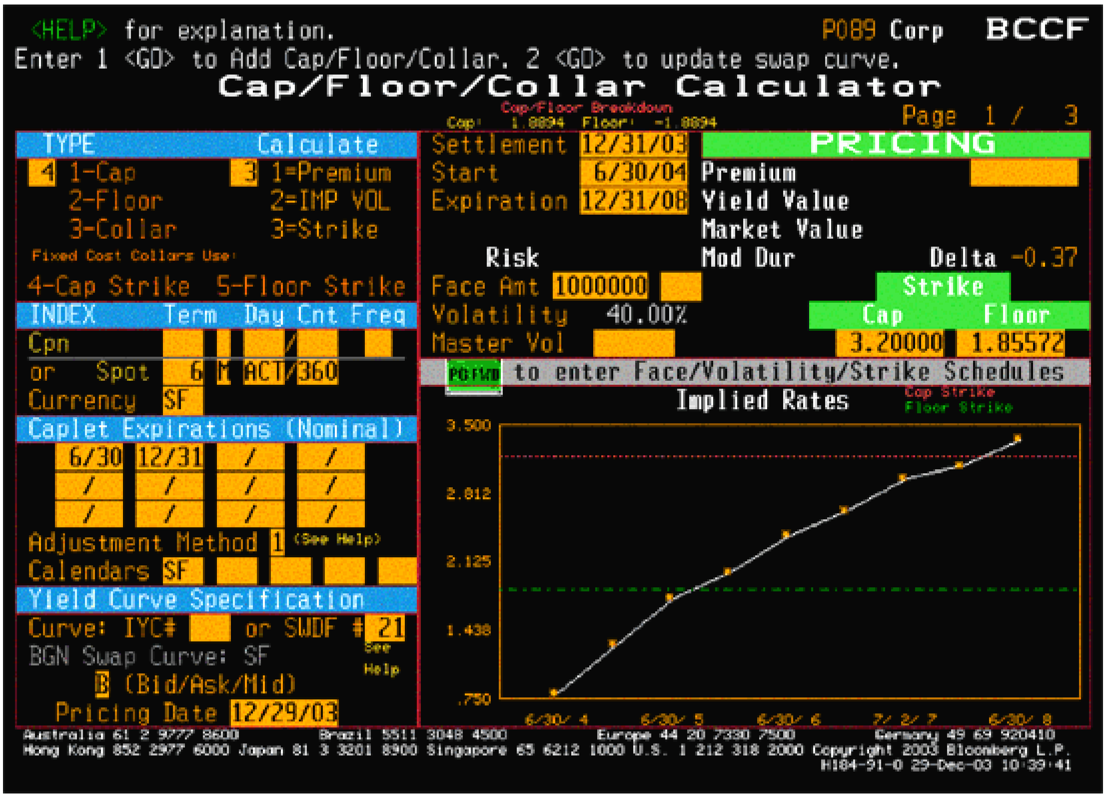
Long a straddle (or strangle) = Long a cap + Long a floor
Short a straddle (or strangle) = Short a cap + Short a floor

Analytic systems
Examples of Bloomberg and Reuters caps, floors and collars pricing functions

Below are sample screens from two widely-used providers of market information and analytics.

These examples are for illustration purposes only and do not form part of the IFID Certificate syllabus.

Bloomberg cap/floor/collar calculator

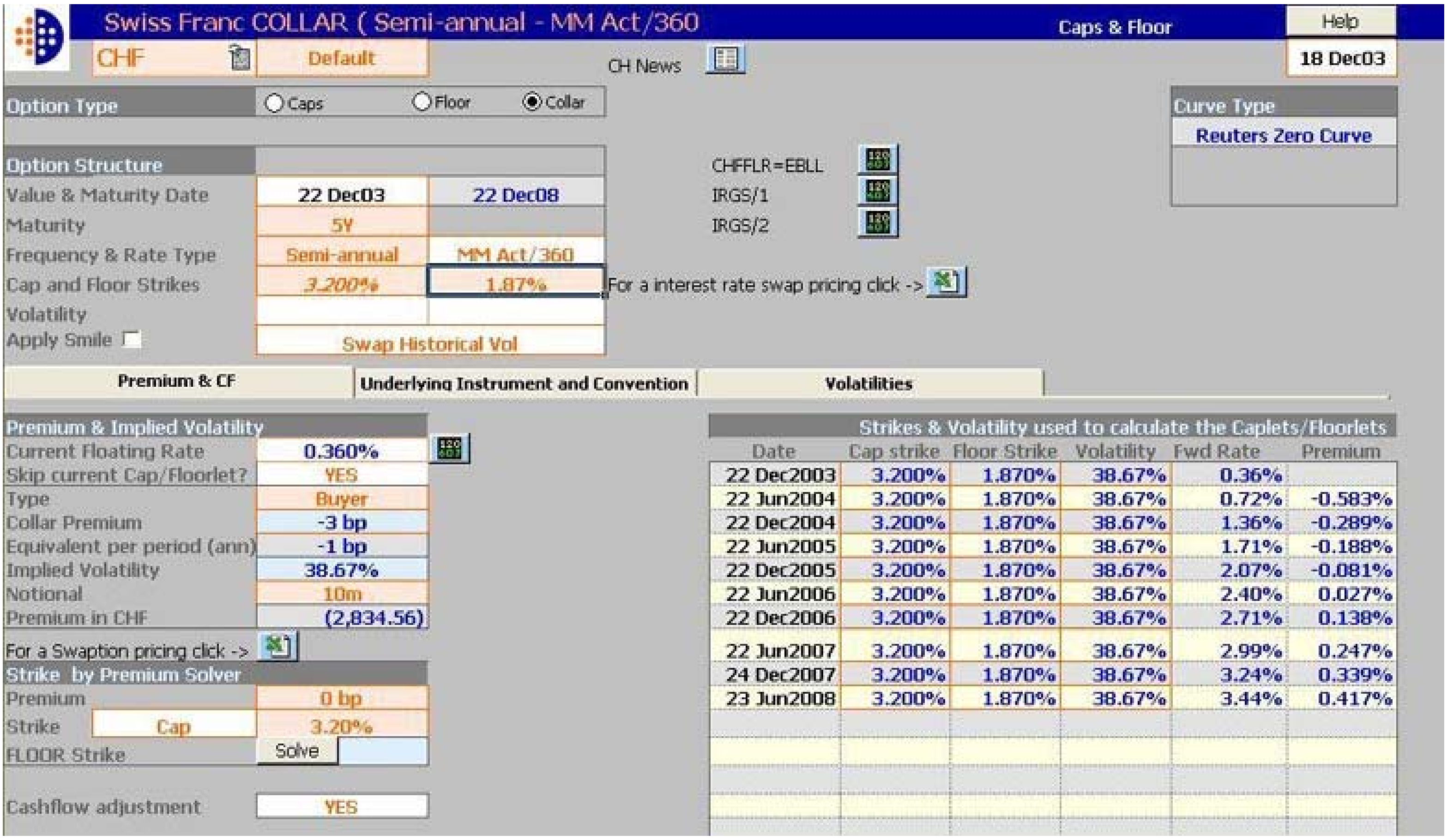


Notes

- The example prices a 5 year collar on 6 months CHF LIBOR with strikes of 3.20% and 1.856% and 40% volatility for all the caplets and floorlets embedded within the structure

- Given the cap rate of 3.20%, the floor's strike has been set at a level that gives a zero-cost collar using the calculator at the top-right of the screen (ie. 1.856%)

Reuters caps and floors



Date	Cap strike	Floor Strike	Volatility	Fwd Rate	Premium
22 Dec2003	3.200%	1.870%	38.67%	0.36%	
22 Jun2004	3.200%	1.870%	38.67%	0.72%	-0.583%
22 Dec2004	3.200%	1.870%	38.67%	1.36%	-0.289%
22 Jun2005	3.200%	1.870%	38.67%	1.71%	-0.188%
22 Dec2005	3.200%	1.870%	38.67%	2.07%	-0.081%
22 Jun2006	3.200%	1.870%	38.67%	2.40%	0.027%
22 Dec2006	3.200%	1.870%	38.67%	2.71%	0.138%
22 Jun2007	3.200%	1.870%	38.67%	2.99%	0.247%
24 Dec2007	3.200%	1.870%	38.67%	3.24%	0.339%
23 Jun2008	3.200%	1.870%	38.67%	3.44%	0.417%

Notes

- The example prices a 5 year collar on 6 months CHF LIBOR with strikes of 1.87% and 3.20% at 38.67% volatility
- Given the cap rate of 3.20%, the floor's strike has been set at a level that gives near-enough a zero-cost collar using the calculator at the bottom-left of the screen
- Notice from the table on the bottom-right that in this 5 year collar there are only 9 caplets and floorlets (not 10) because the first LIBOR is fixed on the trade date, therefore there is no market risk on it

6. Swaptions

Swaption: an option to enter into an interest rate swap.

Terminology

	What it means
Long a payer swaption	Has the right to pay the fixed rate and receive floating
Long a receiver swaption	Has the right to receive fixed
Short a payer swaption	Has the obligation to receive fixed
Short a receiver swaption	Has the obligation to pay fixed

Question 1

a) Which of these positions would you enter into if you believed swap rates were likely to fall?

- ☐ Buy a receiver swaption
- ☐ Sell a receiver swaption
- ☐ Sell a payer swaption
- ☐ Buy a payer swaption

6.1. Example - Hedging

Date: 10 March 1998

Scenario: You have a GBP 100 million 5 year fixed sterling Eurobond (AA-rated, annual coupon) which matures in 3 months and you intend to refinance this by issuing another similar 5 year straight.

5 year AA corporate bonds currently yield 7.50%, but you are worried that they may rise in the near future.

Strategy: Buy a **3 months into 5 years** payer swaption (i.e. a 3 month option to be a fixed payer on a 5 year swap)

Swaption Terms
Underlying: A 5 year GBP swap (annual 30/360 fixed against 12 Month LIBOR)
Notional: GBP 100 million
Expiry: 12 June (the swap Effective Date)
Strike: 7.65%
Price: 0.70% flat

Premium cost = 0.70% x 100 million
= **GBP 700,000**, payable spot

Option cost per annum amortised @ (say) 7.75% over 5 years = **0.17%**

Outcome – 10 June:

- **Scenario 1**: 5 year swap rate = 7.25% and the option expires OTM
  AA bond yields should be around 7¼%.
  All-in borrowing cost = 7.25 + 0.17 = **7.42%**

- **Scenario 2**: 5 year swap rate = 7.85% and the option is exercised
  Gain on the option = 7.85 – 7.65 = 0.20% per annum
  AA bond yields should be around 7.85%
  All-in borrowing cost = 7.85 - 0.20 + 0.17 = **7.82%**

  Mark to market value of the exercised swaption is the present value of 0.20% per annum discounted @ (say) 7.85% = **0.80%**

  The net profit on the option (0.10% = 0.80% - 0.70%) is used to subsidise the cost of the new issue, allowing the bond issuer to pay effectively 7.82% per annum instead of 7.85%.

Warning - the options hedges against market risk, but not against:
- **Spread risk (the swap rate may vary relative to the yield on a AA Eurobond)**
- **Liquidity risk (there may be little market appetite for this issuer's name)**

6.2. Other Applications

- **Advancing swaps**: a borrower plans to issue a 5 year bond in about 9 months, which it intends to swap into floating. If market conditions are favourable, the borrower may advance the issue and would like to enter into a 9 months into 5 years forward-start swap with the option to advance the start date by 8 months (see Interest Rate Swaps – Product Variations).

  Advancing swap = 9 mth into 5 yr forward swap + 1 mth into 8 mth receiver swaption

- **Extendible (or putable) swaps**: a borrower has a 5 year floating rate loan which it can repay after 2 years. The borrower would like to swap this into fixed with the option to cancel the swap contract if the loan is repaid early.

  Putable swap = 5 year vanilla swap + 2 into 5 year receiver swaption

  Which is identical to:

  Extendible swap = 2 year vanilla swap + 2 into 5 years payer swaption

- **Asset swaps**: an investor would like to strip the option embedded in a callable bond.
  Strategy:

  Long synthetic straight bond = Long callable bond + Long receiver swaption

The option embedded in callable bonds is typically Bermudan-style - i.e. it can only be exercised on the coupon dates. Therefore the swaption must be on the same terms. (For a discussion on how to price Bermudan options see Callable Bonds - Pricing).

6.3. Swaptions and Caps Compared

Question 2

Date: 10 March 1998
Scenario: You issued a 5 year GBP 100 million Floating Rate Note on which you pay 3 month LIBOR + 0.20% and you are worried that UK interest rates may rise on a five year view. Current 3 month LIBOR: 7.45%

Strategies:
1. Buy a 5 year 7.65% cap on 3 month LIBOR (19 caplets)
2. Buy a 3 months into 4¾ years 7.65% payer swaption

a) Which one or more of the following best describe these two strategies?

- [ ] The swaption potentially locks you into a fixed rate
- [ ] The cap is a strip of options on forward LIBORs
- [ ] The cap protects you against rate rises but allows you benefit if they fall
- [ ] The Swaption is an option on a swap (i.e. a strip of LIBORs)

b) Other things being equal, which one of the following is preferable?

- ○ The swaption
- ○ Cannot determine from the information given
- ○ Both are equally beneficial
- ○ The cap

c) Which strategy do you think will be more expensive?

- ○ Cannot determine from the information given
- ○ The swaption
- ○ The cap
- ○ Both should cost the same

6.4. Market Quotation

The table below shows typical offer prices for swaptions. Each row indicates a different expiry date and each column indicates a different maturity for the underlying swap.

1151 EURO BROKERS INT. LDN
SWAPTIONS ATM VOLS

EUR	1YR	2YR	3YR	4YR	5YR	7YR	10YR
3M	26.5	28.8	25.1	21.5	19.7	16.4	14.3
6M	25.8	27.5	23.9	20.3	18.4	15.2	13.0
1YR	25.0	24.5	21.1	18.0	16.2	13.2	11.3
2YR	22.1	18.7	17.1	14.8	13.7	11.4	10.0
3YR	19.3	16.0	14.4	12.9	11.9	10.2	9.0
GBP							
3M	18.0	20.0	19.0	18.2	17.2	16.6	16.0
6M	20.0	19.5	18.5	17.7	16.7	16.1	15.5
1YR	21.9	19.5	18.5	17.7	16.7	16.1	15.5
2YR	21.7	18.6	18.1	16.7	15.7	15.1	14.5
3YR	21.4	18.2	17.6	16.1	15.0	14.4	13.8

Volatility Pricing

The market quotes prices in terms of implied volatilities. Most swaptions are traded European-style and for these contracts the convention has become to use the standard Black model (see Option Pricing - Analytic Models).

For example, the figure above shows that the market currently offers the 3 months into 5 years swaption ATM forward (i.e. with a strike equal to the forward swap rate) at 19.7%. When a counterparty takes one of these prices, the two parties then enter the agreed volatility into their respective pricing models, along with all the other market variables, to calculate the premium payable. Again, this practice only works if both parties use the same pricing model!

Notice that volatilities for longer-dated swaptions tend to be cheaper than for short-dated ones. In the next section we discuss why this might be so.

As in the caps & floors market, the market trades swaption volatilities using straddles or strangles (see Options Strategies - Volatility Trading).

Long straddle (or strangle) = Long payer swaption + Long receiver swaption
Short straddle (or strangle) = Short payer swaption + Short receiver swaption

As in the interest rate swap market, the majority of the business is concentrated into standard structures that have become the norm and require no qualification beyond the basic terms (see Interest Rate Swaps - Quotation). Thus in the EUR sector:

"I'm a seller of 3 into 5 years, 4.12% payer's at 11.9"

means I write a 3 year European-style payer's option on a 5 year swap with a fixed annual rate of 4.12%, 30/360, against 6 month LIBOR, actual/360, for a volatility price of 11.9%.

Although in the professional market swaptions are quoted in volatility terms, banks typically quote their clients swaption premiums as a percentage of the notional principal amount.

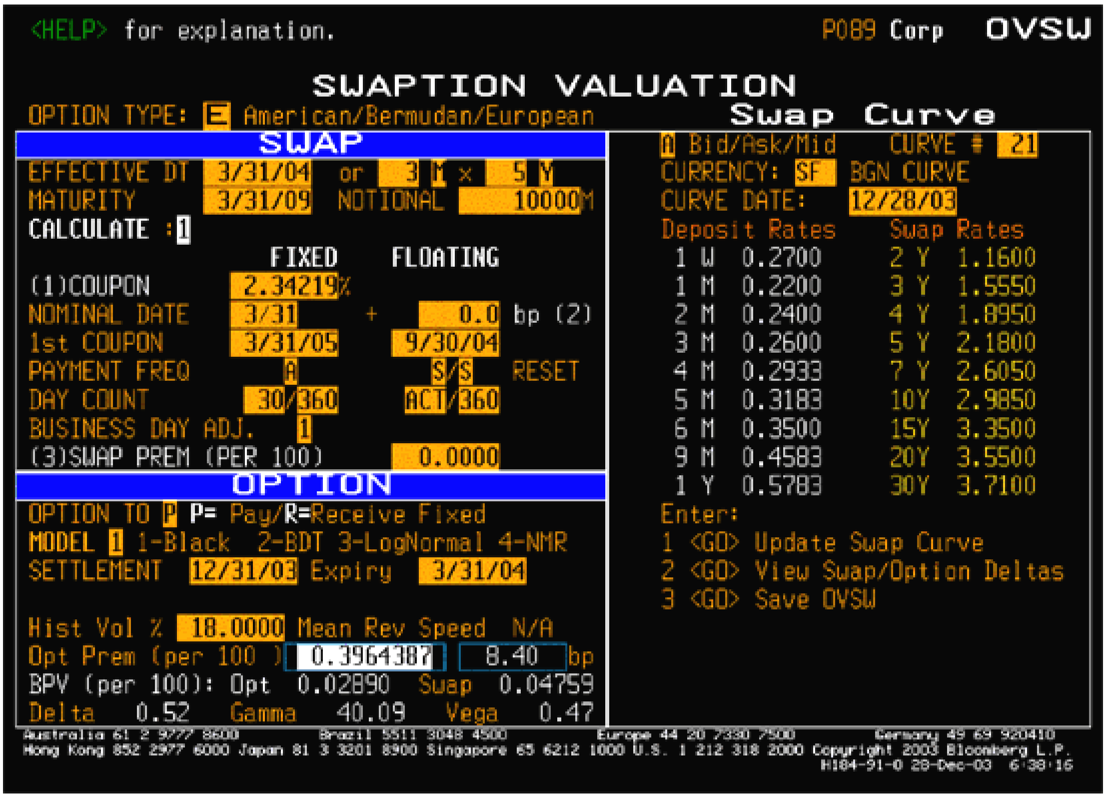
Analytic systems

Examples of Bloomberg and Reuters swaption pricing functions

Below are sample screens from two widely-used providers of market information and analytics.

These examples are for illustration purposes only and do not form part of the IFID Certificate syllabus.

Bloomberg swaption



Notes

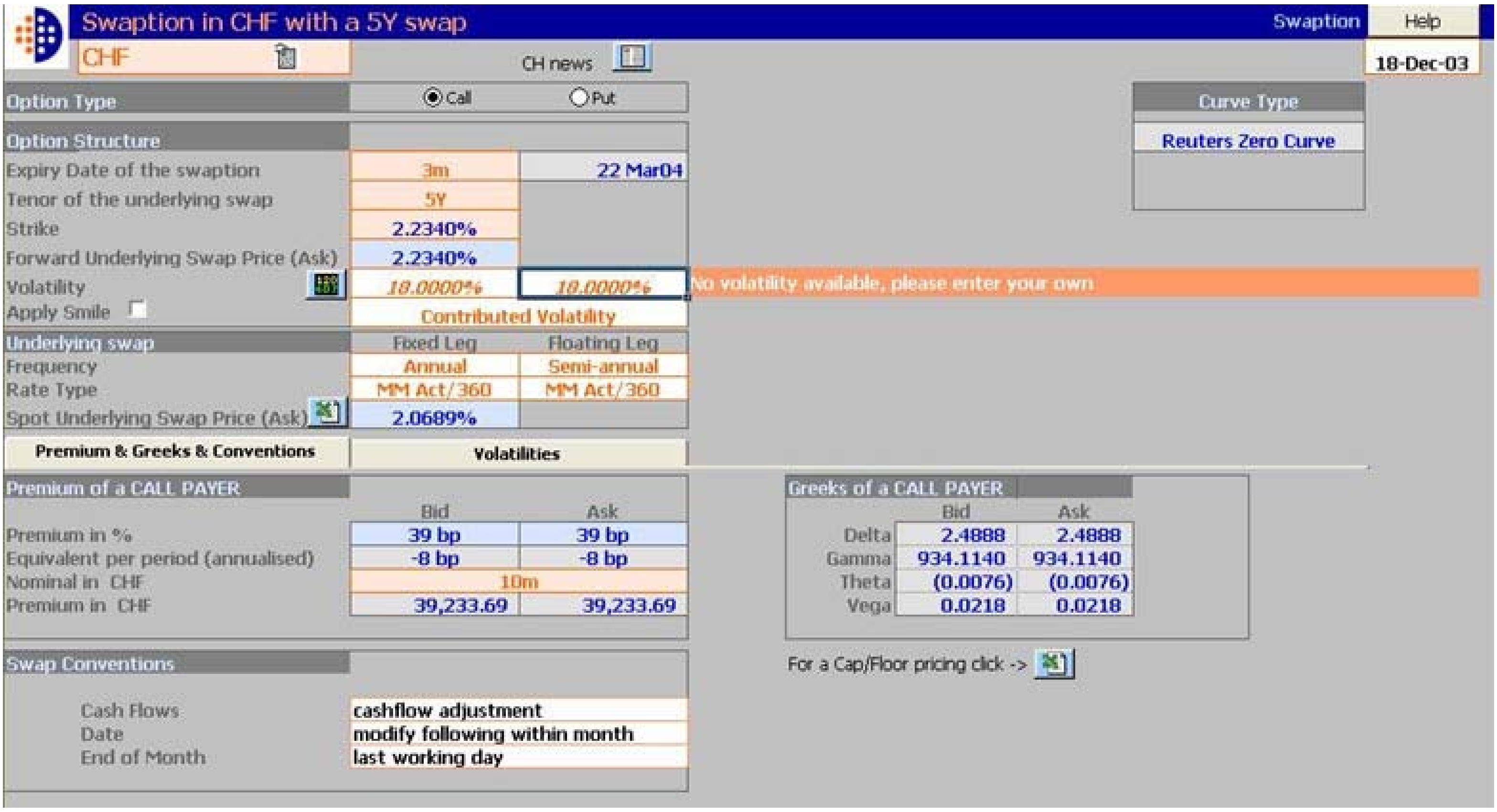
- This example prices a 3 month option into 5 year swap to pay CHF fixed (payer or **call** swaption) with a strike of 2.34219% and 18% volatility. The swaption is ATM forward – i.e. at a strike equal to the 3 months into 5 years forward swap

- The function allows calculation of:
    - Either the premium on your swaption, given the desired swap rate
    - Or the appropriate swap rate, given a desired premium

- The premium is calculated as a percentage of face value and also on an annually amortised basis - in our case, 39 basis points or 8 basis points respectively.

  Annually amortised premiums are use to calculate the all-in cost of the swaption, if it is exercised: in this case the swaption buyer is effectively paying 2.43% fixed pa in the swap (= 2.34219% + 8.4 basis points).

Reuters swaption



Notes

- The example prices a 3 months into 5 years CHF payer swaption (**call**) with a strike of 2.2340% and 18% volatility

- The swaption is ATM forward – i.e. at a strike equal to the 3 months into 5 years forward swap

- The premium is calculated as a percentage of face value (39 basis points) and also on an annually amortised basis (8 basis points)

7. Exercise

Question 3

In this exercise we explore the price behaviour of European caps and floors using an Excel-based pricing model. Please ensure the following data is specified in the model:

Option type	Cap/floor
Notional Amount	$100,000,000
Valuation date	01-Jan-00
Reset period	Semi-annual
Year basis	Actual/360
Effective (yrs)	0.0
Term (max. 10 yrs)	10.0
Cap rate	8.00%
Floor rate	0.00%
Volatility	21.0%

	Raw Yld.	**Yld+Shift**	**Yld+Pivot**
Overnight	3.00%	3.00%	3.00%
1 Yr	3.20%	3.20%	3.20%
2 Yrs	3.60%	3.60%	3.60%
5 Yrs	5.00%	5.00%	5.00%
10 Yrs	6.00%	6.00%	6.00%
		0.00%	0.00%

The yield curve is generated from rates quoted in the money market and the swap market for various fixed maturities. The model uses cubic splines to fit a smooth swap curve passing through the specified yield vertices (see Yield Curve Fitting).

a) Complete the table below, showing the price of a cap, in percentage per annum and the capped interest rate to a borrower funding at LIBOR flat. Type your answer in each box and validate.

Cap rate	Cap price	Capped cost
8.00%		
7.00%		
6.00%		

b) What would be the price of the 7% cap, in percentage per annum, if other things being equal the yield curve pivoted clockwise by 50 basis points? (Enter -0.50 in the **Yld+Pivot** cell in the model.)

c) Interpret the result:

- ☐ A flatter yield curve makes all the caplets OTM
- ☐ A flatter yield curve reduces the implied forward rates
- ☐ A flatter curve implies a less volatile market
- ☐ If the curve is flatter there is less demands for caps, so it becomes cheaper

d) Restore the yield curve to its original setting (i.e. reset the **Yld+Pivot** cell in the model to zero). What is the price of the 7% cap, in percentage per annum, for the following levels of volatility?

Volatility	Cap price
31.00%	
26.00%	
21.00%	

e) Restore the volatility back to 21%. A borrower considering a 7% cap would like to reduce its net cost to 75 basis points per annum, net, by selling a floor as well. Which one (or more) of the following is true?

- ☐ The borrower will not benefit if LIBOR fell below the floor rate
- ☐ The floor would have to be set at 5.00%
- ☐ The borrower has sold a collar
- ☐ The floor could be set at 3.68%

f) The borrower now wishes to buy a zero-cost collar. What rate should be set on the floor to achieve zero-cost structures for the following cap rates? Enter the floor rates rounded to the nearest 1 decimal place.

Cap rate	Floor rate
8.0%	
7.0%	
5.9%	

Instructions

You may find the answers by trial-and-error, or you can let the **Goal Seek** function in the Excel **Tools** menu do most of the work for you! Enter the following pre-set labels (in **bold**) in the Goal Seek dialog box:

Set cell: **C22** (the net cost of the collar)
To value: **0.0**
By changing cell: **Floor_rate**

g) Which of the following statements are true?

- ☐ Selling the floor always neutralises the benefits of buying the cap
- ☐ For a zero-cost collar, the lower the cap rate, the higher must be the floor rate
- ☐ A zero-cost collar with a floor rate equal to the cap rate is a synthetic swap!
- ☐ A zero-cost collar with the floor rate equal to the cap rate is a swaption