TATA CONSULTANCY SERVICES

Experience certainty. IT Services
Business Solutions
Outsourcing

Chapter-14 Caps, Floors and Swaptions

Certificate in Risk Management

Confidentiality Statement

This document should not be carried outside the physical and virtual boundaries of TCS and its client work locations. The sharing of this document with any person other than TCSer would tantamount to violation of confidentiality agreement signed by you while joining TCS.

Contents

Chapter – 14 Caps, Floors and Swaptions

Introduction

Caps and floors are essential tools in managing floating rate liabilities while minimizing hedging and opportunity costs. They protect against adverse rates risk, while allowing gains from favorable rate movements. Caps and floors are forms of option contracts, conferring potential benefits to the purchaser and potential obligations on the seller. Caps and floors greatly enhance a treasurer's flexibility in managing financial assets and liabilities. Used together or in combination with other hedging instruments, caps and floors are efficient tools for reconfiguring a company's financial risk profile.

Learning Objective

- Understand the concepts of Caps, Floors, Collars and Swaptions
- Understand the working and uses of these derivative instruments
- Understand the difference between various instruments
- Understand the valuation of these instruments

14.1 CAPS & Floors

A cap is a series of European call options that a borrower buys after paying a premium. A cap is more often used when the borrower expects the interest rates in the market to rise.

Caps create a ceiling on floating rate interest costs. The cap ensures the borrower that the interest rate costs will never exceed the cap rate. A seller pays the difference between the market rates and the cap rate when the market rates move above the cap rate to the purchaser.

Caps are referred to as "calls on floating rate" or put options on an underlying time deposit. The holder "exercises" the option if current floating rate exceeds the cap rate or "selling" the relatively low interest rate deposit.

To protect against a rate rise a company borrowing on a floating rate basis when 3 month LIBOR is 5% may purchase a 6% cap, for example, above that level. If the market rates rise to 9%, the company will receive a 3% cap payment which will compensate for the rise in market rates.

Interest rate Cap

A cap is closely associated with the interest rate swap market. Just like swaps, they enable the borrower to fix the amount of interest that they have to pay.

- A cap provides a guarantee to the issuer of a floating or variable rate note or adjustable rate mortgage that the coupon payment each period will be no higher than a certain amount.
- In other words, the coupon rate will be capped at a certain ceiling or cap rate or strike rate.
- Caps are either offered over-the-counter by dealers or embedded in a security.
- Interest rate exceeds the agreed strike price. An example of a cap would be an agreement to receive a payment for each month the LIBOR rate exceeds 2.5%.

For example, a borrower who pays interest at LIBOR on a principal of 10 million has the option of either entering into a fixed rate swap (if he expects the interest rates to rise) or he can buy a cap, which would help him fix the maximum interest that he will pay.

When the borrower purchases the cap, if the LIBOR rate is less than the rate of the cap (which is called the strike rate), the borrower will pay the LIBOR itself. If the LIBOR rate rises above the strike rate, then he'll pay interest equal to the strike rate, regardless of the rise in LIBOR. This is unlike a swap where the borrower will have to pay a higher rate even if the LIBOR falls.

Caps are different from standard options in that they have a series of exercise dates; a cap is made up of multiple call options all of which have different exercise dates, each option in the cap is called a 'caplet'. The caplets have a series of exercise dates; usually every six months there is an option that can be exercised.

Cap

A call option on interest rates, often with multiple exercise dates.

Interest rate Cap

The seller agrees to compensate the buyer for the amount by which an underlying short-term rate exceeds a specified rate on a series of dates during the life of the contract.

Example

An example of how a cap is used: A borrower pays to buy a cap (which is logical since, by buying the cap, the borrower is limiting the amount of interest his lender can earn) at a strike price of 5% on a loan at LIBOR. If the LIBOR rate is 4.5%, the borrower pays 4.5% to the lender.

However if the LIBOR rises to 5.5%, the borrower pays 5.5% to his lender, and the bank (from whom the borrower buys the cap) pays the differential 0.5% on the nominal principal to the borrower. So, effectively the net cash outflow for the borrower is fixed at 5% of the nominal principal plus the cap premium that he pays.

FLOORS

A Floor is a series of European put options. Like caps, floors are also an extension of interest rate swaps, they allow an investor to fix the minimum amount of cash flow (CF) he would get, however low the interest rates would fall. As against a cap, a floor is used more when the investor fears that the interest rates will fall and wants to lock in the minimum amount of income he wants.

A floor is just like a cap the only difference is that it creates a floor for the borrower and ensures that the interest rate cost will not go down below the floor value. The difference between the market rate and the floor rate is paid to the purchaser, when market rates fall below the floor rate.

For example a 5% floor will make a payment to the purchaser whenever market rates will fall below 5%. Floors guarantee a minimum return on floating rate assets to asset managers. By selling the floors they generate higher returns. Floors are also bought to protect against opportunity losses on fixed rate debt when interest rates fall. Floors may be sold as the part of hedging strategy. Floor is an instrument which protects the buyer from losses resulting from a decrease in interest rates.

Let's take an example, if the floor rate is 6% and let on a particular day, the rate on the investor's floating-rate loan of $2 million is 5%. The floor will provide a payoff of $10,000 [i.e. ($2 million *.06) - ($2 million*.05)].

Interest rate floor

An interest rate floor is a series of European put options or floorlets on a specified reference rate, usually LIBOR.
The buyer of the floor receives money if on the maturity of any of the floorlets; the reference rate is below the agreed strike price of the floor.

Like caps, floors are also made up of multiple options i.e. put options (option to sell) in this case, which are called 'Floorlets'.

Example

An example where a floor can be used: An investor expects that interest rates will rise and therefore makes a floating rate investment of 10 billion dollars at LIBOR. However he also wants to make sure that he earns at least 5% on the investment as interest. Then he can buy a floor with strike price as 5%. If the LIBOR rate is more than the strike price, say LIBOR is 6%; then the investment will earn him 6%. However, if the LIBOR falls below 5%, say to 4%, the investor will still get 5% on the investment.

In the above scenario the investor can enter into an interest rate swap too, his interest income however would be fixed only for a certain direction then. Say he fixes the rate at 6%; he books a loss if the LIBOR is above 6%, which is not the case with a floor.

Both caps and floors offer more flexibility to the investors, and are more useful in a volatile market, where it is difficult to predict the interest rate movements.

Floor

A put option on interest rates, often with multiple exercise dates.

Interest rate Floor

The seller agrees to compensate the buyer for a rate falling below the specified rate during the contract period.

Types of Caps and Floors

i. Participatory Caps and Floors

A participatory collar aims to achieve zero-premium collars. If a borrower wants to limit the interest paid on a 5 year loan (on which he pays 6%) to 6%, he'd sell a 4% floor to get a zero-price collar (assuming that the swap rate is 5%).

In a participating collar, he'd sell a 6% floor (same as the cap), which would give him more revenue (since he's saying I'll pay more to his lender). To achieve zero-premium, he'd cut down on the nominal capital of the floor, so that the absolute amounts of the premium earned and premium paid match.

Thus if interest rates go above 6%, he'd exercise the cap and pay 6%. The floor is expired. If the interest rates fall to 3.9%, he'd pay 6% on the part of the nominal principal used for the floor; on the rest he pays only 3.9%.

Participatory caps and floors make more sense if big interest rate fluctuations are expected.

ii. Binary caps and floors

Digital or Binary caps and floors are structures that pay out the same amount regardless of how far in-the-money the cap or floor might be at expiry. A digital cap is usually a combination of the purchase of a KI (Knock in) cap and the sale of a vanilla cap.

For example, a RKI cap purchased at strike rate 5% and trigger 6% and a cap sold at strike rate 6% (Agreeing to receive a maximum 6% interest and paying 5% if the interest rate touches 6%). These are useful if the investors believe that the caps and floors might be breached, but only by small margins

Uses of Caps and Floors

Caps and floors are used to:

- Increase investment returns
- Hedge against major interest rate changes.
- Create profitable investments
- Help in offsetting the loss made by one instrument with the gains of the other instrument.

Pricing Caps and Floors

An instrument is said to be at-the-money if it neither makes a profit, nor books a loss. An instrument is said to be 'In-the-money' if it is making a profit, and 'out-of-money' if books a loss. A call option is said to be in the money when the market price of the underlying asset is more than the option's strike price. A put option is said to be in the money when market price of the underlying security is below the strike price of the option. In other words, in the money means when your stock option is worth your money and you can turn around and sell or exercise it for a profit.

Caps and floors are compared with the swap rate (which has the same life as the cap or the floor) to find if they make a profit or loss. The at-the-money price of any cap (or floor) is the equivalent swap rate for the period of the cap (or floor).

A cap is said to be 'in-the-money' if the swap rate is greater than the strike rate of the cap. When the swap rate is greater, the cap option is executed and the borrower makes a profit by paying less than what he should have otherwise. If the swap rate is less than the cap strike rate, the borrower will not execute the cap (he'll pay the swap rate which is lesser), and therefore option expires without being executed and the premium paid for the cap is a loss.

Similarly for a floor, it is said to be in-the-money if the swap rate is less than the floor strike rate, because the owner of the floor will earn more than what he otherwise would have. If the swap rate is more than the floor strike rate, the floor option will not be executed (as the investor would earn at the market rate, which is higher) and the premium paid for the floor is a loss.

Caps and floors that are in-the-money are more costly than out-of-money (as in-the-money instruments give profits). The distance from the at-the-money value determines the price of the cap or collar. The more out-of-money it is, the cheaper it would be.

For example, if the swap rate for 5 years on USD 5 million is 5%, then a cap with strike rate 6% is costlier than a cap with strike rate 7%. This is because the probability of the cap being executed is more at 6% (therefore more chances of being in-the-money) than for 7%.

The volatility in the market also adds to the price of the caps and floors. If the interest rate volatility in the market is high, the price of caps and floors will be higher (as they offer better hedging opportunities). Each caplet/floorlet requires its own volatility figure to price it.
The price paid for a cap or floor is the sum of the premiums paid for the individual caplets or floorlets. The price of the individual options depends on certain other factors.

The other factors that affect the price of caps and floors are the time value and intrinsic value of the individual options. Every instrument's price is divided into time value (which is

dependent on the life left for instrument, after which it expires) and the intrinsic value that depends on the performance of the underlying security (asset or liability). Each individual option has a separate time value and a separate intrinsic value. An option that has the strike price equal to the value of the underlying security is said to have only time value and no intrinsic value (as explained in session 9).

Time value of an instrument allows for the fact that the price of the underlying security might change in the future. Therefore an option with a larger maturity will have more time value (and therefore a larger premium).

As indicated by the time value, the further is the period of the cap or floor (the number of years it stays alive), the costlier will be its price.
All these factors are considered for pricing, and the Black and Scholes model is used to find the price of each individual option, therefore the price of the cap or floor.

14.2 Collars

'Collar' is used to describe the use of a cap and a floor to reduce the cost incurred on them, and to hedge the asset/liability at the same time. It is the simultaneous buying of an interest rate cap and selling of an interest rate floor for the same maturity and same capital investment.

- Collar is a protective option strategy that is created by purchasing an out of the money put option and simultaneously selling an out of the money call option.
- A collar protects the investors against rising interest rates. The purchase of an out-of-the money put option will protect the underlying shares from a large downward move. The premium collected by selling the out of the money call is deducted from the price paid to buy the put.
- The goal of this position is to let the value of the underlying security stock to rise till the written strike is reached. Otherwise also "collar" can be understood as the strategy to buy a floor and sell a cap or vice versa.
- The premium due for the cap (floor) is partially offset by the premium received for the floor (cap). This makes the collar an effective way to hedge rate risk at low cost. A collar creates an effective range or band of interest rates within which the investor's interest rates vary.

Example

Let's take an example: A borrower purchasing a 6% cap and selling a 4% floor guarantees a 4-6% base rate on a floating rate loan. A costless collar is created when the cap and floor levels are such that their premiums exactly offset each other.

The most commonly used collar is the purchase of a cap and a sale of a floor. The reason why collars came into existence was to reduce the overall premium paid for hedging; that is the premium paid for caps and floors. Therefore a collar involves a purchase and a sale of instruments.

When a borrower purchases a cap and sells a floor, he is setting the maximum and minimum limits for the interest that he'll pay on the notional principal. For example, a borrower wants to limit the interest that he would pay on his loan of 100 million (at LIBOR) to 6%. He can purchase a cap to that effect. To set off the premium that he pays for the cap, he sells a floor (therefore earning income), fixing the minimum amount of interest that he'd pay to his lender, however low the LIBOR might fall.

i. Reverse Collar

A reverse collar is one in which the investor buys a floor and sells a cap. This is usually done when the investor expects the interest rates to fall. Therefore, here the investor is making sure that he earns a minimum amount of interest in any case, while running the risk that he might lose certain income if the interest rates increase by a large margin (i.e. if they become more than the strike price of the cap).

- Buying an interest rate floor and simultaneously selling an interest rate cap.
- The objective is to protect the bank from falling interest rates.
- The buyer selects the index rate and matches the maturity and notional principal amounts for the floor and cap.
- Buyers can construct zero cost reverse collars when it is possible to find floor and cap rates with the same premiums that provide an acceptable band

ii. Interest rate collar

The simultaneous purchase of an interest rate cap and sale of an interest rate floor on the same index for the same maturity and notional principal amount.

- The cap rate is set above the floor rate.
- The objective of the buyer of a collar is to protect against rising interest rates.
- The purchase of the cap protects against rising rates while the sale of the floor generates premium income.
- A collar creates a band within which the buyers effective interest rate fluctuates

Advantages and disadvantages

Advantages

1. Collars provide you with protection against unfavorable interest rate movements above the Cap Rate while allowing you to participate in some interest rate decreases.
2. Collars can be structured so that there is no up-front premium payable. While you can also set your own Cap Rate and Floor Rate, a premium may be payable in these circumstances.
3. The term of a Collar is flexible and does not have to match the term of the underlying bill facility. A Collar may be used as a form of short-term interest rate protection in times of uncertainty.
4. Collars can be cancelled (however there may be a cost in doing so–see the Early termination section for further details

Disadvantages

1. While a Collar provide with some ability to participate in interest rate decreases, interest rate cannot fall to less than the Floor Rate.
2. To provide a zero cost structure or a reasonable reduction in premium payable under the Cap, the Floor Rate may need to be set at a high level. This negates the potential to take advantage of favorable market rate movements.
3. You will be exposed to interest rate movements if the term of the Collar is shorter than that of the underlying bank bill facility.
4. There is no cooling off period.

14.3 Swaptions

A Swaption is over the counter (OTC) option on a swap. Usually the underlying swap is a vanilla Interest Rate swap (when fixed rate options are swapped with floating rate options). A Swaption can be visualized as a generalization of caplets and floorlets. Swaptions are options on swaps and can be written on any kind of swap. These give the holder the option to enter into swaps at a certain date in the future on terms and conditions agreed at the time of purchase of the swaption. They are over- the-counter instruments. They give the holder the right but not the obligation to enter into a swap with a counter party

A swaption is an option on swap. The buyer of a call swaption has the right to buy a swap by paying the exercise price (payer swaption). The seller of a call is obliged to sell the swap for the exercise price. The buyer of a put swaption has the right to sell a swap for the the exercise price (receiver swaption). The seller of a call is obliged to buy the swap by paying the exercise price. The purchaser of an option will pay a premium at the origination of the transaction. The exercise price is a specified fixed rate. Swaptions are known as entry and exit options on swaps. They give the holder the right, but not the obligation, to get either into or out of a swap.

Swaptions can be classified as of three types:

- American Type Swaption: The holder of the swaption can enter into the swap any time in the period of time between the two days specified in the contract.
- Bermudan Type Swaption: The holder can enter into the swap on a series of dates provided in the contract.
- European Type Swaption: The holder can enter the swap only on specified day that is mentioned in the contract. European Swaptions are the most popular among the three.

If the movements of the interest rates are highly unpredictable then swaptions offer greater protection. Swaptions can be used as hedging tools to protect against interest rates. Also they can be used to lower the costs of financing or borrowing by making sure that the firm doesn't need to pay any more than what it should actually pay.

Swaption process

There are many points over which the buyer and seller of the swaption agree before entering into the swaption. These are:

- the strike rate
- length of the option period
- the term of the swap
- notional amount
- frequency of settlement.

If the strike rate of the swap is more favorable than the prevailing market swap rate then the swaption will be exercised and the holder of the swaption will be benefited. A swaption hedges the buyer against downside risk as well as it lets the buyer to take advantage of any upside movements of the market. Like any other option, if the swaption is not exercised by its maturity date it will simply expire.

The following graph shows that the customer of a swaption is hedged against rises in interest rates and enjoys the full benefits of falling rates.

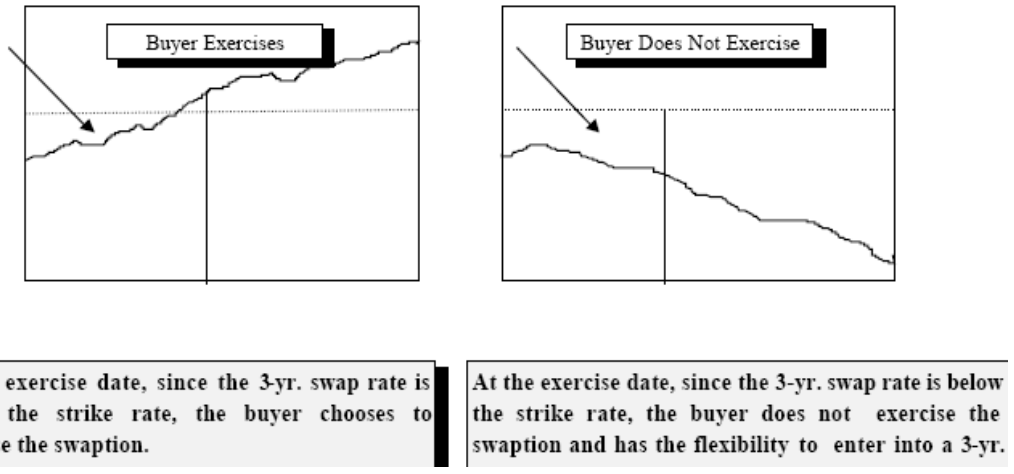

Figure 12.1 Swaption (*Source: nationalcity.com*)

Did You Know? The first ever swaption took place at the First Inter State Bank, Los Angeles in 1983.

The Use of Bermudan Swaptions

The Bermudan Swaption bridges the gap between caplets and floorlets of caps and floors (which have multiple exercise dates) and plain vanilla European options (which has only one exercise date).

A Bermudan swaption has a series of dates when the option can be executed, i.e. the swap can be entered into. Once a Bermudan swaption has been entered into, all the other exercisable dates are cancelled out; this induces conditional probability into the swaption. Its value is dependent on the fact that it has survived till now. Because of their inherent conditionality, Bermudan swaptions are cheaper than usual European swaptions.

Bermudan swaptions are used as hedging tools, particularly by bond issuers or those trading in embedded bonds (bonds which have certain special features, like callability, etc.) because it is easier to quantify (and monetize, that is put in money terms) the gains made because of the multiple exercise dates.

Pricing Swaption

Swaption premiums are expressed in basis points that are paid against the nominal principal amount. A swaption with a life of 5 years on a notional principal of 100 million with a bid-offer premium of 110-115 means that: if the buyer wants to buy the swaption, he would have to pay 1.15 %(100 million) =1.15 million. If the person wants to sell the swaption, the dealer (usually the bank) would give him 1.10 %(100 million) =1.1 million for it.

A swaption is at-the-money if its strike price is the forward starting swap rate for the same period. The price of the swaption depends on how much in-the-money or how much out-of-money is the swaption. For a payer swaption, the swaption is in-the-money if the forward swap rate is greater than the strike rate of the swaption. Similarly, for a receiver swaption, it is in-the-money if the swap rate is less than the strike price of the swaption.

As with caps and floors, the prices of swaptions increase in a more volatile market. And the Black and Scholes model is used to find the price of the swaption (using the assumption that a payer swaption is a call option, and a receiver swaption is a put option).

Comparison of Caps and Floors with Swaption

A swaption is an option on a swap. It gives the holder of the swaption a right, but not the obligation to enter into the swap.

A payer swaption gives the holder a right to pay fixed interest payments. This is meaningful in a rising interest rate scenario; it can be thought of as a call option on rates (a call option usually enables the holder to buy lower than the market; here the holder is paying lower than the market). The holder of this swaption is long (buys and holds) on a call on interest rates. Similarly, a receiver swaption (which gives the right to receive fixed interest in falling rate scenario) can be thought of as a put on rates (enables selling higher than the market).

Swaptions and caps and floors can be used to serve the same purpose, a payer swaption could easily replace a cap (the borrower pays fixed income rate if the LIBOR rises beyond a certain level, the function is very similar to that of a cap)

The price of a swaption is usually lesser than that of a cap or floor. That is because the caps and floors have the advantage of multiple exercise dates, unlike a swaption. Therefore, a cap (or floor) has more chance to be in-the-money than a swaption. Therefore swaptions are priced lower than caps and floors.

Summary

- Interest rate option markets are amongst the largest and most liquid option markets in the world today, with daily trading volumes of trillions of US dollars, especially for caps/floors and swaptions.
- These options are widely used both for hedging as well as speculation against changes in interest rates.
- Caps, floors and collars are a simple but very effective way to control risk and manage hedge costs.
- The option characteristics of caps and floors offer unique opportunities to minimize borrowing costs or achieve higher investment returns.
- Barrier options are like plain options, but along with a strike price, they have a trigger price (or interest rate usually) which if touched, the option either ceases to exist or comes into effect.

TATA CONSULTANCY SERVICES

www.tcs.com