Management of Fixed Income Securities
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Lecture - 59
Fixed Income Securities Derivatives - IV

Welcome back. So, we were discussing about the different type of fixed incomes derivatives and their uses and how those instruments are used for the risk management. So, in that part we have discussed about the futures and options and their applications.

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Today we will discuss about another major interest rate derivative or we can say that one of the major derivatives instrument generally we call it the interest rate swap. And today we will be covering of these different concepts like interest rate swap, how the swaps are evaluated or the swap valuation then the forward swap and the swaption. Basically, it is a combination of swap with the option.

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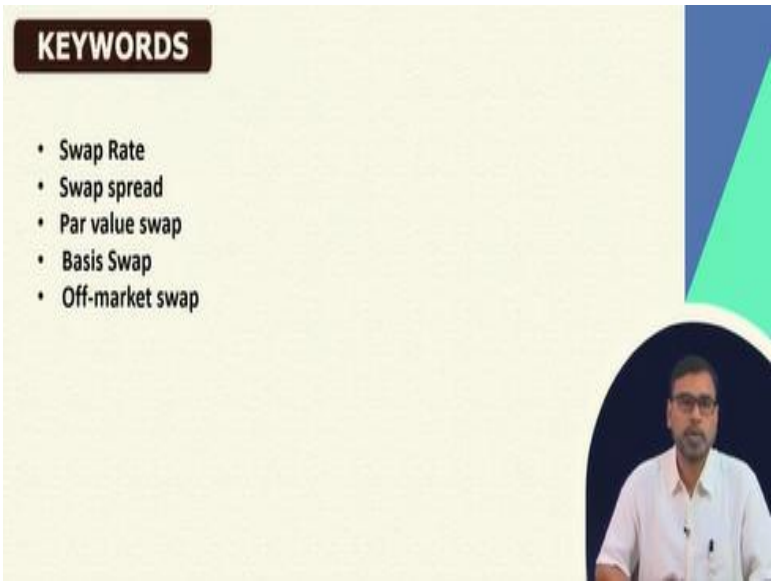

So, we will come across certain keywords like swap rate, swap spread, par value swap, basis swap, off market swap; all kinds of keywords basically you will find while discussing about these particular concepts or this particular issue.

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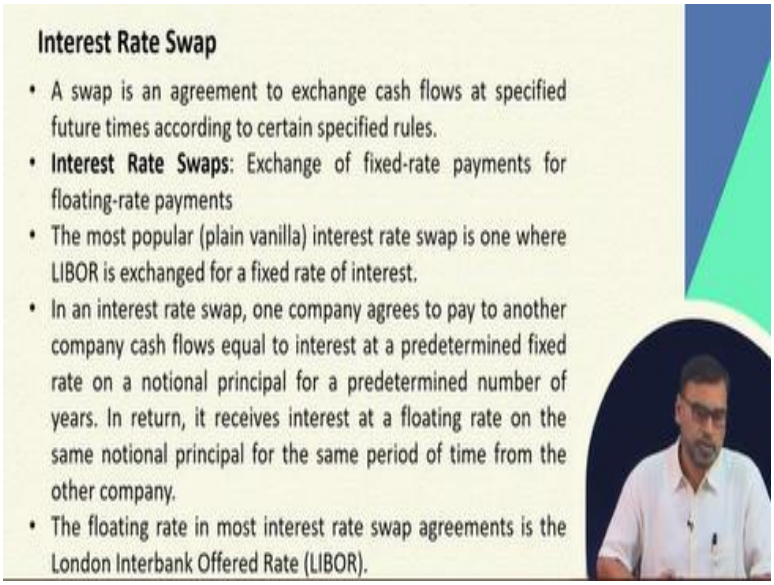

So, let us start the discussion on what exactly the swap is and what the interest rate swap is all about. A swap is nothing but it is an agreement basically to exchange the cash flow at a specified future time according to certain specific rules. It is basically contract where certain type of cash flows will be exchanged between the two parties and there are certain objectives of exchanging this cash flow that we will discuss that what those different objectives are and what are those different uses of this particular swap.

And one of the major swaps if you see from the financial market point of view that is basically your interest rate swap. So, in this interest rate swap generally what we find it is basically exchange of fixed rate payments for the floating rate payments. So, one particular company or particular kind of market participants they always go for this kind of swap to change their nature of assets or nature of the liabilities.

So, that will see that how this particular change can take place. And the most popular swap if you talk about the interest rate swap or generally, we call it the plain vanilla swap. Here generally your LIBOR is exchanged for a fixed rate interest. So, LIBOR is used as a variable rate interest and there is a fixed rate of interest which has been fixed as per the contract as per the agreement and accordingly the particular exchange can take place between these two.

So, generally in an interest rate swap, which happens between the two different entities mostly between the two companies? So, here one company agrees to pay another company, the cash flows equal to the interest rate at a predetermined fixed rate on a notional principal for a predetermined number of years. In return this company basically receives at a floating rate on the same notional principal for the same period of time from the other company.

So, why we call it the notional principal? Because actually the principal is not used in the particular cash flow. The principal is basically notional and on the basis of that principal this particular cash flow is determined. So, the floating rate of swap generally always based upon the LIBOR that already what basically we have discussed just now.

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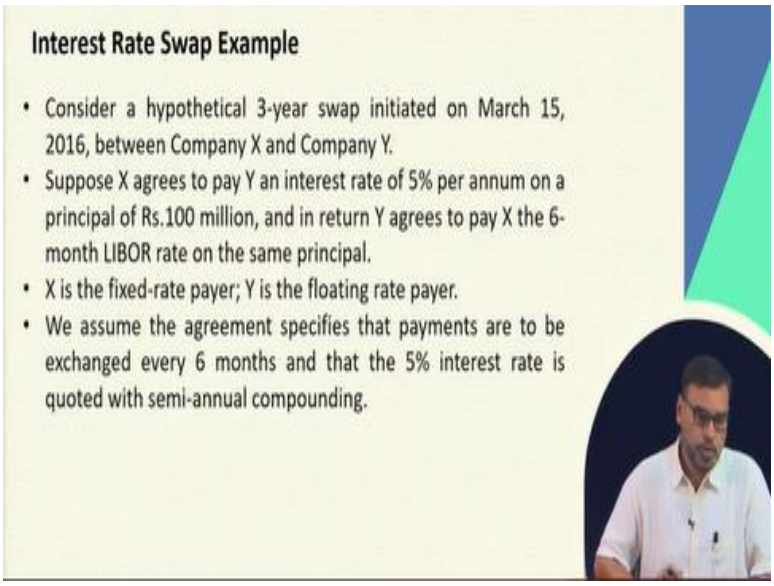

So, in this case if you take a example let consider a hypothetical three year swap which is initiated in march 15, 2016 between company X and company Y.

Suppose X agrees to pay Y on interest rate of 5% per annum on a principal of let 100 million and in return Y agrees to pay the X the 6 months LIBOR rate on the same principle. So, one is a fixed player another one is the floating rate player. X is here in this case is the fixed rate player and Y is the floating rate player.

So, we assume the agreement specifies that payment has to be exchanged every six months, every six months basis the payment has to be made and the 5% interest is quoted with semi-annual compounding. So, that is the assumption what basically we are taking.

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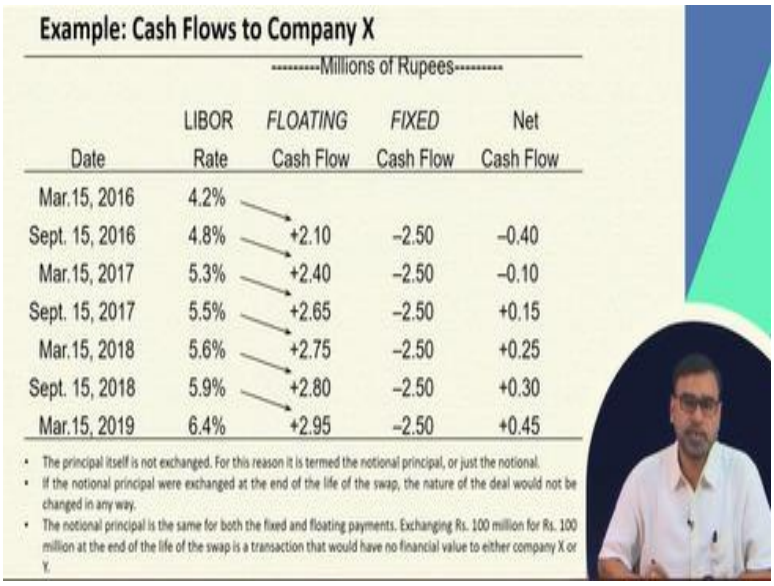

So, let us see how the basically cash flow looks like. So, this particular contract is initiated in March 15, 2016. So, let on that particular day, the LIBOR rate is 4.2%. The cash flow will take place in every 6 months basis.

So next class cash flow will be September 15 then next will be March 15, 2017 and so on and it will over by March 15, 2019 because it is a three year swap basically what we have assumed.

So, the LIBOR rate in the date of March 15, 2016 then the floating rate cash flow in the month of September on the date of September 15 will be basically six months basis. This LIBOR rates are annual basis so that's why the floating rate cash flow will be 2.1. So, let the LIBOR rate has changed in the next six months on the September it was 4.8 then in the march 15, 2017 the cash flow will be 2.4 and so on.

So, the fixed cash flow is the 5% so that will remain as 2.5. So, if you are talking about the cash flow which is happening to company X then the company X will receive 2.1, 2.4, 2.65, 2.75 and so on up to 2.95; So, these are the cash flow where that's why it is a plus sign, they will be receiving that and they will be paying basically this which is fixed as per the agreement. So, this is the basically the net cash flow.

And the principal is not exchanged that already we have assumed that's why you call it is a notional principal. If the principal also will be exchanged then the nature of the deal would not

be changed in any way because the amount of money which was initiated from the beginning that money will be paid back in the end of this particular contract.

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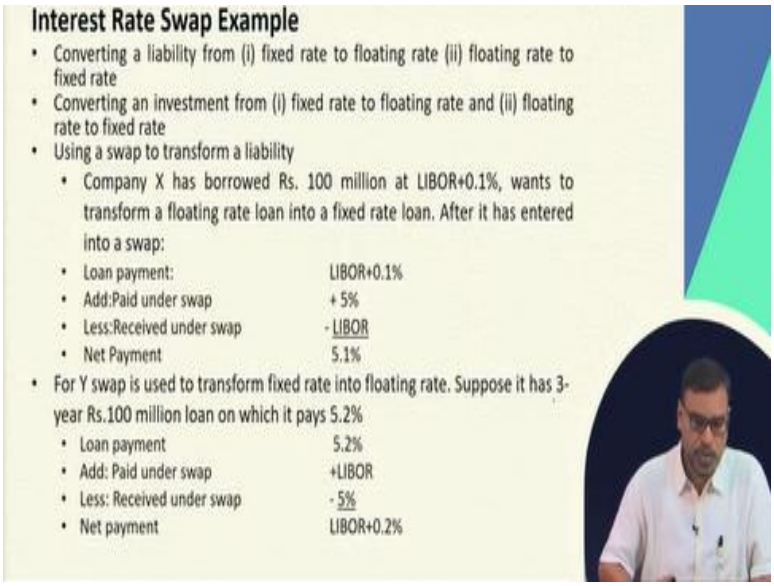

Let us see how this particular swap is helping us or how this swap is used. So, the basic use of the interest rate swap if you see basically, it is a converting a liability from a fixed rate to floating rate or from floating rate to fixed rate if you talk about the liability side. If you talk about the asset side it can also change or convert the investment from the fixed rate to floating rate or from floating rate to fixed rate.

So, let us see in our example how it happens. For example, the company X has already certain amount what it has borrowed from the market. Let it has borrowed at a variable rate basis and that particular rate is determined at LIBOR plus point 1%. So, they want to transform that floating rate loan to a fixed rate loan for some reason. So, once they have entered into this swap whatever example we have taken if you look at whenever they entered into this particular swap. Then what is happening?

The loan payment is the LIBOR plus 0.1% and they will be paid under swap that is 5%.

They will receive basically the LIBOR.

So, in this case the net payment is basically your 5.1%. It is calculated as:

Net Payment=Loan payment + paid under swap – received under swap

= (LIBOR+0.1%) + (5%) – LIBOR

= 5.1%

So, the signs are given on that basis so LIBOR plus point 1% they are paying to the outside from where they have borrowed the money. And also, if you see that they will basically LIBOR plus point 1% they are paying here and here they are getting that again the received under the swap that is the LIBOR. End of the day, the 5.1% is net payment which is basically converted from the floating rate to the fixed rate.

For Y if you look at swap is used to transform their fixed rate to the floating rate suppose it has a 3 year 100 million loan which pay, they are paying 5.2% and they want to convert that 5.2% fixed rate to a floating rate. So, then here also the same thing loan payment is 5.2%, paid under the swap LIBOR, received 5%. Then end of the day it has been converted into LIBOR + 0.2% because the 5%- 5% will be cancelled and LIBOR will remain unchanged and 0.2% will be remain then finally they will convert from LIBOR plus point 2%.

So, in this case the net payment is LIBOR +0.2%. It is calculated as:

Net Payment=Loan payment + paid under swap – received under swap

= (5.2%) + (LIBOR)–5%

= LIBOR +0.2%

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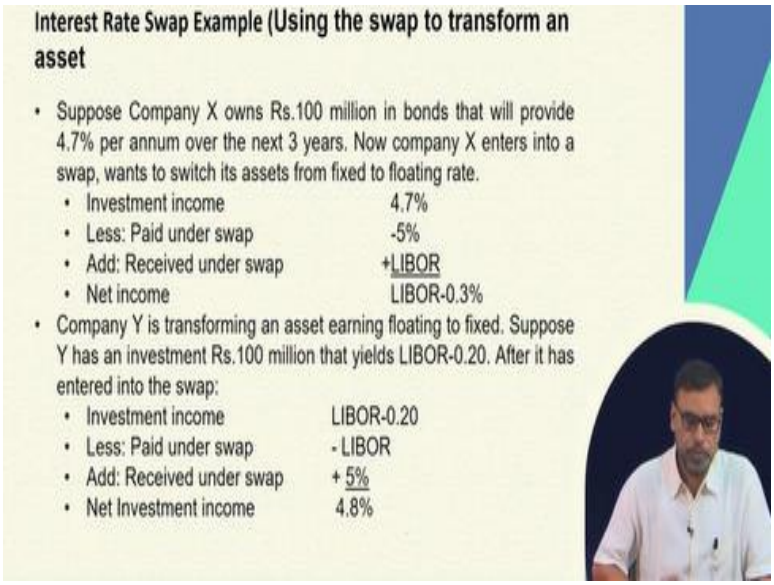

Same way, if you see also that the interest rate swap also can be used to transform the nature of the asset from fixed to floating and from floating to fixed. If you go by the same example suppose X owns 100 million in bonds that will provide 4.7% per annum over the next three years. Now once the company X enter into the swap and wants to switch it from fixed to the floating.

Then investment income, they are getting 4.7% and paid under the swap is (-5%), receive LIBOR then end of the day it has been converted into LIBOR - 0.3%.

Net Income = Investment income – Paid under swap+ received under swap.

= (4.7%)-(5%) + LIBOR

= LIBOR - 0.3%.

So, like that the same thing also will happen to the company Y. If they are transform their asset earning floating to the fixed suppose Y has a investment of 100 million which yields LIBOR - 0.2% then after it has entered into the swap then finally their net invest income will come down or will remain at 4.8% which is fixed in nature.

Net Investment income for company Y will be:

Net Investment income = Investment income – Paid under swap+ received under swap.

= (LIBOR-0.20%) – LIBOR + 5%

= 4.8%

So, that's why the basic use of the swap is to change the nature of assets and nature of the liabilities; fixed to floating and floating to fix.

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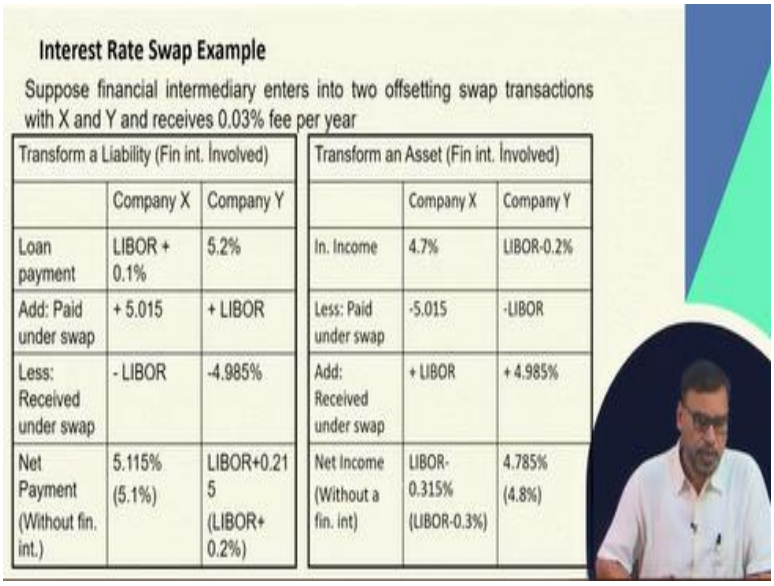

So, then in our example generally it is not possible always to have a swap between the two different parties and they may not have this kind of opportunity always available in the market and one to one interaction may not be possible. So, because of that the financial institution generally plays a mediatory role between them and let you assume that the financial institution charge is 0.03% fee per year.

Then if you see that the same way if you look at if the looking at the transform a liability and the financial institution is involved then you will find that the net payment will be 5.11% for company X and LIBOR + 0.21 5% for company Y which was previously without the financial institution it was 5.1% and for LIBOR it was 2% because the 0.03% will be divided between the two parties. So, in the same thing also you can observe in terms of the transform of the asset.

Net Payment in case of company X when FI is involved will be:

Net Payment=Loan payment + paid under swap – received under swap

= (LIBOR+0.1%) + (5.015%) – LIBOR

= 5.115%

Net Payment in case of company Y when FI is involved will be:

Net Payment=Loan payment + paid under swap – received under swap

= (5.2%) + (LIBOR)– 4.985%

= LIBOR +0.215

So, here it will find that net income will be LIBOR - 0.315, it is 4.785 and previously without the financial insurance involvement it was basically LIBOR - 0.3% and it was 4.8%.

Net income in case of company X when FI is involved will be:

Net Income = Investment income – Paid under swap+ received under swap.

= (4.7%)- (5.015%) + LIBOR

= LIBOR - 0.315%.

Net income in case of company Y when FI is involved will be:

Net Investment income = Investment income – Paid under swap+ received under swap.

= (LIBOR-0.20%) – LIBOR + 4.985%

= 4.785%

So, generally in the market, any kind of financial institutions always plays a significant role for this kind of swap contract.

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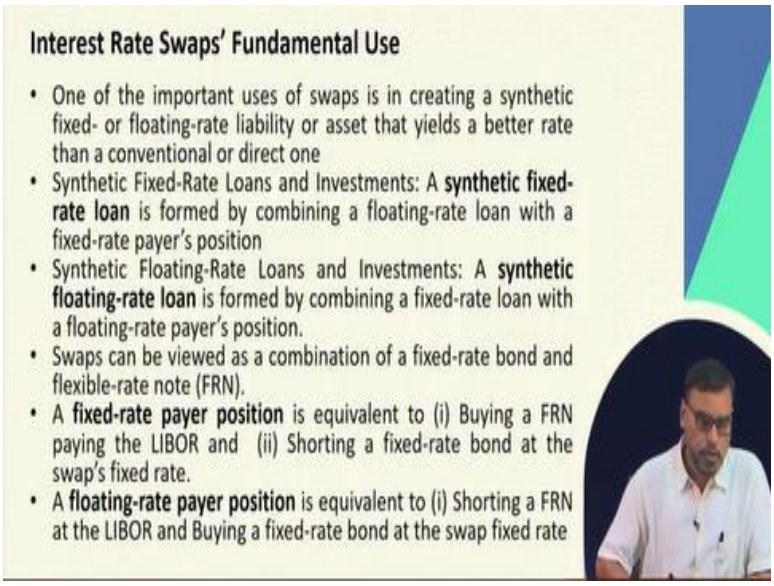

So, in another use if you look at about the interest rate swap so here the one of the important uses creating a synthetic fixed or floating rate liability or asset which can yield a better rate than the conventional one. So, what do you mean by the synthetic fixed rate loan or the investment? Here in this case already we have taken the example. A synthetic fixed rate loan is generally formed by combining a floating rate loan with a fixed rate payer's position.

And a synthetic floating rate loans and investment is nothing but combining the fixed rate loan with the floating rate payer's positions. So, swaps also can be viewed as a combination of fixed rate bond and flexible rate note in short, we call it the FRN and a fixed rate pairs position is equivalent to buying a FRN paying the LIBOR and selling or sorting a fixed bond or the swaps fixed rate.

And the floating rate fair position is equivalent to sorting a FRN at the LIBOR and buying a fixed bond at the swap fixed rate that with the example that already we have explained.

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So, generally always in the market, we get a swap rate which is quoted by the market makers and swap rate is a kind of average rate of the most both fixed rate that a market maker is prepared to pay in exchange of receiving LIBOR which is basically the bid rate. And the fixed rate that it prepared to receive in return for paying the LIBOR which is called the offer rate. So, for example with the different maturity if your bid rate is given an offer rate is given.

Then the swap rate is nothing but the average of these two rates, 6.03% + 6.06% divided by 2 that will give you your 6.045%.

Here, swap rate = $\frac{Bid\ rate + offer\ rate}{2}$

Swap rate in case of maturity 2 years will be: $\frac{6.03+6.06}{2} = 6.045$

Swap rate in case of maturity 3 years will be: $\frac{6.21+6.24}{2} = 6.225$

Swap rate for other maturity will be calculated accordingly.

So, like that the swap rates are nothing but the average of the offer rate and the bid rate which generally quoted by the market makers.

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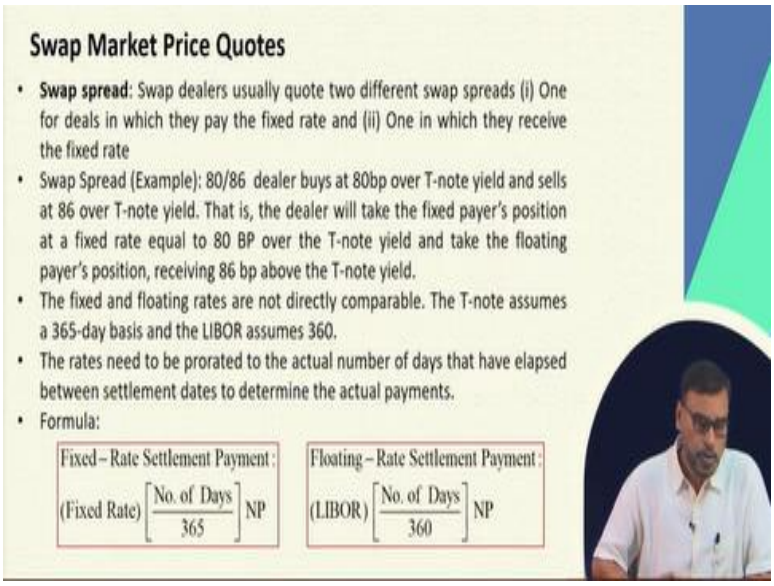

Then how the swap market price basically is quoted? Generally, this is quoted or the swap dealers usually quote to different swap spreads. One for deals in which they pay the fixed rate and other one in which they receive the fixed rate. So, if you look at the example let 80 by 86 dealers if you take the example, it buys a 80 basis point over T-note yield and sales at 86 over T-note yield.

That means the dealer will take the fixed payer's position at a fixed rate which is equal to 80 basis point over the T-note yield. And take the floating payer's position receiving the 86 basis point above the T-note yield. And the fixed and floating rates are not directly comparable the T-note basically assumes a 365 day basis and the LIBOR generally assumes the 360 day basis these are basically about the account conventions.

So, that's why the rates needs to be reported to the actual number of days that have generally over between the settlement dates to determine the actual payments. So, if you look at this formula this is fixed rate settlement payment is basically the fixed rate into number of days divided 365 into notional payment. And the floating rate settlement payment will be your LIBOR into number of days by 360 into the notional payment. That is the way the stock in the market the swap prices are quoted.

Fixed rate - settlement Payment: (Fixed rate) $[\frac{No\ Of\ days}{365}]$ NP

Floating - Rate settlement Payment: (LIBOR) $[\frac{No\ Of\ days}{360}]$ NP

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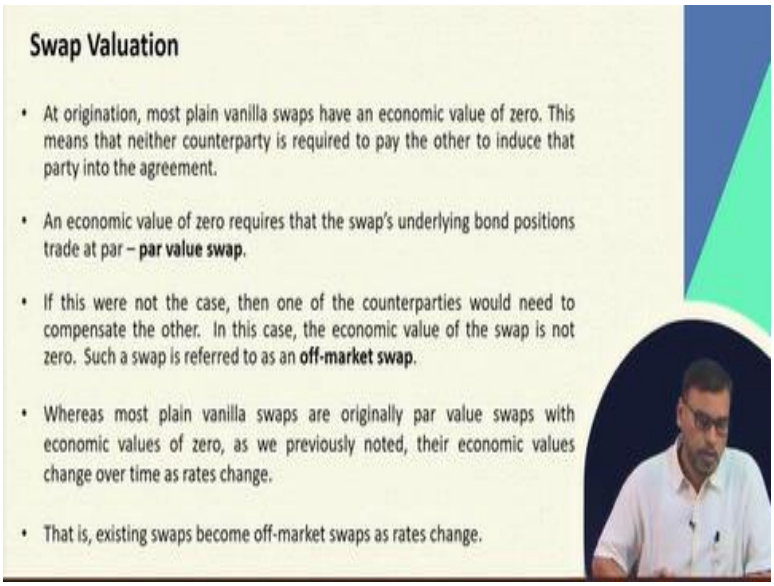

Then how the basically you do the valuation of the swaps? Generally, this off swap has some in the beginning whenever it was initiated in the originating point these particular swaps have zero economic value. That means neither the counter party is required to pay the other to induce that party into the agreement, none of them basically is paying anything. So, the economic value of zero basically requires that these swaps underlying bond positions trade at par that is basically we call it the par value swap.

So, if this were not the case then one of the counter parties would need to compensate the other. And in this case the economic value of swap is not zero and these swaps has basically called the off market swap. But if you look at the most of the plain vanilla swaps there are originally par value swaps where the economic value is zero and the economic value change over time when the interest rate changes or the LIBOR rate changes.

So, the existing swaps becomes off market swaps whenever the interest rate changes in the market or the LIBOR rate basically changes in the market.

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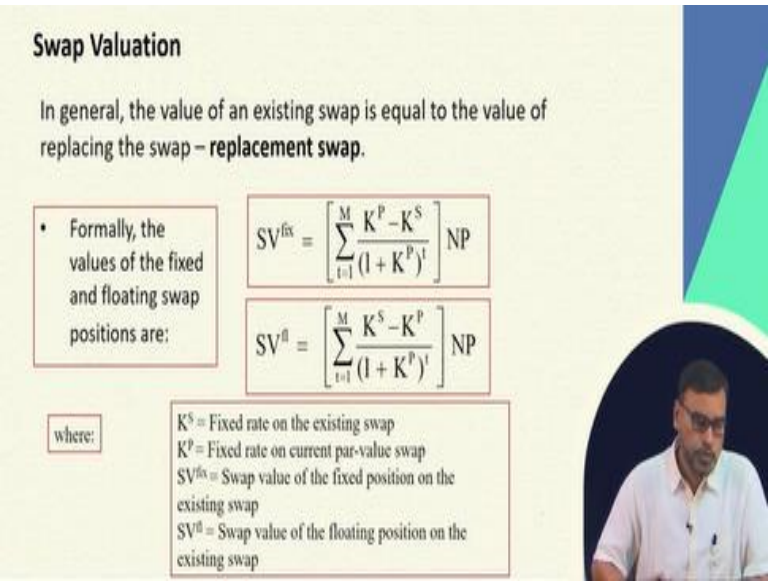

So, if you look at in general the value of an existing swap is equal to the value of the replacing the swap, that is called the replacement swap. So, if you calculate the value of the fixed rate and floating swap positions then if you look at this swap value of the fixed positions on the existing swap that is nothing but the summation t = 1 to M, K^P - K^S divided by 1 + K^P to the power t into NP.

$$SV^{fix} = \left[\sum_{t=1}^{M} \frac{K^P - K^S}{(1+K^P)^t}\right] NP$$

And if you look at the swap value of floating rate positions on the existing swap that will be your summation t =1 to M, K^S - K^P divided by 1 + K^P to the power t into NP and here your K^S is nothing but the fixed rate on the existing swap and your K^P is basically fixed rate on the current par value swap. So, in this case basically we can calculate this value of the fixed rate and floating rate swap positions.

$$SV^{fl} = \left[\sum_{t=1}^{M} \frac{K^P - K^S}{(1+K^P)^t}\right] NP$$

Where K^S= fixed rate on the existing swap

K^P = fixed rate on current par- value swap

SV^{fix} = Swap value of the fixed position on the existing swap

SV^{fl} = Swap value of the floating position on the existing swap

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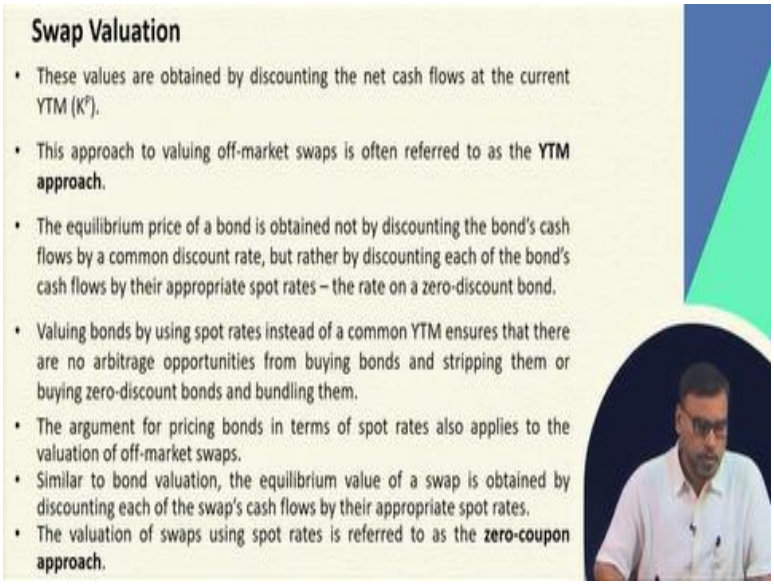

Then these values if you look at these are obtained by discounting the net cash flows at the current YTM that is basically K^P and this approach to evaluation of the off-market swaps generally called as the YTM approach or yield to market approach. So, the equilibrium price of a bond is generally obtained not by discounting bonds cash flow by the common discount rate, but generally the rather by discounting each of the bonds cash flow by their appropriate spot rates.

So, that is called the zero discount bond the rates which are available for the zero discount bonds or the zero coupon bonds. So, valuing the bonds by using the spot rates instead of common YTM generally ensures that there are no arbitrary opportunity from buying bonds and stripping them or buying the zero coupon bonds and bundling them. So, that part already we have discussed extensively also in the previous sessions.

So, the argument for pricing bonds in terms of the spot rates also applies to the valuation of the off-market swaps. So, similar to the bond valuation the equilibrium value of the swap is

generally you can found by discounting each of the swaps cash flow by their appropriate portraits which are available in that particular point of time. So, the evaluation of the swaps using the spot rates generally called as the zero-coupon approach.

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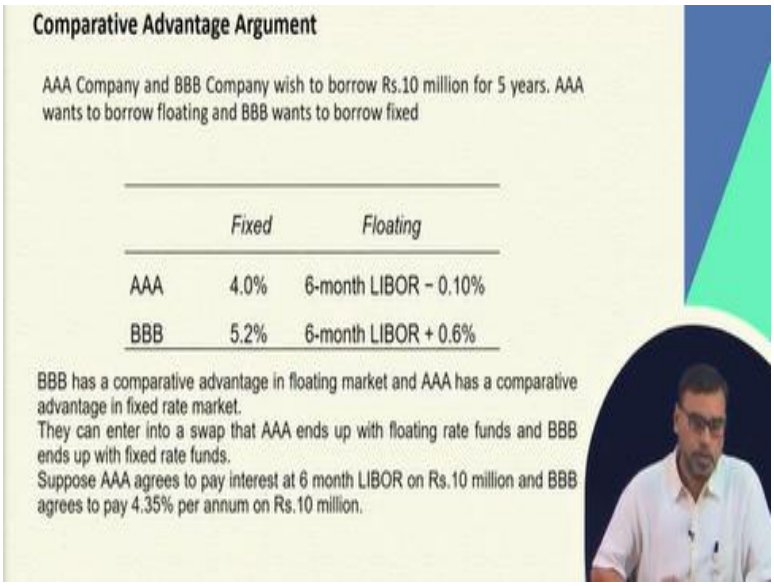

So, these swaps if you look at, we have a comparative advantage argument involves in that particular case. For example, AAA rated company and there is a BBB rated company they wish to borrow 10 million rupees for 5 years and AAA wants to borrow floating and BBB wants to borrow fixed. So, in the market these are the quotes which are available for them that for AAA if they want to borrow at fixed, they will get it at 4% if they want to floating then they will get a rate of six months LIBOR - 0.1%.

Obviously, it is much cheaper for in comparison to the BBB rated bond, BBB rated company if you look at the fixed rate is for them the fixed rate is 5.2% and the floating rate is six months LIBOR + 0.6%. If you make a comparison between these two then you will find that BBB has a comparative advantage in floating market and AAA has a comparative advantage in the fixed rate market.

But they the AAA wants to borrow floating and BBB wants to borrow fixed. So, what basically will happen in that case they can enter into the swap which basically end of the day if you see that AAA ends up with floating rate and BBB ends up with the fixed rate. So, suppose the swap

agreement is like this AAA agrees to pay interest at 6 months LIBOR on 10 million and the BBB agree to pay 4.35% per annum for the 10 million.

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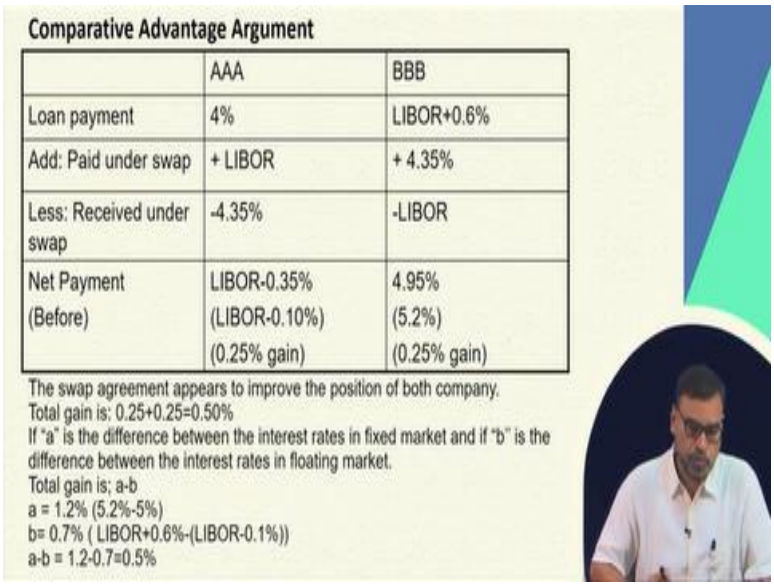

So, if this kind of swap will take place, then you will find that the net payment for the AAA will become LIBOR - 0.35% which was before in the market it was available at LIBOR - 0.1%. And for BBB previously it was 5.2% and it will become 4.95%. So, 0.25% gain for AAA and 0.25% gain for the BBB. So, then what is this difference? The 0.25% is nothing but the difference between the interest rates in the fixed market.

Let A is the difference between the interest rate in the fixed market and B is the difference between interest rate in the floating market

then the total gain will be A - B. So,

A = 1.2% that means 5.2% - 4% and

B will be 0.7% (that is LIBOR + 0.6% minus your LIBOR - 0.1 %.)

So, then the total difference will be 1.2% - 0.7% = 0.5%. So, that is the difference they gain from the market.

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So, there is another forward swap. The forward swap also is an agreement to enter into a swap that starts at a future date at an interest rate agreed upon today. And forward swap generally provides the borrower and investor with a tool for locking in a future interest rate. So, they can generally use to manage the interest at risk for the fixed income positions. And the financial and non-financial institutions which are future borrowing obligations can also lock in a future rate by obtaining the forward contracts on the fixed pair swap positions.

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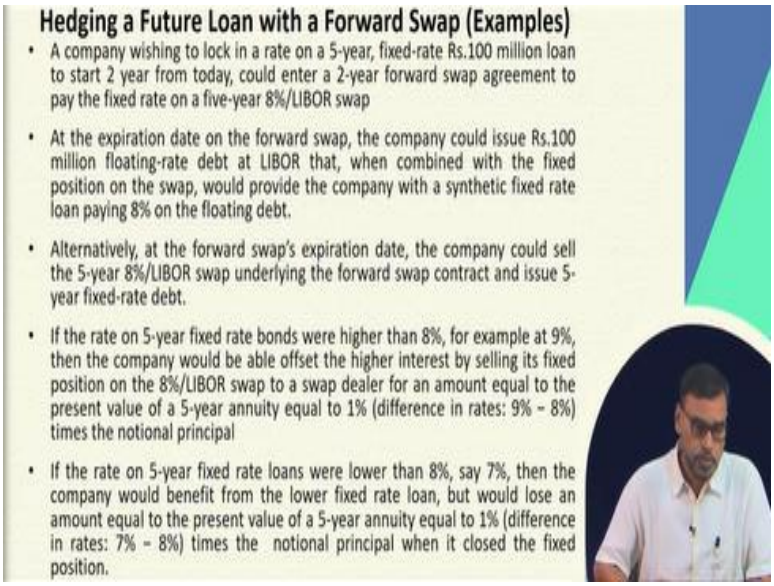

So, how you can hedge a future loan with a forward swap? So, if you look at a company wishing to lock in a rate on 5 year fixed rate, let 100 million loan to start two years from today. They could enter a two year forward swap agreement to pay the fixed rate on a five year 8% LIBOR

swap. So, at the expiration date, what will happen? The company would issue 100 million floating rate debts at LIBOR and when combined with the fixed positions on the swap that would provide the company with a synthetic fixed rate loan paying 8% on the floating debt. So, alternatively, at the forward swaps expiration date, the company could sell the five years 8% LIBOR swap underlying the forward swap contract and issue the five years fixed rate debt.

So, if the rate on five year fixed state bond were higher than 8%.

For example, at 9% then the company would be able to offset the higher interest by selling its fixed positions to a swap dealer for an amount which is equal to the present value of the five year annuity equal to 8% which is nothing but the difference between the (9% - 8%) times the notional principal.

If it is lower than 8%; let 7% then obviously this particular company would benefit the lower fixed rate loan. But it will make a loss, an amount equal to the present value of the five per annuity, that is equal to 1% the difference between (8% - 7%) times the notional principal when it close to fixed positions.

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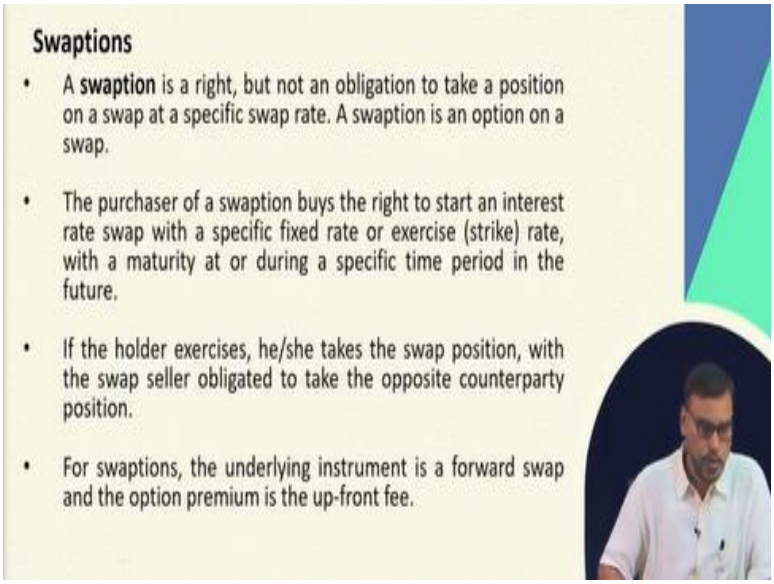

So, another one is swaption, swaption is basically again it is a right but not an obligation to take a position on a swap at a specific swap rate. So, a swaption is an option on a swap that already what we have discussed. So, the purchaser of a swaption buys a right to start an interest rate

swap with a fixed rate or exercise rate with a maturity at or during a specified time period in the future.

So, if the holder exercises this swap option with the swap seller. And the swap seller is obliged to take the opposite counter party positions. So, for swaptions the underlying instrument is forward swap and the option premium is up-front fee.

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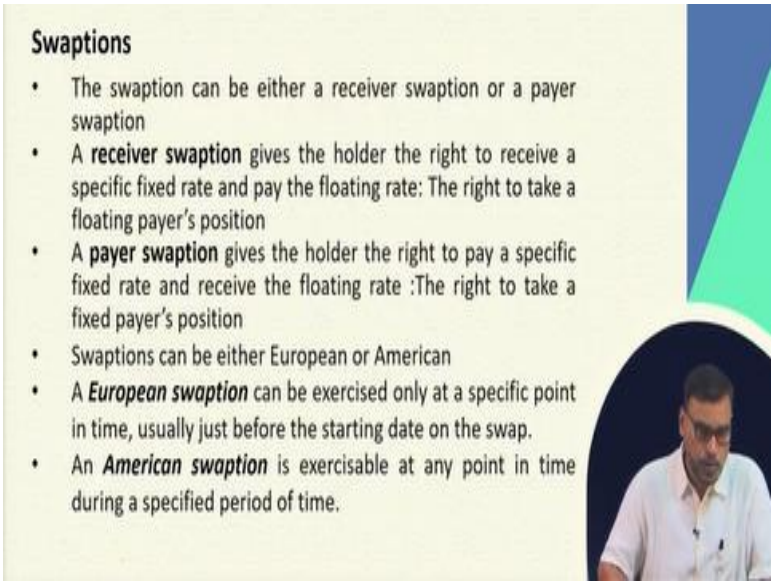

So, these swaptions can be either a receivers swaption or a payer swaption, receivers swaption is gives the holder the right to receive a specific fixed rate and play the floating rate the right to take a floating payer's positions and a payer swaption gives the holder the right to pay a specific fixed rate and receive the floating rate that is basically the right to take a fixed payers positions. So, swaptions can be also European or American.

So, the European option can be exercised only at a specific point of time that already know and the American options can be only exercised at any point in time during a specific time period it will be just like common options.

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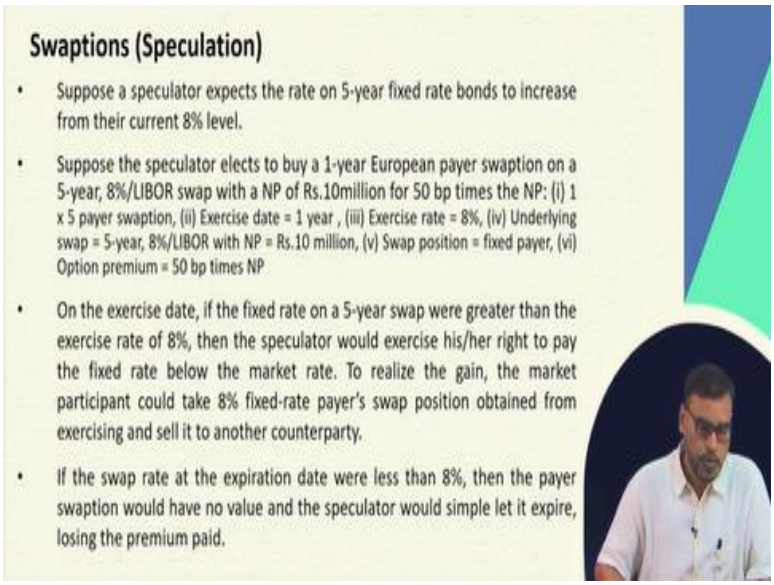

So, this swaptions can be used for speculative purpose it can be also used for the hedging purpose. Suppose, a speculator expects the rate on a five years fixed rate bonds to increase from their current 8% level then the speculator basically decides to buy one year European payers swaptions on a five year 8% LIBOR swap with a notional principal of for 10 million for 50 basis point times the notional principal.

Then you can say that the exercise rate is one year, exercise rate is 8% underlying swap is five years 8% LIBOR with notional principal of 10 million swap positions are basically fixed payer and option premium is 50 basis point times the notional principals. So, on the exercise rate if the fixed rates on a 5 year swap are greater than the exercise rate of 8% then the speculator would exercise is right to pay the fixed rate below the market rate.

And to realize the gain the market participant could take the 8% fixed rate payer swap positions obtained from exercising and sell it to the another counterparty. So, if the swap rate or the expiration date were less than 8%, then the payer swaption would have no value and the speculator would simply let it expire, losing this premium paid.

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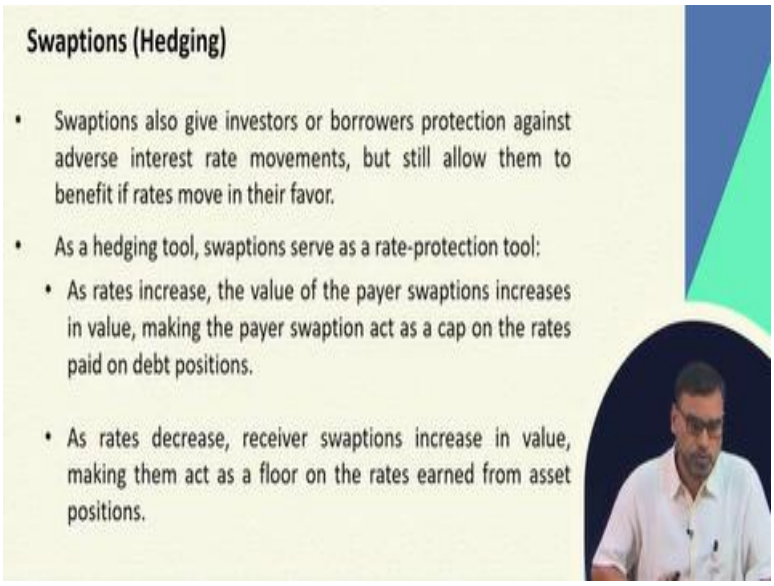

It can be also used for hedging it can also give the investors and borrowers protection against the adverse interest rate movements, but still allow them to benefit if the rates move in their favour. So, as a hedging tool swaptions serve as a rate protection tool. So, when the rate increase the value of the payer swaption increases in value making the payer swaption act as a cap on the rates paid by the debt positions.

If the rates decline then the receivers option increase in value making them act as a floor on the rates earned from the asset positions.

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So, the cancellable swap was a swap in which one of the counter parties has the option to terminate one or more payments. These are swaps can be callable or putable. And callable swap is basically one which the fixed payer has the right to early termination. If the rates decrease the fixed rate payer on the swap with the embedded call option to early termination can exercise the right to cancel the swap.

And a putable swap is one in which the floating payer has the right to early cancellation and a floating rate payer with this option may find it advantageous to exercise early termination right when the rates increase.

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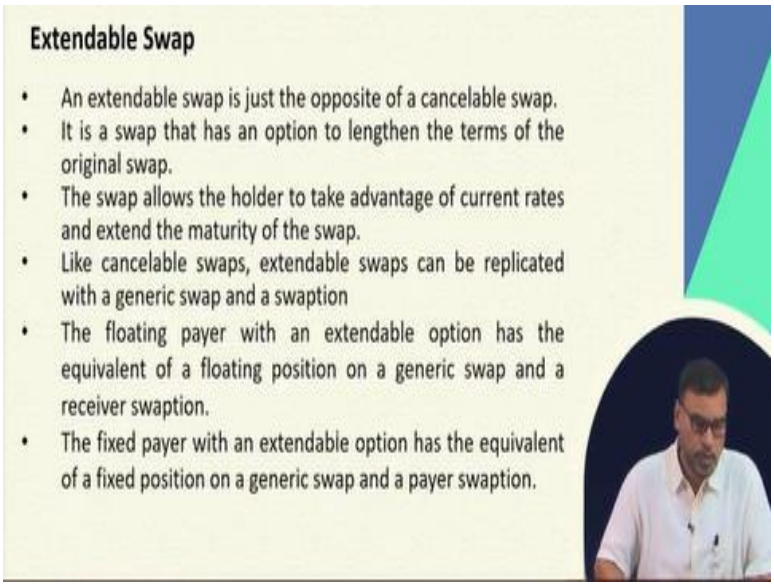

We can also have extendable swap. The extendable swap is just the opposite of the cancellable swap where it has option to lengthen the terms of the original swap. It allows the holder to take advantage of the current rates and extend the maturity of the swap. Like cancellable swap, extendable swaps can be replicated with a generic swap and swaption. The floating rate payer with extendable option has the equivalent of a floating rate position on a generic swap and a receiver swaption.

So, fixed payer with an extendable option has the equivalent of a fixed position on a generic swap and a payer swaption.

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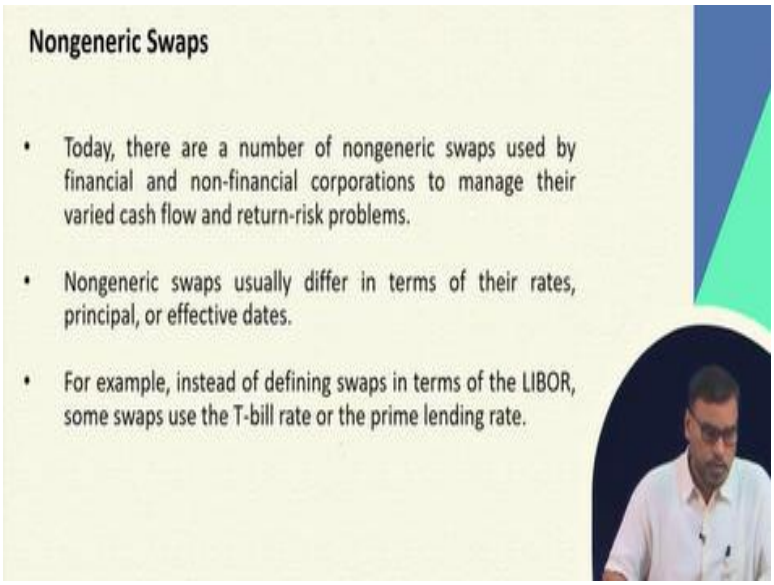

So, there are some non-generic swaps also available in the market. They are different in terms of the rates, principal and effective dates. So, instead of defining swaps in terms of LIBOR, some swaps use the T-bill rate or the prime lending rate and all these things.

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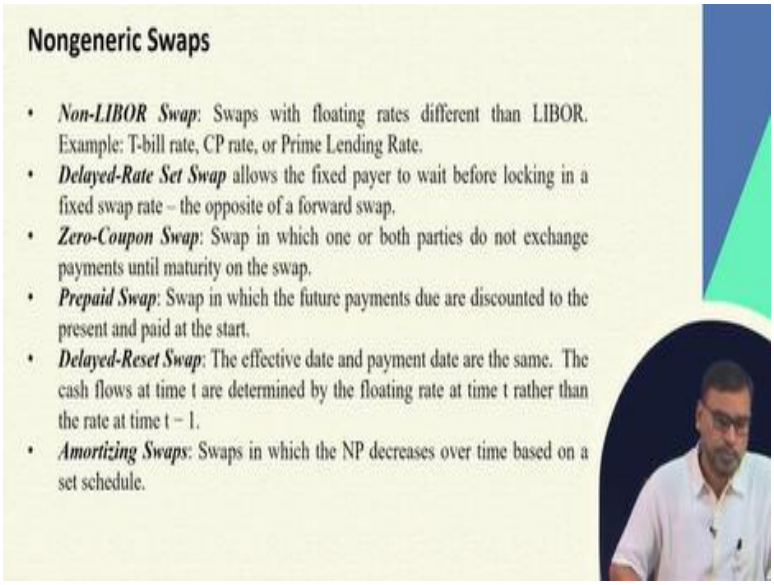

So, these are the different type of non-generic swaps like non-LIBOR swap, delayed rate set swap, zero coupon swap, prepaid swap, delayed reset swap, amortizing swap like swaps in which the notional payment decreases over time based on a set schedule. Prepaid swap is in which the future payments due are discounted to the present and paid at the start and if you look at the zero coupons of here the in which the other or both parties do not exchange payments until maturity on the swap. So, these are basically the different type of non-generic swaps.

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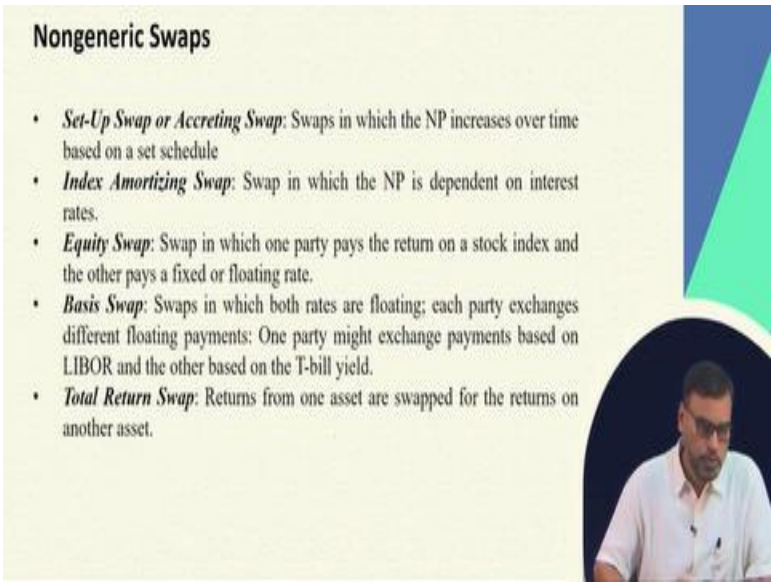

It will go on you can have an equities of in which the one party pays the return on a stock index and the other pays a fixed or the floating rate. Then you have total returns swap, the returns from one asset are swapped for the returns on another asset. We have the basis swap where the both rates are floating each party exchanges different floating payments. One party might extend payment based on the LIBOR and other party or may be on the basis of T-bill yield.

You can have index amortizing swap in which the notional payment is dependent on the interest rates and so on. So, these are the different other type of swaps which are also available in the market.

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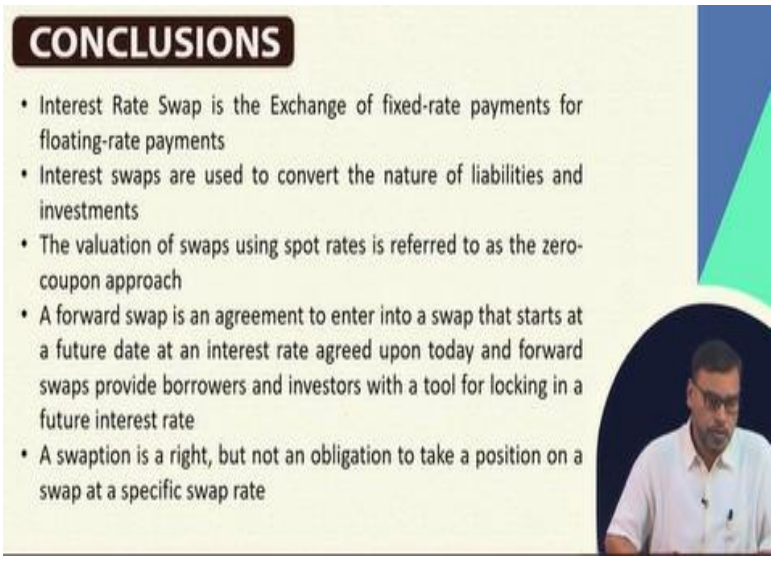

So, what we have discussed, there are interest rate swap where the exchange for fixed payments for the floating rate payments, these are used to convert the nature of liabilities and investments. The value of swaps using spot rates generally called as the zero-coupon approach and forward swap is basically an agreement to enter into swap which starts at the future date at an aggregate interest rate which is agreed upon today.

And forward swaps provide borrowers and investors with a tool for locking in a future interest rate and a swaption is the right but not obligation to take a position on the swap at a specific swap rate.

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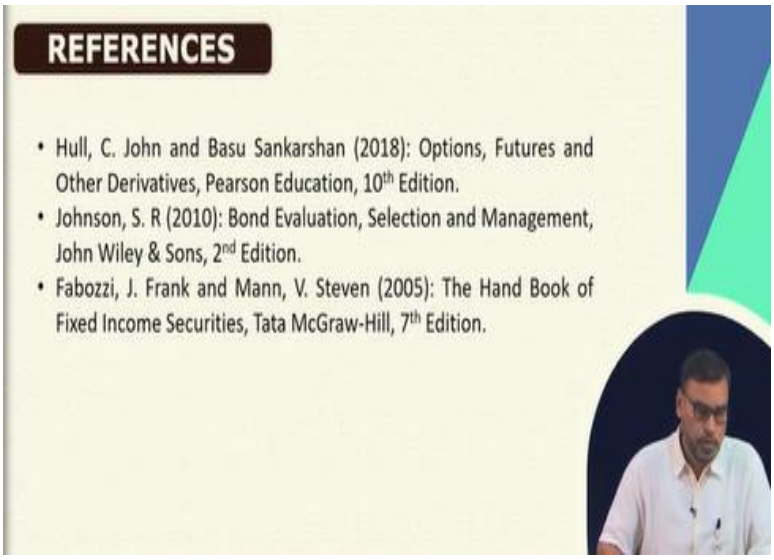

So, these are the references. Thank you.