

Management of Fixed Income Securities
Prof. Jitendra Mahakud
Department of Humanities and Social Science
Indian Institute of Technology, Kharagpur

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.

(Refer Slide Time: 00:37)



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.

(Refer Slide Time: 01:08)



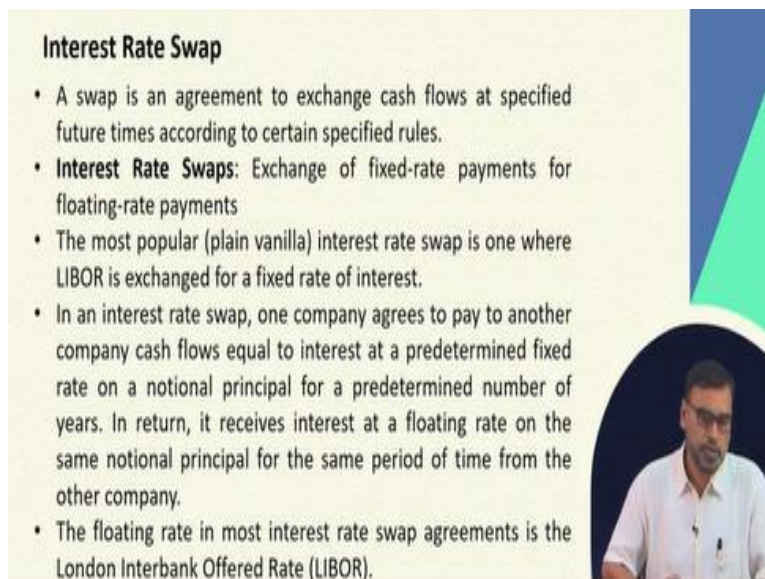
KEYWORDS

- Swap Rate
- Swap spread
- Par value swap
- Basis Swap
- Off-market swap

A video inset in the bottom right corner shows a man with glasses and a white shirt speaking.

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.

(Refer Slide Time: 01:31)



Interest Rate Swap

- A swap is an agreement to exchange cash flows at specified future times according to certain specified rules.
- **Interest Rate Swaps:** Exchange of fixed-rate payments for floating-rate payments
- The most popular (plain vanilla) interest rate swap is one where LIBOR is exchanged for a fixed rate of interest.
- In an interest rate swap, one company agrees to pay to another company cash flows equal to interest at a predetermined fixed rate on a notional principal for a predetermined number of years. In return, it receives interest at a floating rate on the same notional principal for the same period of time from the other company.
- The floating rate in most interest rate swap agreements is the London Interbank Offered Rate (LIBOR).

A video inset in the bottom right corner shows a man with glasses and a white shirt speaking.

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.

(Refer Slide Time: 04:14)

Interest Rate Swap Example

- Consider a hypothetical 3-year swap initiated on March 15, 2016, between Company X and Company Y.
- Suppose X agrees to pay Y an interest rate of 5% per annum on a principal of Rs.100 million, and in return Y agrees to pay X the 6-month LIBOR rate on the same principal.
- X is the fixed-rate payer; Y is the floating rate payer.
- We assume the agreement specifies that payments are to be exchanged every 6 months and that the 5% interest rate is quoted with semi-annual compounding.



So, in this case if you take an 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 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.

(Refer Slide Time: 05:29)

Example: Cash Flows to Company X

-----Millions of Rupees-----

Date	LIBOR Rate	FLOATING Cash Flow	FIXED Cash Flow	Net Cash Flow
Mar.15, 2016	4.2%			
Sept. 15, 2016	4.8%	+2.10	-2.50	-0.40
Mar.15, 2017	5.3%	+2.40	-2.50	-0.10
Sept. 15, 2017	5.5%	+2.65	-2.50	+0.15
Mar.15, 2018	5.6%	+2.75	-2.50	+0.25
Sept. 15, 2018	5.9%	+2.80	-2.50	+0.30
Mar.15, 2019	6.4%	+2.95	-2.50	+0.45

- The principal itself is not exchanged. For this reason it is termed the notional principal, or just the notional.
- If the notional principal were exchanged at the end of the life of the swap, the nature of the deal would not be changed in any way.
- The notional principal is the same for both the fixed and floating payments. Exchanging Rs. 100 million for Rs. 100 million at the end of the life of the swap is a transaction that would have no financial value to either company X or Y.



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 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.

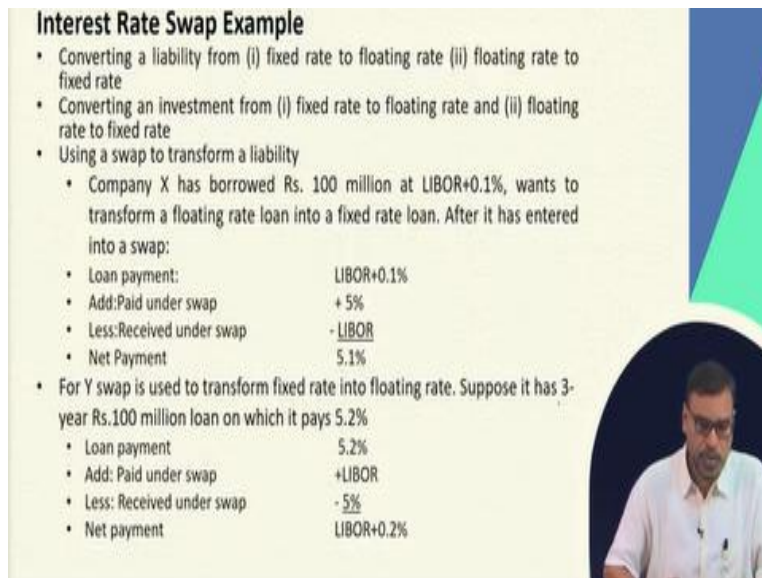
So, the LIBOR rate in the date of March 15, 2016 then the floating rate cash flow in the month of September on the date of September 15 will be basically six months basis. This LIBOR rates are annual basis so that's why the floating rate cash flow will be 2.1. So, let the LIBOR rate has changed in the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

(Refer Slide Time: 07:31)



Interest Rate Swap Example

- Converting a liability from (i) fixed rate to floating rate (ii) floating rate to fixed rate
- Converting an investment from (i) fixed rate to floating rate and (ii) floating rate to fixed rate
- Using a swap to transform a liability
 - Company X has borrowed Rs. 100 million at LIBOR+0.1%, wants to transform a floating rate loan into a fixed rate loan. After it has entered into a swap:

• Loan payment:	LIBOR+0.1%
• Add: Paid under swap	+ 5%
• Less: Received under swap	- LIBOR
• Net Payment	5.1%
 - For Y swap is used to transform fixed rate into floating rate. Suppose it has 3-year Rs.100 million loan on which it pays 5.2%

• Loan payment	5.2%
• Add: Paid under swap	+LIBOR
• Less: Received under swap	- 5%
• Net payment	LIBOR+0.2%

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

$$= (\text{LIBOR}+0.1\%) + (5\%) - \text{LIBOR}$$

$$= 5.1\%$$

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

$$= (5.2\%) + (\text{LIBOR}) - 5\%$$

$$= \text{LIBOR} + 0.2\%$$

(Refer Slide Time: 10:19)

Interest Rate Swap Example (Using the swap to transform an asset)

- Suppose Company X owns Rs.100 million in bonds that will provide 4.7% per annum over the next 3 years. Now company X enters into a swap, wants to switch its assets from fixed to floating rate.

• Investment income	4.7%
• Less: Paid under swap	-5%
• Add: Received under swap	+LIBOR
• Net income	LIBOR-0.3%
- Company Y is transforming an asset earning floating to fixed. Suppose Y has an investment Rs.100 million that yields LIBOR-0.20. After it has entered into the swap:

• Investment income	LIBOR-0.20
• Less: Paid under swap	-LIBOR
• Add: Received under swap	+5%
• Net Investment income	4.8%



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.

$$= (4.7\%) - (5\%) + \text{LIBOR}$$

$$= \text{LIBOR} - 0.3\%.$$

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.

$$= (\text{LIBOR}-0.20\%) - \text{LIBOR} + 5\%$$

$$= 4.8\%$$

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.

(Refer Slide Time: 11:42)

Interest Rate Swap Example
 Suppose financial intermediary enters into two offsetting swap transactions with X and Y and receives 0.03% fee per year

Transform a Liability (Fin int. Involved)			Transform an Asset (Fin int. Involved)		
	Company X	Company Y		Company X	Company Y
Loan payment	LIBOR + 0.1%	5.2%	In. Income	4.7%	LIBOR-0.2%
Add: Paid under swap	+ 5.015	+ LIBOR	Less: Paid under swap	-5.015	-LIBOR
Less: Received under swap	- LIBOR	-4.985%	Add: Received under swap	+ LIBOR	+ 4.985%
Net Payment (Without fin. int.)	5.115% (5.1%)	LIBOR+0.215 (LIBOR+0.2%)	Net Income (Without a fin. int.)	LIBOR-0.315% (LIBOR-0.3%)	4.785% (4.8%)

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:

$$\text{Net Payment} = \text{Loan payment} + \text{paid under swap} - \text{received under swap}$$

$$= (\text{LIBOR}+0.1\%) + (5.015\%) - \text{LIBOR}$$

$$= 5.115\%$$

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

$$\text{Net Payment} = \text{Loan payment} + \text{paid under swap} - \text{received under swap}$$

$$= (5.2\%) + (\text{LIBOR}) - 4.985\%$$

$$= \text{LIBOR} + 0.215$$

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:

$$\text{Net Income} = \text{Investment income} - \text{Paid under swap} + \text{received under swap.}$$

$$= (4.7\%) - (5.015\%) + \text{LIBOR}$$

$$= \text{LIBOR} - 0.315\%.$$

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

$$\text{Net Investment income} = \text{Investment income} - \text{Paid under swap} + \text{received under swap.}$$

$$= (\text{LIBOR}-0.20\%) - \text{LIBOR} + 4.985\%$$

$$= 4.785\%$$

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

(Refer Slide Time: 13:15)

Interest Rate Swaps' Fundamental Use

- One of the important uses of swaps is in creating a synthetic fixed- or floating-rate liability or asset that yields a better rate than a conventional or direct one
- Synthetic Fixed-Rate Loans and Investments: A **synthetic fixed-rate loan** is formed by combining a floating-rate loan with a fixed-rate payer's position
- Synthetic Floating-Rate Loans and Investments: A **synthetic floating-rate loan** is formed by combining a fixed-rate loan with a floating-rate payer's position.
- Swaps can be viewed as a combination of a fixed-rate bond and flexible-rate note (FRN).
- A **fixed-rate payer position** is equivalent to (i) Buying a FRN paying the LIBOR and (ii) Shorting a fixed-rate bond at the swap's fixed rate.
- A **floating-rate payer position** is equivalent to (i) Shorting a FRN at the LIBOR and Buying a fixed-rate bond at the swap fixed rate



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.

(Refer Slide Time: 14:35)

Swap Rate

- It is the average of (a) the fixed rate that a swap market maker is prepared to pay in exchange for receiving LIBOR (its bid rate) and (b) the fixed rate that it is prepared to receive in return for paying LIBOR (its offer rate).

Maturity	Bid (%)	Offer (%)	Swap Rate (%)
2 years	6.03	6.06	6.045
3 years	6.21	6.24	6.225
4 years	6.35	6.39	6.370
5 years	6.47	6.51	6.490
7 years	6.65	6.68	6.665
10 years	6.83	6.87	6.850



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 is 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%.

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

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

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

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.

(Refer Slide Time: 15:33)

Swap Market Price Quotes

- **Swap spread:** Swap dealers usually quote two different swap spreads (i) One for deals in which they pay the fixed rate and (ii) One in which they receive the fixed rate
- **Swap Spread (Example):** 80/86 dealer buys at 80bp over T-note yield and sells at 86 over T-note yield. That is, the dealer will take the fixed payer's position at a fixed rate equal to 80 BP over the T-note yield and take the floating payer's position, receiving 86 bp above the T-note yield.
- The fixed and floating rates are not directly comparable. The T-note assumes a 365-day basis and the LIBOR assumes 360.
- The rates need to be prorated to the actual number of days that have elapsed between settlement dates to determine the actual payments.
- Formula:

Fixed-Rate Settlement Payment:

$$(\text{Fixed Rate}) \left[\frac{\text{No. of Days}}{365} \right] \text{NP}$$

Floating-Rate Settlement Payment:

$$(\text{LIBOR}) \left[\frac{\text{No. of Days}}{360} \right] \text{NP}$$



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.

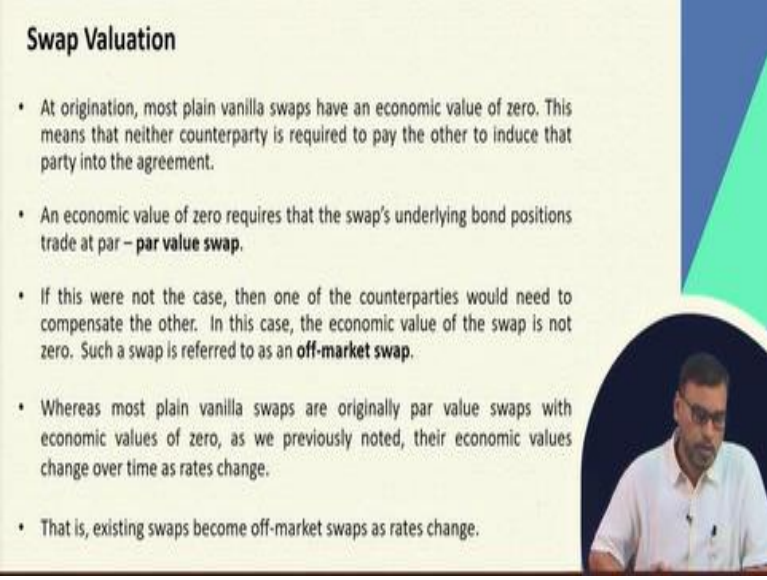
That means the dealer will take the fixed payer's position at a fixed rate which is equal to 80 basis point over the T-note yield. And take the floating payer's position receiving the 86 basis point above the T-note yield. And the fixed and floating rates are not directly comparable the T-note basically 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: $(\text{Fixed rate}) \left[\frac{\text{No Of days}}{365} \right] \text{NP}$

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

(Refer Slide Time: 17:16)



Swap Valuation

- At origination, most plain vanilla swaps have an economic value of zero. This means that neither counterparty is required to pay the other to induce that party into the agreement.
- An economic value of zero requires that the swap's underlying bond positions trade at par – **par value swap**.
- If this were not the case, then one of the counterparties would need to compensate the other. In this case, the economic value of the swap is not zero. Such a swap is referred to as an **off-market swap**.
- Whereas most plain vanilla swaps are originally par value swaps with economic values of zero, as we previously noted, their economic values change over time as rates change.
- That is, existing swaps become off-market swaps as rates change.

The slide features a video inset in the bottom right corner showing a man with glasses and a white shirt speaking. The background of the slide is light yellow with a blue and green geometric design on the right side.

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.

(Refer Slide Time: 18:42)

Swap Valuation

In general, the value of an existing swap is equal to the value of replacing the swap – replacement swap.

- Formally, the values of the fixed and floating swap positions are:

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

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

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



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 .

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

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.

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

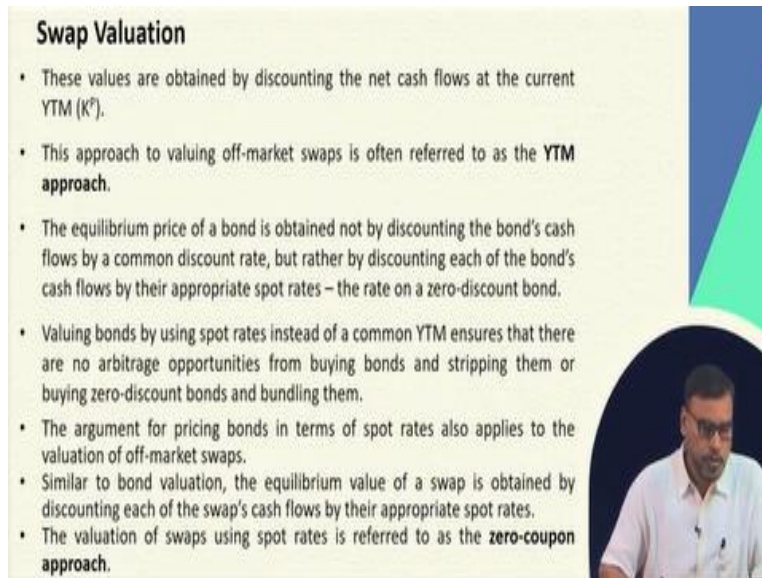
Where K^S = fixed rate on the existing swap

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

(Refer Slide Time: 19:46)



Swap Valuation

- These values are obtained by discounting the net cash flows at the current YTM (K^P).
- This approach to valuing off-market swaps is often referred to as the **YTM approach**.
- The equilibrium price of a bond is obtained not by discounting the bond's cash flows by a common discount rate, but rather by discounting each of the bond's cash flows by their appropriate spot rates – the rate on a zero-discount bond.
- Valuing bonds by using spot rates instead of a common YTM ensures that there are no arbitrage opportunities from buying bonds and stripping them or buying zero-discount bonds and bundling them.
- The argument for pricing bonds in terms of spot rates also applies to the valuation of off-market swaps.
- Similar to bond valuation, the equilibrium value of a swap is obtained by discounting each of the swap's cash flows by their appropriate spot rates.
- The valuation of swaps using spot rates is referred to as the **zero-coupon approach**.

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 find 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.


(Refer Slide Time: 21:23)

Comparative Advantage Argument

AAA Company and BBB Company wish to borrow Rs.10 million for 5 years. AAA wants to borrow floating and BBB wants to borrow fixed

	Fixed	Floating
AAA	4.0%	6-month LIBOR - 0.10%
BBB	5.2%	6-month LIBOR + 0.6%

BBB has a comparative advantage in floating market and AAA has a comparative advantage in fixed rate market. They can enter into a swap that AAA ends up with floating rate funds and BBB ends up with fixed rate funds. Suppose AAA agrees to pay interest at 6 month LIBOR on Rs.10 million and BBB agrees to pay 4.35% per annum on Rs.10 million.



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.

(Refer Slide Time: 23:06)

	AAA	BBB
Loan payment	4%	LIBOR+0.6%
Add: Paid under swap	+ LIBOR	+ 4.35%
Less: Received under swap	-4.35%	-LIBOR
Net Payment	LIBOR-0.35%	4.95%
(Before)	(LIBOR-0.10%)	(5.2%)
	(0.25% gain)	(0.25% gain)

The swap agreement appears to improve the position of both company.
 Total gain is: $0.25+0.25=0.50\%$
 If "a" is the difference between the interest rates in fixed market and if "b" is the difference between the interest rates in floating market.
 Total gain is; a-b
 $a = 1.2\%$ ($5.2\%-4\%$)
 $b = 0.7\%$ ($LIBOR+0.6\%-(LIBOR-0.1\%)$)
 $a-b = 1.2-0.7=0.5\%$



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.

(Refer Slide Time: 24:30)

Forward Swap

- A **forward swap** is an agreement to enter into a swap that starts at a future date at an interest rate agreed upon today.
- Forward swaps provide borrowers and investors with a tool for locking in a future interest rate.
- These can be used to manage interest rate risk for fixed-income positions.
- Financial and non-financial institutions that have future borrowing obligations can lock in a future rate by obtaining forward contracts on fixed-payer swap positions.



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.

(Refer Slide Time: 25:13)

Hedging a Future Loan with a Forward Swap (Examples)

- A company wishing to lock in a rate on a 5-year, fixed-rate Rs.100 million loan to start 2 year from today, could enter a 2-year forward swap agreement to pay the fixed rate on a five-year 8%/LIBOR swap
- At the expiration date on the forward swap, the company could issue Rs.100 million floating-rate debt at LIBOR that, when combined with the fixed position on the swap, would provide the company with a synthetic fixed rate loan paying 8% on the floating debt.
- Alternatively, at the forward swap's expiration date, the company could sell the 5-year 8%/LIBOR swap underlying the forward swap contract and issue 5-year fixed-rate debt.
- If the rate on 5-year fixed rate bonds were higher than 8%, for example at 9%, then the company would be able offset the higher interest by selling its fixed position on the 8%/LIBOR swap to a swap dealer for an amount equal to the present value of a 5-year annuity equal to 1% (difference in rates: 9% - 8%) times the notional principal
- If the rate on 5-year fixed rate loans were lower than 8%, say 7%, then the company would benefit from the lower fixed rate loan, but would lose an amount equal to the present value of a 5-year annuity equal to 1% (difference in rates: 7% - 8%) times the notional principal when it closed the fixed position.



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

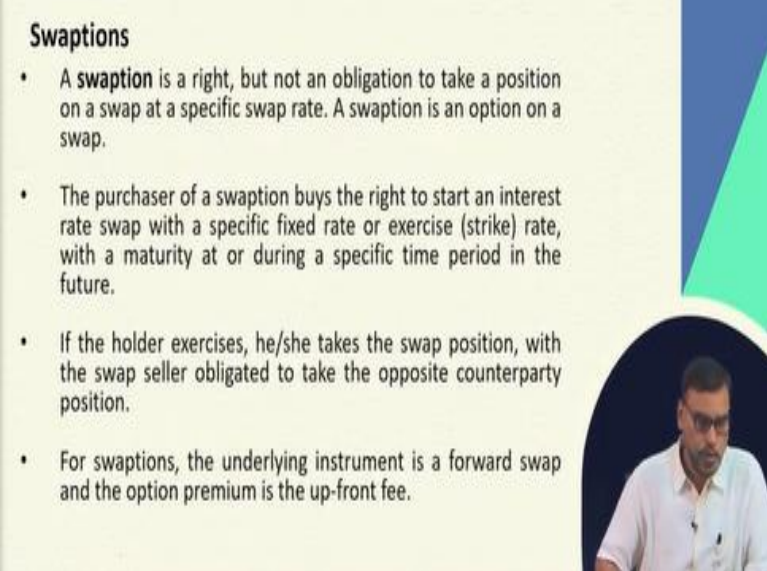
swap. So, at the expiration date, what will happen? The company would issue 100 million floating rate debts at LIBOR and when combined with the fixed positions on the swap that would provide the company with a synthetic fixed rate loan paying 8% on the floating debt. So, alternatively, at the forward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

(Refer Slide Time: 27:01)



Swaptions

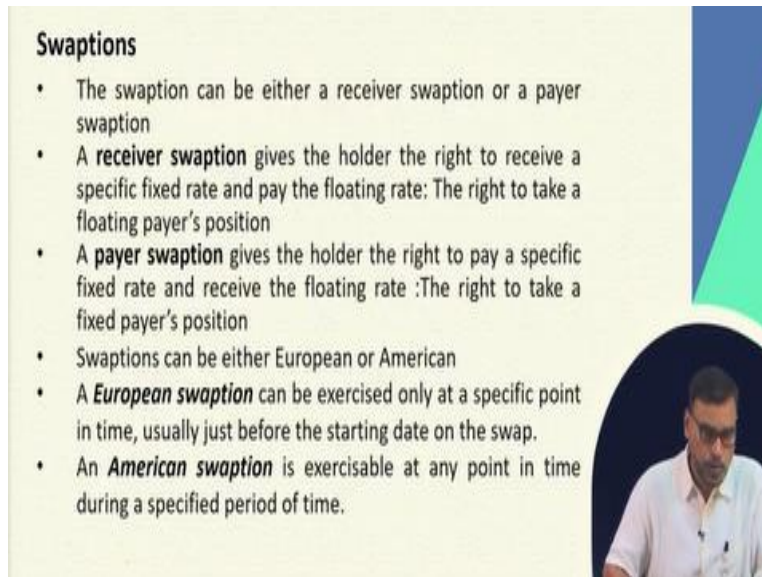
- A **swaption** is a right, but not an obligation to take a position on a swap at a specific swap rate. A swaption is an option on a swap.
- The purchaser of a swaption buys the right to start an interest rate swap with a specific fixed rate or exercise (strike) rate, with a maturity at or during a specific time period in the future.
- If the holder exercises, he/she takes the swap position, with the swap seller obligated to take the opposite counterparty position.
- For swaptions, the underlying instrument is a forward swap and the option premium is the up-front fee.

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.

(Refer Slide Time: 27:47)



Swaptions

- The swaption can be either a receiver swaption or a payer swaption
- A **receiver swaption** gives the holder the right to receive a specific fixed rate and pay the floating rate: The right to take a floating payer's position
- A **payer swaption** gives the holder the right to pay a specific fixed rate and receive the floating rate :The right to take a fixed payer's position
- Swaptions can be either European or American
- A **European swaption** can be exercised only at a specific point in time, usually just before the starting date on the swap.
- An **American swaption** is exercisable at any point in time during a specified period of time.

The slide features a light green background with a blue and green geometric design on the right side. A small inset video in the bottom right corner shows a man in a white shirt speaking.

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.

(Refer Slide Time: 28:32)

Swaptions (Speculation)

- Suppose a speculator expects the rate on 5-year fixed rate bonds to increase from their current 8% level.
- Suppose the speculator elects to buy a 1-year European payer swaption on a 5-year, 8%/LIBOR swap with a NP of Rs.10million for 50 bp times the NP: (i) 1 x 5 payer swaption, (ii) Exercise date = 1 year, (iii) Exercise rate = 8%, (iv) Underlying swap = 5-year, 8%/LIBOR with NP = Rs.10 million, (v) Swap position = fixed payer, (vi) Option premium = 50 bp times NP
- On the exercise date, if the fixed rate on a 5-year swap were greater than the exercise rate of 8%, then the speculator would exercise his/her right to pay the fixed rate below the market rate. To realize the gain, the market participant could take 8% fixed-rate payer's swap position obtained from exercising and sell it to another counterparty.
- If the swap rate at the expiration date were less than 8%, then the payer swaption would have no value and the speculator would simply let it expire, losing the premium paid.



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.

(Refer Slide Time: 29:56)

Swaptions (Hedging)

- Swaptions also give investors or borrowers protection against adverse interest rate movements, but still allow them to benefit if rates move in their favor.
- As a hedging tool, swaptions serve as a rate-protection tool:
 - As rates increase, the value of the payer swaptions increases in value, making the payer swaption act as a cap on the rates paid on debt positions.
 - As rates decrease, receiver swaptions increase in value, making them act as a floor on the rates earned from asset positions.



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.

(Refer Slide Time: 30:34)

Cancelable Swap

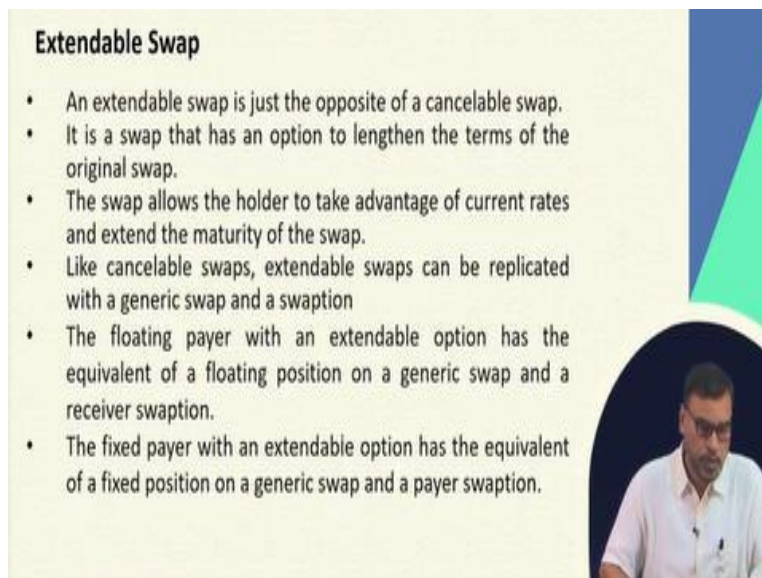
- A **cancelable swap** is a swap in which one of the counterparties has the option to terminate one or more payments. Cancelable swaps can be callable or putable.
- A **callable swap** is one in which the fixed payer has the right to early termination. If rates decrease, the fixed-rate payer on the swap with this embedded call option to early termination can exercise the right to cancel the swap.
- A **putable swap** is one in which the floating payer has the right to early cancellation. A floating-rate payer with this option may find it advantageous to exercise the early-termination right when rates increase.



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.

(Refer Slide Time: 31:15)



Extendable Swap

- An extendable swap is just the opposite of a cancelable swap.
- It is a swap that has an option to lengthen the terms of the original swap.
- The swap allows the holder to take advantage of current rates and extend the maturity of the swap.
- Like cancelable swaps, extendable swaps can be replicated with a generic swap and a swaption
- The floating payer with an extendable option has the equivalent of a floating position on a generic swap and a receiver swaption.
- The fixed payer with an extendable option has the equivalent of a fixed position on a generic swap and a payer swaption.

The slide features a light green background with a blue and green geometric design on the right side. A small circular inset in the bottom right corner shows a man in a white shirt speaking.

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.

(Refer Slide Time: 31:58)

Nongeneric Swaps

- Today, there are a number of nongeneric swaps used by financial and non-financial corporations to manage their varied cash flow and return-risk problems.
- Nongeneric swaps usually differ in terms of their rates, principal, or effective dates.
- For example, instead of defining swaps in terms of the LIBOR, some swaps use the T-bill rate or the prime lending rate.



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.

(Refer Slide Time: 32:15)

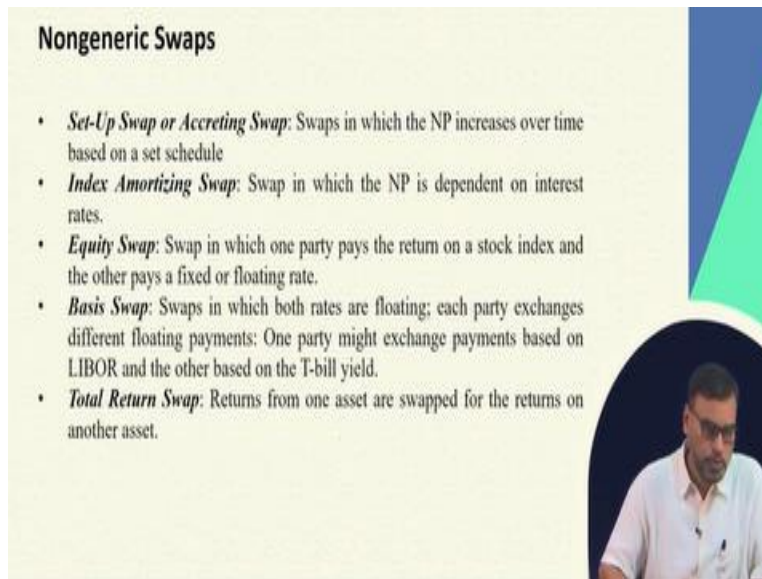
Nongeneric Swaps

- *Non-LIBOR Swap*: Swaps with floating rates different than LIBOR. Example: T-bill rate, CP rate, or Prime Lending Rate.
- *Delayed-Rate Set Swap* allows the fixed payer to wait before locking in a fixed swap rate – the opposite of a forward swap.
- *Zero-Coupon Swap*: Swap in which one or both parties do not exchange payments until maturity on the swap.
- *Prepaid Swap*: Swap in which the future payments due are discounted to the present and paid at the start.
- *Delayed-Reset Swap*: The effective date and payment date are the same. The cash flows at time t are determined by the floating rate at time t rather than the rate at time $t - 1$.
- *Amortizing Swaps*: Swaps in which the NP decreases over time based on a set schedule.



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.

(Refer Slide Time: 32:53)



Nongeneric Swaps

- *Set-Up Swap or Accreting Swap*: Swaps in which the NP increases over time based on a set schedule
- *Index Amortizing Swap*: Swap in which the NP is dependent on interest rates.
- *Equity Swap*: Swap in which one party pays the return on a stock index and the other pays a fixed or floating rate.
- *Basis Swap*: Swaps in which both rates are floating; each party exchanges different floating payments: One party might exchange payments based on LIBOR and the other based on the T-bill yield.
- *Total Return Swap*: Returns from one asset are swapped for the returns on another asset.

The slide features a video inset in the bottom right corner showing a man with glasses and a white shirt speaking. The background of the slide is light green with a blue and green geometric design on the right side.

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.

(Refer Slide Time: 33:36)

CONCLUSIONS

- Interest Rate Swap is the Exchange of fixed-rate payments for floating-rate payments
- Interest swaps are used to convert the nature of liabilities and investments
- The valuation of swaps using spot rates is referred to as the zero-coupon approach
- A forward swap is an agreement to enter into a swap that starts at a future date at an interest rate agreed upon today and forward swaps provide borrowers and investors with a tool for locking in a future interest rate
- A swaption is a right, but not an obligation to take a position on a swap at a specific swap rate



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.

(Refer Slide Time: 34:19)

REFERENCES

- Hull, C. John and Basu Sankarshan (2018): Options, Futures and Other Derivatives, Pearson Education, 10th Edition.
- Johnson, S. R (2010): Bond Evaluation, Selection and Management, John Wiley & Sons, 2nd Edition.
- Fabozzi, J. Frank and Mann, V. Steven (2005): The Hand Book of Fixed Income Securities, Tata McGraw-Hill, 7th Edition.



So, these are the references. Thank you.