Quantitative Finance

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Module – 05

Lecture - 25

So, welcome back to the quantitative finance course to the nth number of lecture. So, we were in the last class just started the concept of Swap.

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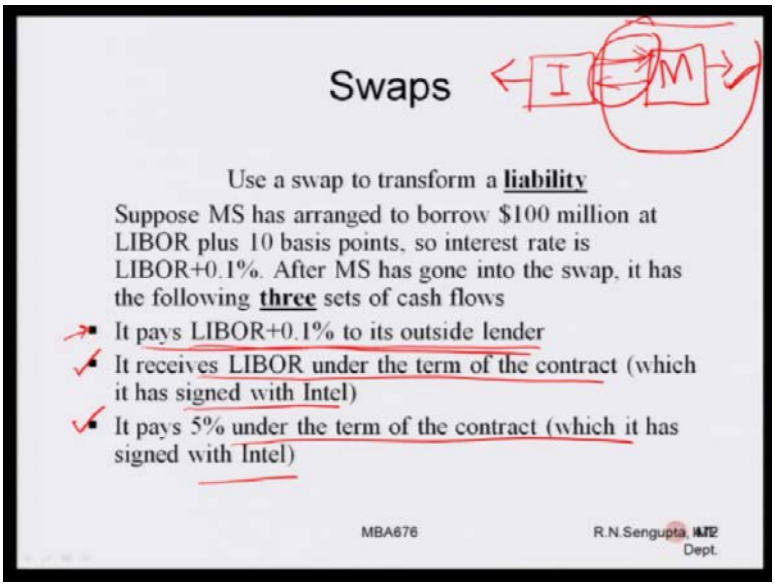

Swap means in English word exchange, some sort of exchange. So now, in the swap is basically type of financial product or a derivative, which is basically being designed in order to mitigate the overall risk to parties faced on two different fronts. So, as your are discussing swaps would be consider here in our course based on two fronts; one is the risk based on interest rate and one is the risk based on foreign currency. And obviously, you can combine them accordingly.

So, coming back to the swap for the example, which we are considering this Microsoft it needs chips from Intel and Intel also once to sell them at some future date and time and based on that they want to basically go for a swap. Swap means a type of financial transactions such that they are able to mitigate or reduce the overall risk.

So, here we are using a Swap to transformer liability. So, suppose Microsoft arrange to

borrow, as we are say discussing 100 millions at LIBOR rate. LIBOR rate is again I am created thing, is the London interbank offer rate. Similarly we have the Mumbai interbank offer rate. So, LIBOR plus 10 basis point, so the interest rate to be paid by Microsoft based on the borrowing money is LIBOR plus 0.1 percent. After ms has gone into a swap, it has the following 3 sets of transactions. So, what are the transactions will consider? So, the 1st one is it pays LIBOR plus 1.2 outside lender.

So now, what initially if you remember, I have discussed this is Intel and this is Microsoft. So, if they was no third party, no financial institutions in between, the amount of transaction would have taken between these two. But the problem is that each faces a risk, in case one defaults the overall risk is totally faced by the other party. If Microsoft defaults everything rest on Intel, how is it able to overcome the risk? In case Intel defaults then all the risk goes on to Microsoft. So; obviously, both the parties would not want this. So, what they would do is that? They would goes simultaneously with the 3rd party outside.

So, this is what is, what I am trying discuss. It face LIBOR plus 0 point 1 percent to one outside lender. So, this is the outside lender, it receives LIBOR under the term of the contract which is already signed with Intel. So; obviously, the LIBOR contract is between Intel and Microsoft. And it pays under the term of contract which is already signed with Intel. So, the second and the third point are these two transactions. So, it receives Microsoft basically receives LIBOR and it gives 5 percent. And also it gives to the 3rd party which is the 1st point, is basically the LIBOR plus 0 point 1 percent. So, if you consider the overall transaction from Microsoft, it will be LIBOR plus 1 percent to the outside percent; that means, arrow coming inside is LIBOR and arrow going outside is basically 5 percent. So these are the 3 transactions for form the point of view of Microsoft, such that it has been able to convert the liabilities; from what? That is the main question.

From if you see, it pays LIBOR. So LIBOR is going out plus 0.1; LIBOR is also coming in. So, LIBOR LIBOR cancels. So, what you actually have would be a fixed rate of 5 percent plus 0.1 percent? So, what is actually happening is, the floating interest rate which was being paid is now been converted into a fixed interest rate for the point of view of Microsoft.

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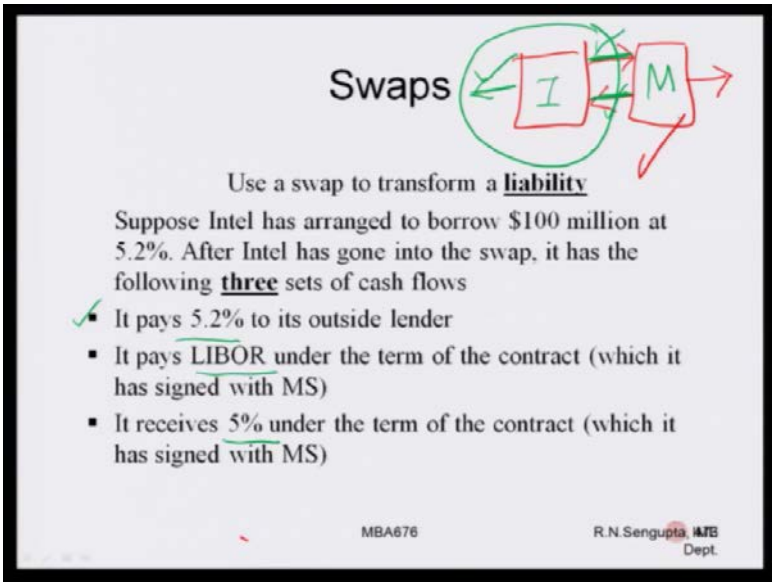

Now consider that Intel point of view. So, what was Intel doing, and what it is now doing? They would be two different scenarios and again you will see this is the same implication as we saw in the just slide last slide for Microsoft. Suppose Intel as agree arrange to borrow 100 million at 5.2 in percentage and after Intel has gone to a Swap, it has the following 3 transactions. Again we have Intel, we had Microsoft; Microsoft with it was a outside party. So, this scenario we have already covered in the last slide. So, now will consider these 3; where this will also we consider for the 2nd time, this will be consider again for the 2nd time and they would be 3rd party, which Intel will now consider. So, this was Intel and this one Microsoft. So, this red one is whole thing which have just raised, we have already considered. Now we are going to consider the green circle and the corresponding transactions. So, what are the transactions? Intel pays 5.2 percent to the outside party, which is the 1st transaction which is here. It pays LIBOR under the terms of the contract which has sign with Intel, which is this contract it pays and it receives 5 percent under term contract for Microsoft. So, this is the one.

So now, if you consider all the three transactions cumulatively, what you have is? LIBOR is there, plus going and coming; some amount is going out, some amount is coming in. What is going out? 5.2 percent is going out, and it receives 5 percent. So, the net out flow is 0.2 plus the LIBOR which is already there. Which means, Intel is technically able to converts is old position, from a fixed rate to basically a floating rate; whether the floating rate is now LIBOR plus some basis points. And what is that basis point? That basis point is, 0.2 percentage.

So, we see Microsoft was more than willing to convert its position from all floating to a fixed, which we saw that in the last slide. And now Intel has been more than willing to converts its position from a fixed floating, which we have just done. Now there is a difference here. In the initial stage, the parties are only two; Microsoft and Intel. So, in order to convert they floating to a fixed and fixed to a floating, we bought two other place in to the market; one is Microsoft with the 3rd party and the second instance is basically Intel in the 3rd party. So, the last 2 slides basically discuss that.

But still if you consider Microsoft and Intel are dealing among them self only. Which means in case there is a default by Microsoft, in the whole amount of risk is passed on to Intel and vice versa; this part we have not considered yet. Even though the Swap has been done, in such a way that the position from a fixed to a floating, floating to a fixed has been convert it, still the overall risk still remains. So now question would, all of you would be asking is that how do you do that? So now, what will do is that? In the last stage of the transaction what is there, where there is Intel are shown, Microsoft a shown plus two 3rd parties one from Microsoft one for Intel. We will slowly being a 4th party into the scenario which is the financial institution. So, as we being the financial institution into the focus; obviously, it would be two things. Number one, overall risk from Microsoft which it is facing from Intel or the overall risk which Intel is facing from Microsoft would be shared and taking care by the financial institution point one. Point two, if financial institution is willing to take up the risk, then it should matter that how that overall risk is being partition between these two payers; such that the financial institution make some profit in new of the overall risk is going to face for both the parties. So, here 3rd party is not there in a into the consideration, we are only considering a financial institution in between along with the fact that Microsoft and Intel is already there. And each of them, that is Microsoft and Intel has it is own third party already into the picture.

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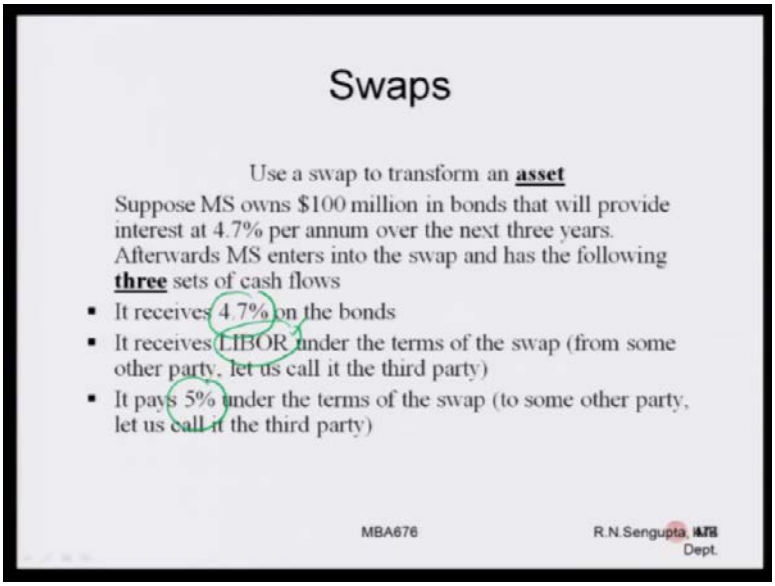

Now will basically use a swap transform in asset. So, I will come to the concept of from Microsoft in this financial institution later on. So, let us consider go one by one and basically try to analyze the problem, in its first stage of swaps and then slowly bring the Microsoft this financial institution in the picture.

Now suppose Microsoft owns again the same problem, owns 100 millions in bonds that will provide interest rate of 4.7 percent per annum; this is risk free interest rate per annum. Over the next 3 years afterwards a Microsoft enters into a swap and has the following 3 sets of transactions. What are the some transactions? It receives 4.7 on the bonds, it receives LIBOR under the term of the contracts it pays five percent. So, if you consider the overall scenario, 4.7 receives, receives LIBOR pays 5 percent; which means, the overall interest rate which is being paid by Microsoft would be basically, now a floating interest rate. Because LIBOR is there, plus and minus the overall difference in the fixed interest rate which is there; that means, it receives 4.7 it gives 5 percent. So, the overall difference is basically 0.03 percentages plus the LIBOR which is already there.

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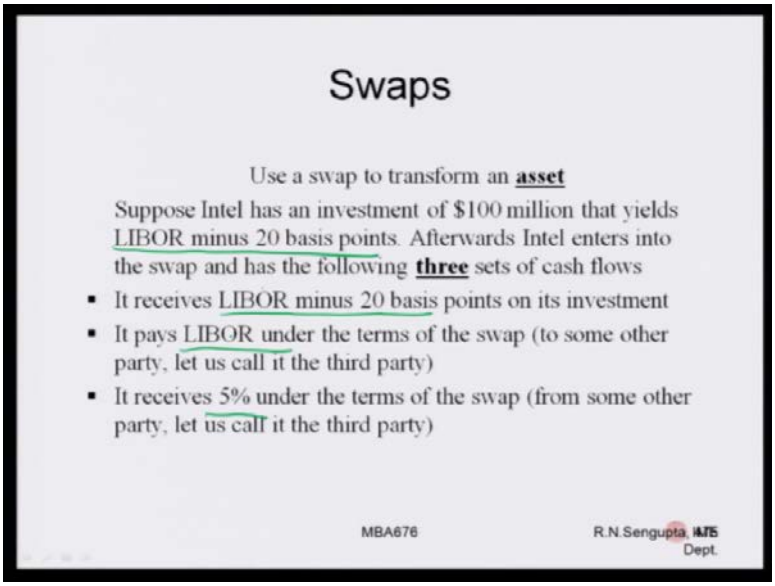

Consider Intel, again the same thing. Now initially it was only LIBOR minus 20 basis points. So now, Intel is enters in to a swap which has three different components; one is LIBOR minus 20 basis point. So, initially let me recap which not again. Initially it was only LIBOR minus basis points. So, at which means that Intel was going into a floating interest only. Now in the second scenario it does is basically receives LIBOR minus 20 percent which is same, but also pays LIBOR and receive 5 percent.

So, if you consider this LIBOR this LIBOR they would cancel out. So, we have 20 basis points minus plus 5 percent it receives. So, the overall interest rate is being change from a floating to a fixed for Intel case and in the last slide we saw that in the case of Microsoft; it was being change from a fixed to a floating interest rate. Fixed in the sense they was no floating and LIBOR concept, but it brought it to the picture, the concept of the LIBOR. So, hence Intel was able to change its position from a floating to a fixed or fixed to a floating depending on whatever its advantages for it and similarly Microsoft and Intel would also do the same thing. In case If floating was advantages it will convert from fixed to a floating or vice versa depending on the situation it is facing.

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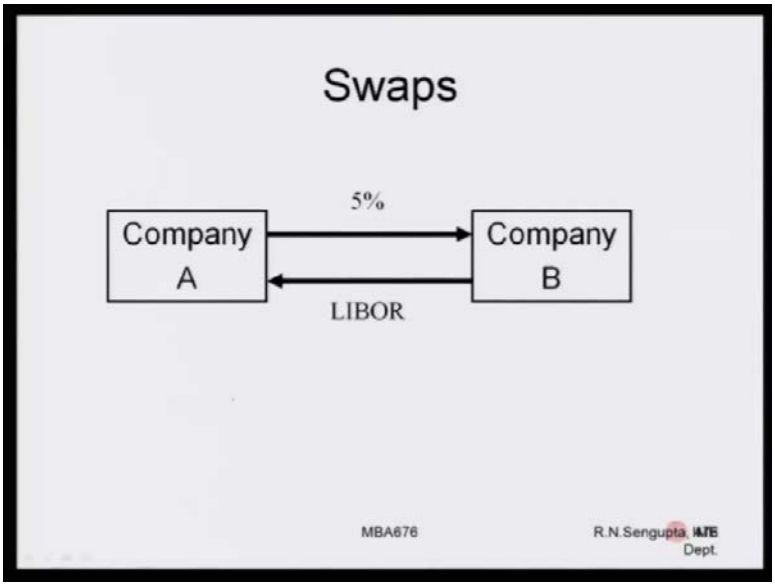

So, this was the basics scenario, company was there 5 percent was being pay to company B. Company B was it facing paying LIBOR. So; obviously, we have to mean that company A or company B maybe advantages to convert its floating to fixed or fixed to a floating. So, we have to basically check the context of the problem and then decide which is better for which company. So, here now till now in this example which you are seeing, there is two boxes; boxes A company and company B. There are no 3rd party, they are no financial institution.

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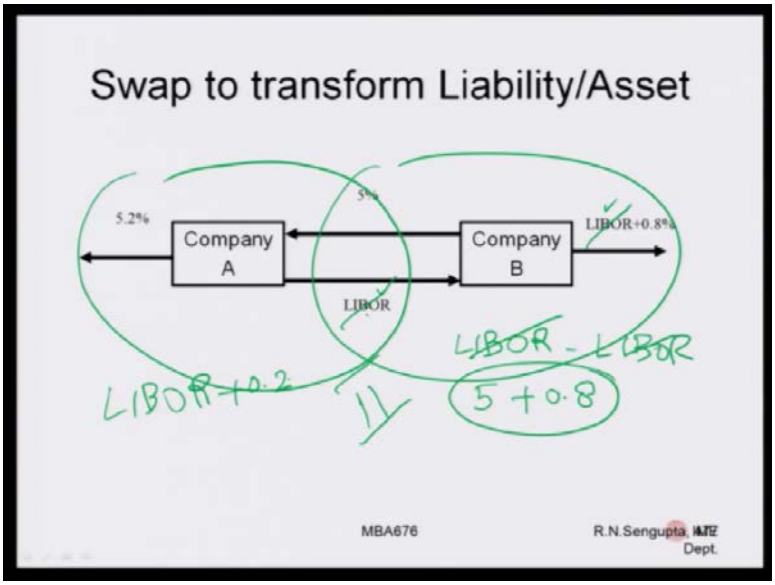

Now consider 2 3rd parties come. So, if you compare with the last slide and this slide what you see that, company B was basically giving 5 percent and getting LIBOR. Now it

gives LIBOR plus some basis point to a 3rd party. So, the for company B if you considered, overall scenario is this. LIBOR LIBOR cancels. So now, what you actual have is? Is 5 percent plus 0.8 percent which is going out from company B. So company B is now changing its position from a floating to fixed rate.

Now what about A? If you compare the overall transaction, it is basically initially it was only getting 5 percent. Now if you consider the LIBOR on the 5 percent, it is basically now converting is position from a fixed to floating. Because LIBOR is already there, LIBOR plus 0.2 percent which is also going. So; obviously, company B would be paying LIBOR 0.2 and company A would be paying 5 plus 0.8, which is fixed in the case of company B.

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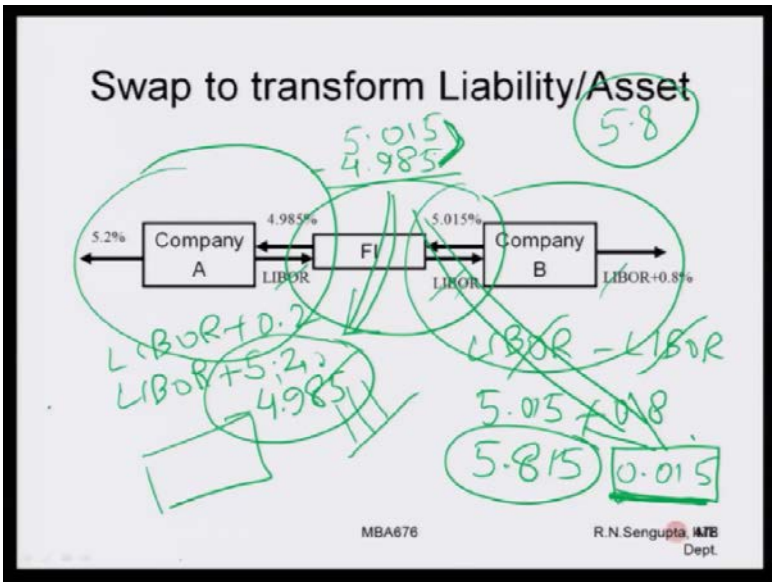

Now consider 3rd scenario where we have now brought of financial institution. Now company B if you consider is no longer interacting with A or A is no longer interacting with B. The financial institution which is in between is now able to take care of the overall risk, that company a is facing from B or company B is facing from A; such that the overall risk is being shared by FI. How?

If you consider only company B; so obviously, the transactions are this. So, LIBOR LIBOR cancels, the overall percentage is 5.015 going outside to FI and 0.85 percent going to the this 3rd party. So, overall interest rate going out from company B, A's only fixed; which is 5.015 plus 0.8 percentage. Now for company A if you consider, the 3rd party was already there. So, now, it is interacting not with B, but with the financial

institution which is in between, but the interest rate have change, in what way? So, now, initial it was a fixed case for A, now it is a floating case for A. How? If you add up all these three, LIBOR is going out and the extra percentage which is going out overall of the LIBOR would be 5.2 minus 4.985. So, overall company A has converted his position form a fix to a floating, while company B has converted is position from a floating to a fixed.

Now if you compare this scenario, this is case 3 if you note and if you compare the last slide which is case 2, you will see this is a certain difference. If you compare the overall risk return risk being paid or obtain by A or paid or obtain by B, this is a difference. So, if you consider the overall scenario for company B in this case, case 2 it is LIBOR minus LIBOR; these are canceling out, what are canceling out? These two and the overall one is 5 percentage plus 0.8. So, the overall value which is going out for company B is 5.08. So, with this let us go back to the other slide.

So, let us write 5.8. Now if you consider this, here LIBOR plus LIBOR minus cancels and it is 5.015 plus 0.8. So, the overall becomes 5.815, so if we compare this and this the overall differences is 0.015 which is the extra one which is being paid by company B. Similarly you can find out for A, if you go back to the last slide; it is LIBOR plus 0.2, here it is LIBOR plus 0.2 is for the last example, here it will be LIBOR plus 5.2 minus 4.985. If you find out this, you will find out the value is a little bit more then 0.2. So, now, overall interest rate being paid by A is of definitely still remains of floating rate, but the floating rate has increased. So, here initially to LIBOR plus 0.2 now it is LIBOR plus some value which you can find out the difference between them.

Now, you will say where did this difference of 0.015 and the difference from this and both this cases. So overall extra percentage which is being paid by B with respect to scenario 2 and 3 is 0.15 and extra interest rate being paid by A; is this difference. Where? Where did this vanish? So obviously, this extra must have taken by somebody. So, let us see only concentrate on the FI.

So, what is happening for the FI? LIBOR LIBOR cancels, 5.015 is coming in, 4.985 is going out. So, overall is 5.015 minus 4.985, if you see this difference. These difference would be equally shared by A and equally share by B. So, the overall percentage difference is being now shared by A and B in such a way. The overall risk is increasing in quantum sense, but the risk actually is not be been taken care by either A or or B,

because if there is a default by A; FI is there to take care for B and if there is a default by B. F I is there to take care on the point of view of A. So, whichever default is there, the FI is there definitely they are to take care the other risk. But obviously, A it has to be compensated. That compensation is coming in equal proportions from A, equal proportions of B such that the overall risk is extra profit is this one.

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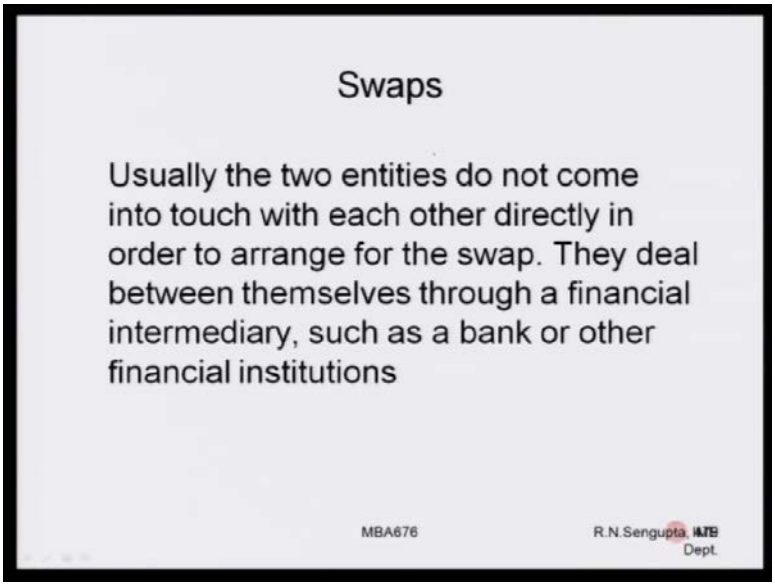

So, swaps usually the two entities do not come into touch with each other directly in order to arrange for swap. They deal between themselves through financially intermediary, at I just discussed such that as a bank or other FI.

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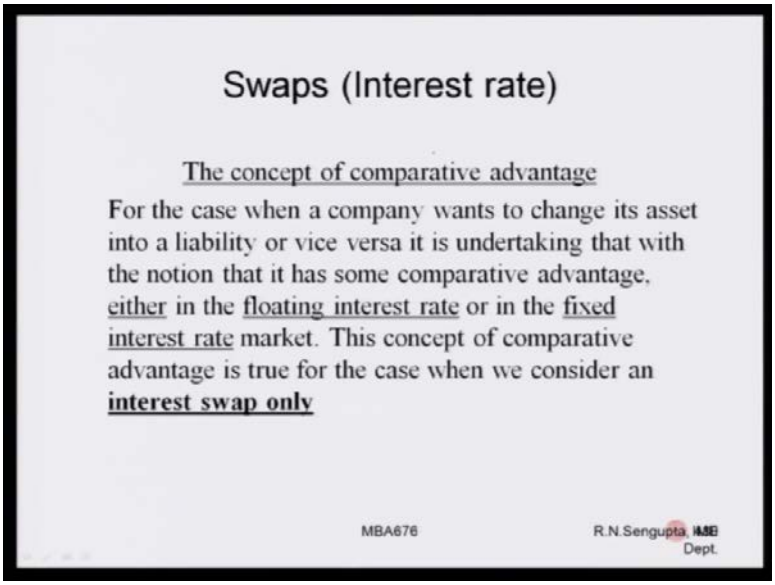

The concept of comparative advantage is very important for a swap. So, whenever you converting a position of a liability of to a asset or asset to a liability or you converting a position from a fixed to a floating, floating to a fixed interest rate or you converting position from a rupee to dollar to rupee to yen or rupee to yen to rupee to dollar; or or a combination of that. Combination means you have you are phasing the risk from both perspective a interest rate as well as foreign currency. So, here it should be thought about that, what is the comparative advantage to parties would get; such that it really make sense for both of them to change the position, such that the overall swap can be brought into the place. Considering this in a financial institution which is able to take care of the overall risk, in live of some percentage of profit which has to be shared equally by both the though players. So, that means if they are two equal players A and B. A would gives some percentage of the profit to F I and we would give the same percentage of profit to the FI such that the F I make some profit in the overall transaction.

For the case when a company wants to change its assets into a liability or liability an asset, in its overall understanding and undertaking. So, it has to basically analyze where does is basically make and competitive advantage. So, is it comparative advantages to convert from floating to a fixed or vice versa. So, this concept of comparative advantage is two for the case when we consider and interest rate swap only. Comparative advantage would also be there in the case of currency. So, we have to see in the currency perspective which currency is basically make making some comparative advantage for player A or for player B; based on that will make a swap, based on the concept of currency swap only.

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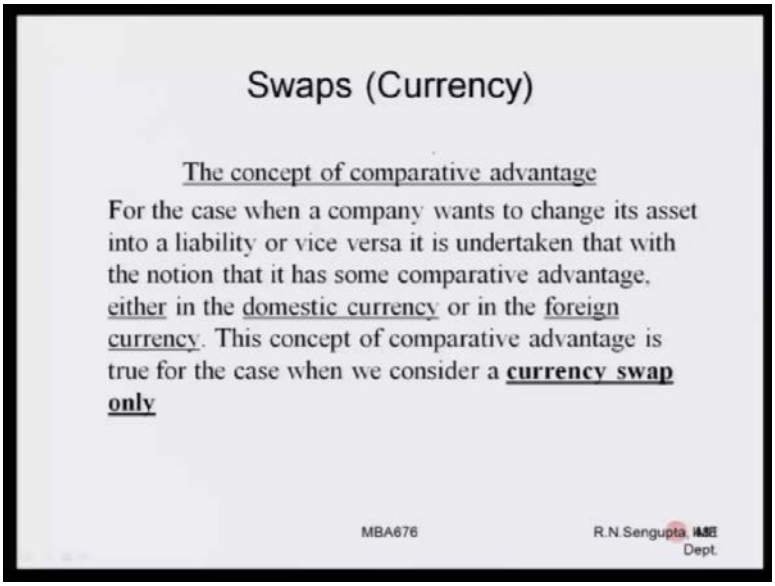

The concept of a comparative advantage, as well as saying for the currency. For the case when a company wants to changes its asset into a liability or liability into a asset, it is undertaken with the notion that it has some comparative advantage either in the domestic currency or in the foreign currency. So, this concept of comparative advantage is if for this case which will consider later on. Is consider as the currency swap, in the currency swap only and will consider them separately depending on the comparative advantage or disadvantage for two players who are coming into a swap.

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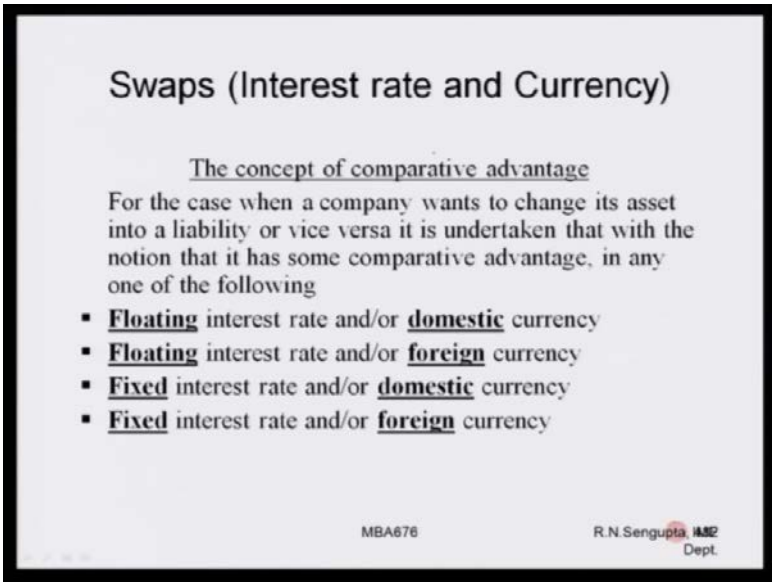

So, the concept of comparative advantage would be basically there are four different type of concepts. One is floating interest rate being convert to a fixed, fix to a floating. So, these are two scenarios and a domestic currency will converted to foreign currency or a foreign currency being converted to a domestic currency; so, there are another two. So, 2 into 2, 4 different transactions would be dealt with the simple manner; obviously, they can other type of risk also. So, we are not going to consider other type of risk and let are discussion be limited to the currency creates swaps only and the interested swaps only.

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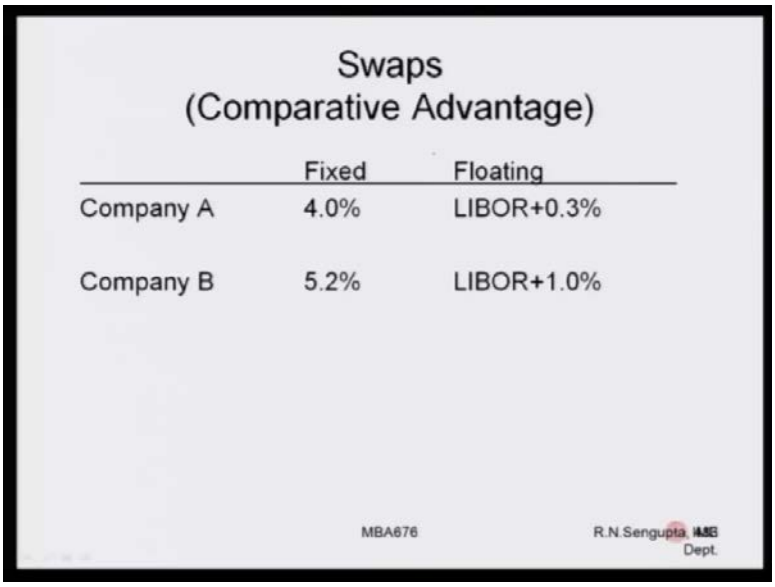

So, consider this. Company A has fixed of 4 percent and floating of LIBOR plus 0.3. So,

this is only based on the interest rate. Company B has 5.2 and LIBOR of plus 1 percentage. So, let us pause and look at this. The difference between company B and A is 1.2 on the fixed rate and difference between company A and B is basically in the LIBOR LIBOR cancels. is basically 0.7 percentage. So, if I consider company B, company B is paying more in both the cases as 2, but it is facing a huge amount of risk from the point of view of fixed case, because it is paying an extra amount of interest rate which is 1.2 over A. But if I consider the floating one overall in extra interest rate is going to pays 0.7.

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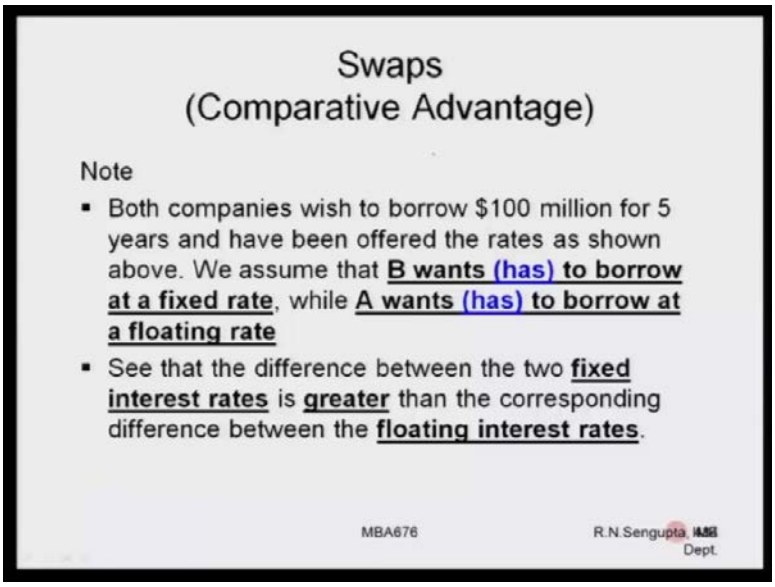

So, if I compare these two statement it would mean both companies wish to borrow the same amount per 5 years period. So, time is basically being brought in the picture in order to understand how the swap, if you draw the matrix would coming to the picture. Principal amount, notional amount is 100 millions and have been offer the rates as shown in the previous slide. We assume that B wants or has to borrow at a fixed rate, while A has or wants to borrowing the floating rates. So obviously, if A goes, B goes for a fixed rate it is facing a disadvantage with respect to a floating case. While if A wants to do that, it is just facing the other way type of disadvantage. So, see that the difference between the two fixed rate is greater than the corresponding difference between the floating rate from the point of view of B.

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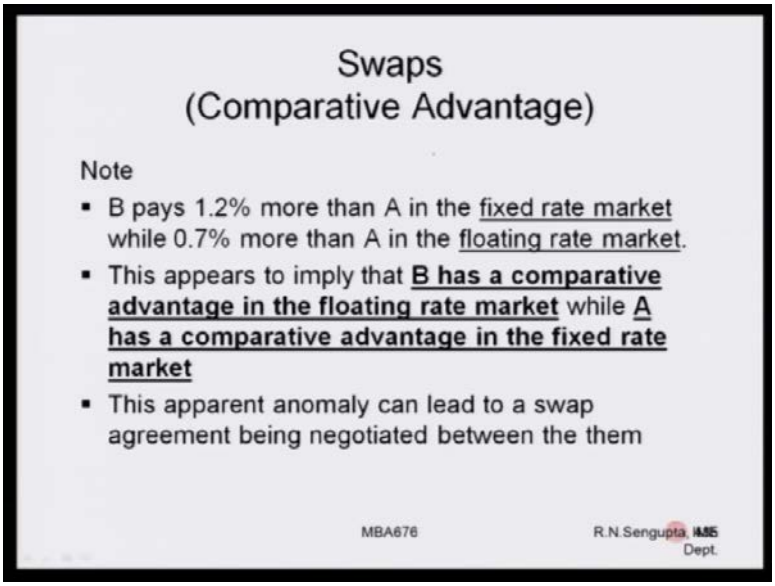

So, if that is the case. B pays 1.4 more 1.2 more than in A in the fixed rate and 0.7 more than a in the floating rate. So, this appears to imply that B has a comparative advantage in the floating rate market and A has a comparative advantage in the fixed rate market. So, this apparent anomaly based on what is the advantage and what they have to do? Has to be basically brought into reality into the picture. So, this apparent an anomaly can lead to a swap agreement between these two parties, how? Let us see.

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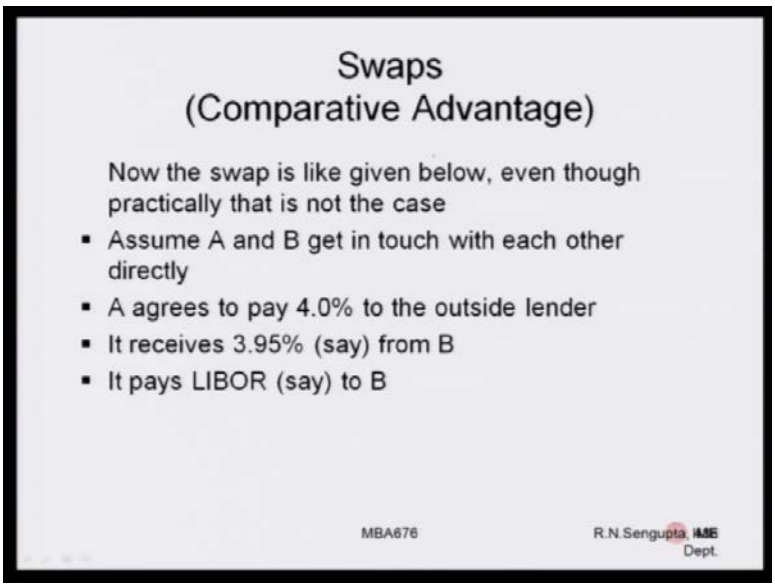

Now the swap is like as discussed, even the practically this is not the case. We will just consider simple theoretical case, assume A and B get in touch with the each other. A agrees to pay 4 percent to the outside lender, it receives 3.95 and it pays LIBOR to B;

which means that in the overall case the interest rate is still floating, but the still floating is being done in such a way. That it is basically passing getting the comparative advantage with respect to that case when it was basically dealing on it is own.

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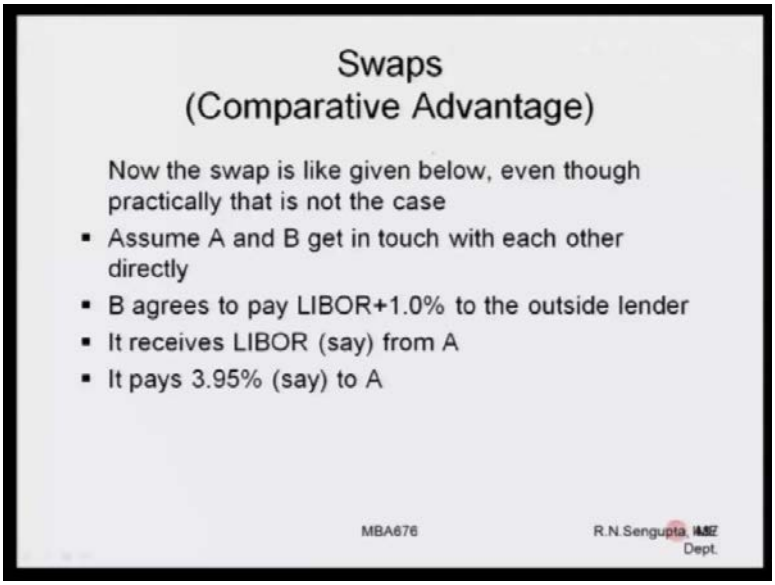

Now what does point company B do? Assume A and B again get together, I am considering the other scenario B. B agrees to pay LIBOR plus 1 percent to the outside lender as per the table which we have already seen. It receives LIBOR say for example, from A, it pays 3.95 to B. So; obviously, LIBOR LIBOR cancels. Which means that company B has been able to convert its position, in such a way that is basically converting fixed to a floating or a floating to fixed.

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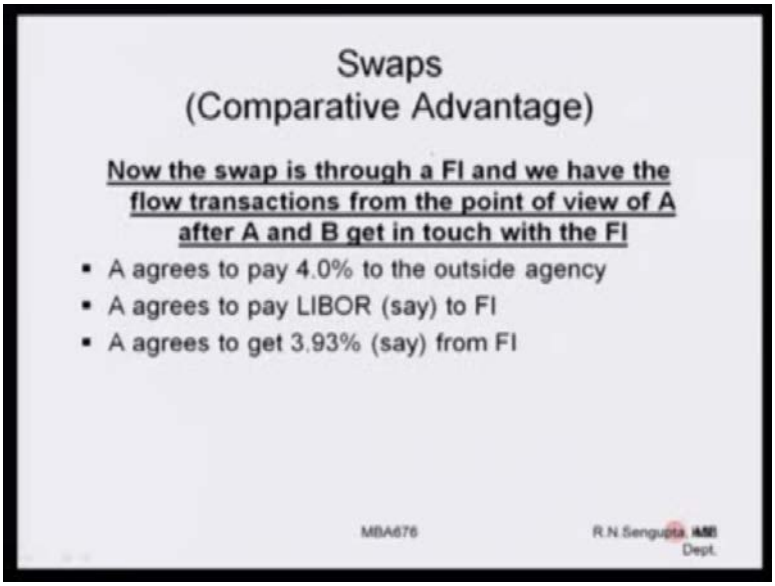

Now, the swap is through a FI and we have the flow, the following flow transaction from the point of view of A after A and B get in touch together. Obviously, it can be done for the case of B to A also. So, with this I will I will take a break and consider at the more details between the financial institution and the A and B, considering the comparative advantage they are facing and continue in the next class.

Thank you.