fQuantitative Investment Management
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Lecture 52
Futures – 2

So, let us continue from where we left off, I was going to talk about default risk. Now, the basic property of forward contracts is that it is a contract between two parties. And as a result of which, because the two parties are directly connected with each other, each party has access to information relating to the other party and also the opportunity to appraise or to assess the creditworthiness of the other party and the possibility of default by the other party.

And as a consequence, there are two, that each party can take adequate remedial actions like stipulation of margin or whatever the case may be, when it enters into the forward contract with the other party. However, in the context of futures contracts, which are traded on exchanges, this is really not possible. Why it is not possible?

Because if the futures are to be freely tradable, then the flow has to be maintained that is, if A and B enter into the agreement at the initial point and thereafter if B wants to sell its leg of the contract with C in the case of forwards, the concept of A must necessarily be taken, but if that is necessary, then you cannot have free trading.

And as a result of which in order that this kind of situation does not arise the need for risk appraisal at the point of every trade does not arise only solution that comes out is that the futures are should be made default free. If the futures are made default free, then of course, you can have free trading in this instrument. And that is precisely what is done, that is done through the intervention of the clearing house.

The clearing house becomes an intermediate party to both the legs of the contract that is if A and B are bound by the futures contract, then it is split up into two parts. One is between A and the clearing house and the other part is between B and the clearing house. The clearing house guarantees the performance of both the A's leg and the B's leg of the futures contract that is the role of the clearing house.

That is how the default risk is mitigated when we talk about futures contract. So, let me repeat this very important feature of futures contracts. In the case of forwards, there exists adequate opportunities for both the parties to assess the creditworthiness of the other party and take remedial measures for elimination of the or for management of the default risk.

However, in the case of futures, in order that they maybe made freely tradable trading be inhibited and smooth it is necessary that they be devoid of any kind of default risk, because if it is not so, then in the possibility of default by counterparties will not enable the instruments to be traded with any degree of ease or convenience. And as a result of which, as a consequence there to the futures contracts are made default free.

How they are made default free? By the intervention of the clearing house. The clearing house of the exchange at which they are traded becomes a counterparty to both the legs of the contract, it becomes an intermediate party, and it guarantees the performance of both the legs of the contract.

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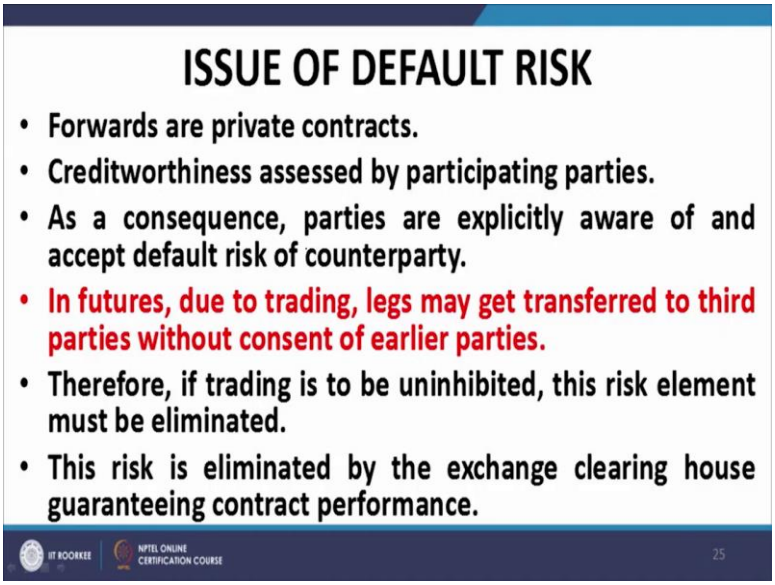

So, that is a fundamental feature that of futures contracts that they are free of default risk. Let me read it out. Forwards are private contracts. Creditworthiness assessed by participating parties. As a consequence, parties are explicitly aware of and accept default risk of Counterparty. So, that is the important part. And they can also take remedial measures as they deem appropriate to manage the default risk arising out of the futures contract with the counterparty, a forward contract with the counterparty I am sorry.

In futures, due to trading, legs may get transferred to third parties without consent of earlier parties. Therefore, if trading is to be uninhibited, this risk element must be eliminated. This risk is eliminated by the exchange clearing house guaranteeing contract performance.

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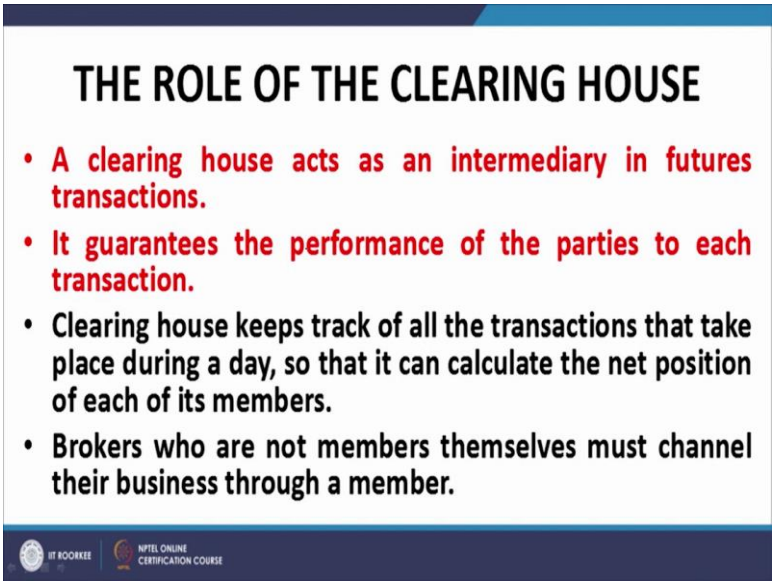

The role of the clearing house that is what I mentioned just now there are other functions of the clearing house. So, let us quickly read through this. A clearing house acts as an intermediary in futures transactions. It guarantees the performance of the parties to each transition. This is the most important job most important function of the clearing house. Clearing house keeps track of all the transactions that take place during a day, so that it can calculate the net position of each of its members. Brokers who are not members themselves must channel their business through a member of the clearing house.

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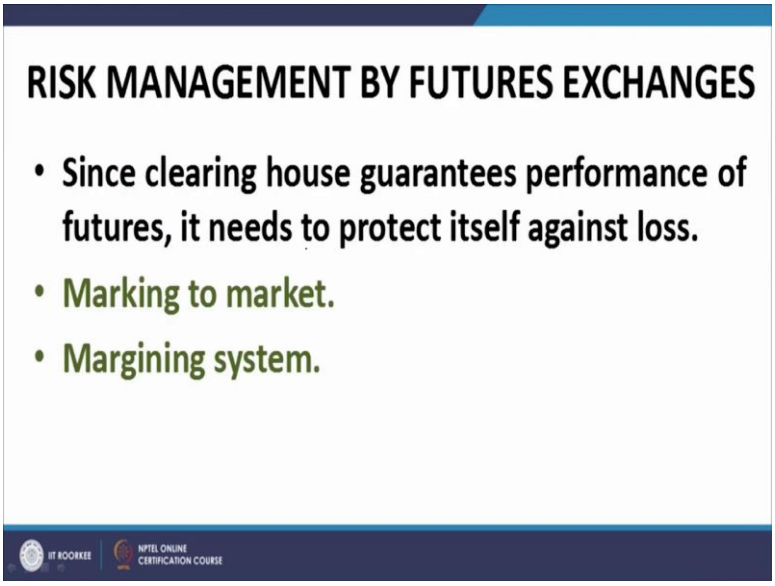

Risk management by futures exchanges. Now, the question is, how does the clearing house protect itself? You see on the basis of what I have discussed just now, the clearing house

become the scapegoat, it becomes that one party who is to bear the possibility of default on the part of A as well as B. If A defaults, a clearing house is to compensate, if B defaults clearing house is to compensate.

So, the next question arises, how does the clearing house protect itself in such a situation? It protects itself in such a situation by the twin operations of marking to market and margining. So, these two processes that are put in place, when we talk about trading of futures, ensure that the risks placed by the clearing house of default of either party is absolutely minimal. So, let us understand what is marking to market and margining.

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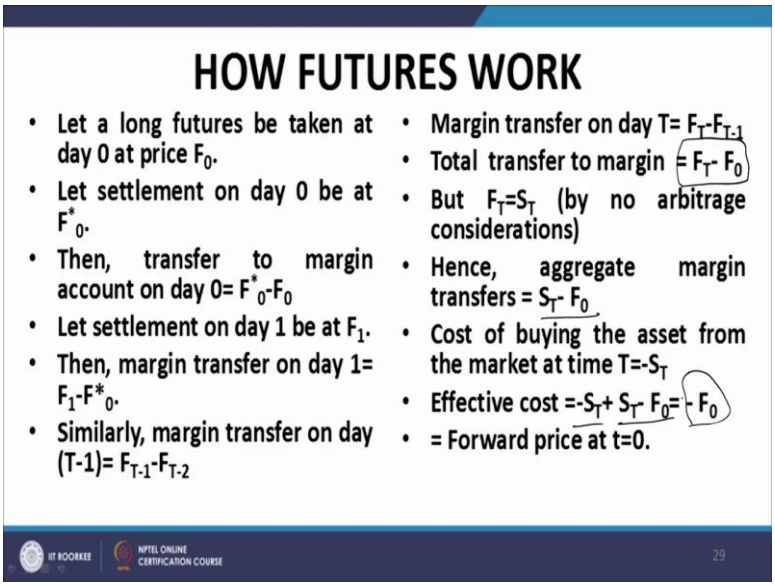

Let us see how futures work for that purpose, let us see how the marking to market starts or is facilitated, let a long future be taken at day 0 at price F0. Let settlement on day 0 be it at F star 0, you take a long position in a futures contract at a futures price of F0. And at the settlement on that particular date on the same day, the price is F star 0. Then what happens F star 0 minus F0 amount is transferred to your margin account and an equivalent amount is transferred to the other party to the short party with a negative sign of course.

You see it is a zero-sum game. So, if you have made a profit because if F star 0 is greater than F0, you made a profit that profit will be transferred to your account on the same day, whereas the converts that is a loss would be transferred to the party will short in the futures contract, an amount equal to F star 0 minus F0 will be debited to his account and credited to your account. So, that is how it will operate it to start with.

Then transfer to the margin account on day 0 is equal to F star 0 minus F0. Let settlement on day 1 be at F1, then at the end of day 1 after settlement an amount F1 minus F star 0 that is today's settlement price minus the settlement price of the previous day will be transferred to your account and the equivalent amount transferred to the short party with the negative sign of course.

Similarly, margin transfer on day T minus 1 will be equal to F T minus 1 minus F T minus 2. Margin transfer on date T is equal to F T minus F T minus 1. So, the total transfer of margin that has taken place to your account is what F star 0 minus F0 plus F1 minus F star 0 plus F2 minus F1 plus FT minus FT minus 1.

All the intermediate terms will cancel out and what is left is F capital T minus F0, that is this amount. This is the net transfer of margin to your account during the life of the futures contract. But FT that is the futures price on the date of maturity of the futures contract must be equal to the spot price to avoid arbitrage and that means FT is equal to ST, therefore, the aggregate transfer to margin becomes ST minus F0.

Now, if you buy the asset on the state of maturity that is at t equal to capital T from the market, the amount that you pay is S capital T. So, the cost of the asset to you is minus S capital T. And if you include the profit that you have made on your futures position, the net cost works out to minus S capital T plus ST minus F0 which is the transfer to your margin account.

And that is equal to F0, minus F0 that is the forward price that we agreed at T equal to 0. So, this process of marking to market insofar as the essential character of the futures contract or forward contract is concerned that it entails buying or selling the underlying asset at a future date at a price which is agreed upon at t equal to 0 that remains intact because you are now paying a price of F0 which you agreed at t equal to 0.

So, that feature of the forward of futures contract remains intact. Notwithstanding the fact that there is a transfer to margin accounts at the end of every day, in other words, this process of marking to market on every day at settlement does not infringe upon does not spoil does not destroy the fundamental feature of the forward contract or futures contract that it entails the buying or selling of an asset at a future date at a price which is agreed upon at t equal to 0, because this F0 is agreed upon at t equal to 0.

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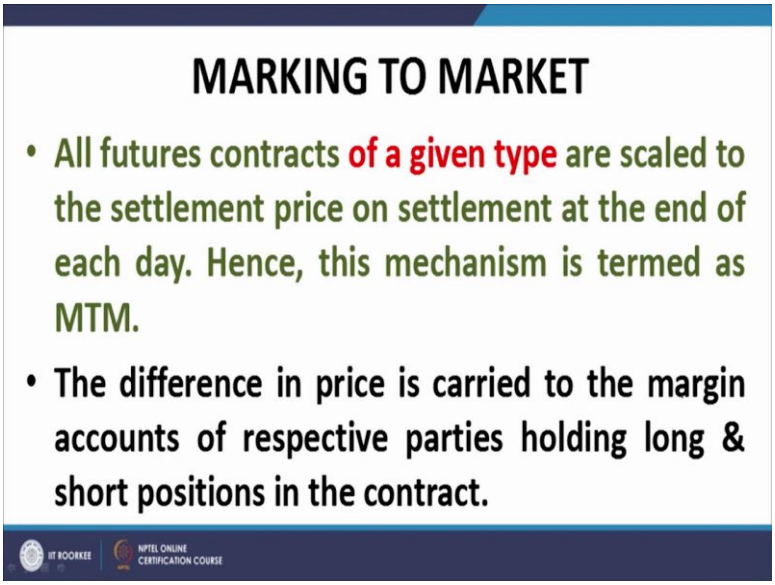

So, marking to market. All futures contracts of a given type are scaled to the settlement price on settlement at the end of each day. Hence, this mechanism is known as marking to market. All the contracts are scaled to the same price, irrespective of what has happened during the day or your earlier for that matter during the life of the contract since its creation. At the end of a particular day, all contracts of a particular type are scaled to the same price by marking to market that is called the settlement process.

All futures contracts of a particular type are scaled to the settlement price on settlement at the end of each day. Hence, this mechanism is termed marking to market. The difference in price. For example, the difference at which you took the position and the settlement price for the day on which you took the position or if you hold on to a futures contract, the current settlement price minus the previous settlement price.

The difference in price, difference in price means either if you have taken a position on the same day, then the price at which you took the position and the settlement price. And if you held on to that position from the previous day then the current settlement price and the previous settlement price. A difference in price is carried to the margin accounts of the respective parties holding long and short positions in the contract.

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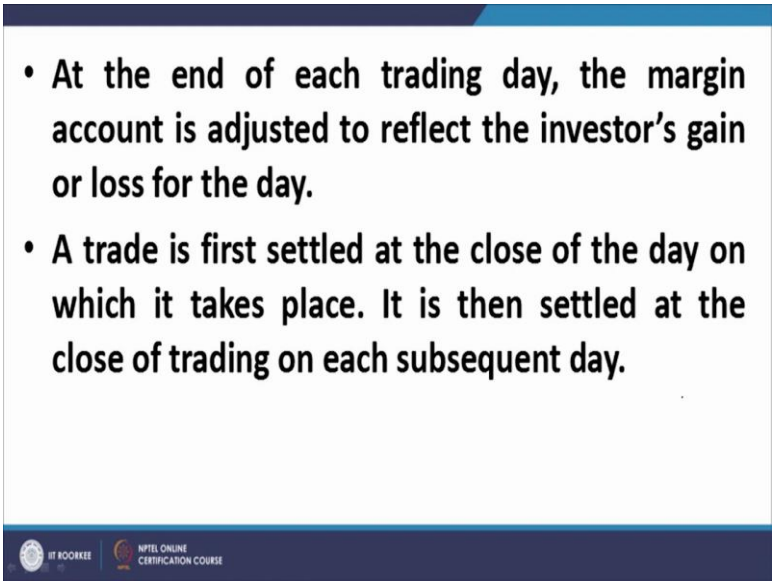

At the end of each trading day, the margin account is adjusted to reflect the investors' gain or loss for the day. At the end of each trading day, the margin account is adjusted to reflect the investors' gain or loss for the day. Just as I explained in the example, if the futures price increases, the party was long in the futures will get a credit entry in his margin account for the amount of increase during the day, that is today's settlement minus yesterday's settlement.

And if the futures price decreases, there will be a debit entry in the long party and a credit entry in the short party. A trade is first settled at the close of the day on which it takes place that is what again I showed in the example, F star 0 was the closing price, F0 was the price at which the position was taken, so F star 0 minus F0 is the amount that will be transferred to the margin account of the long party. Notwithstanding the fact that it may be positive or it may be negative. It is then settled at the close of trading on each subsequent day.

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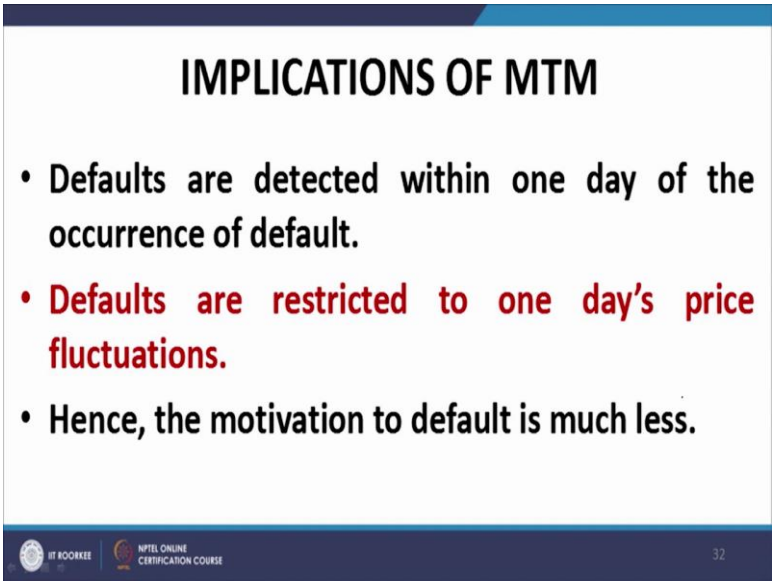

Implications of marking to market. This is very interesting. You see as a result of marking to market what is happening, suppose I have taken futures position, then yesterday, and then today's settlement price minus yesterday's settlement price. Let us assume that this is a negative quantity, this will be debited to my account, let us assume that I am a long party. Let me repeat, I am a long party in the futures contract I have held on to the contract since the previous day. So, and the futures price has gone down.

As a result of which today's price minus yesterday's price, it will be a loss and it will be debited to my account, margin account with my broker. Now, there is a level up to which the margin account can balance can reduce can fall. I will come back to it later in a minute. But that level is called the maintenance margin. If as a result of debits, the amount in the margin account falls below this level, then a margin call is initiated.

So, you have to replenish your account back to a certain level. Now, the point is, if you are committing default in paying this margin amount, it will be immediately known the next day because the broker will find that the amount has not been deposited, the margin has not been topped up to the necessary level and the default will be detected. So, that is the important part, defaults are detected within one day of the occurrence of the default.

If you do not deposit the margin by tomorrow morning, your broker will come to know and he will immediately take the necessary remedial action as per the terms of the exchange. So, defaults are detected within one day of the occurrence of default. And secondly, the second

feature is because the marking to market it is taking place every day, therefore, the transfer of profits or loss is split up on a day to day basis.

In the case of a forward contract the entire profit or loss on the forward contract up to the date of maturity is settled one particular day when the actual forward contract is settled. Here, that is not the case. Everyday whatever is the profit or loss that is transferred to your accounts, and therefore, the default if any, can be restricted or is instructed only to one day's profit and loss, because if the default was earlier, it would have been detected on the previous day.

Therefore, the fact that the default has occurred today means that it is relating to the profit or loss transfer for the previous day. So, the basic thing is that defaults are restricted to one day because every day's profit and loss has been transferred. So, you cannot have a situation where two days or more a profit and loss are in default, profit and loss is transferred and the party is not paying up on that count.

So, defaults are detected within one day of the occurrence of the default. Defaults are restricted to one day's price fluctuations. Hence, the motivation to default is much less. As I mentioned, in the case of a forward contract, the entire cumulative effect of price changes is felt when the contract is settled on the date of maturity of the forward contract. Here, that is not the case.

Day to day price changes are transferred to your accounts, and therefore, the defaults can be restricted only to if you do default, you are benefiting only by the price change of that particular day. So, that is why the motivation to default is very little. Obviously, the price changes for a day are usually not as large as price changes for a longer duration, at least that is believed to be the case. That is usually the case not necessarily though that is usually the case.

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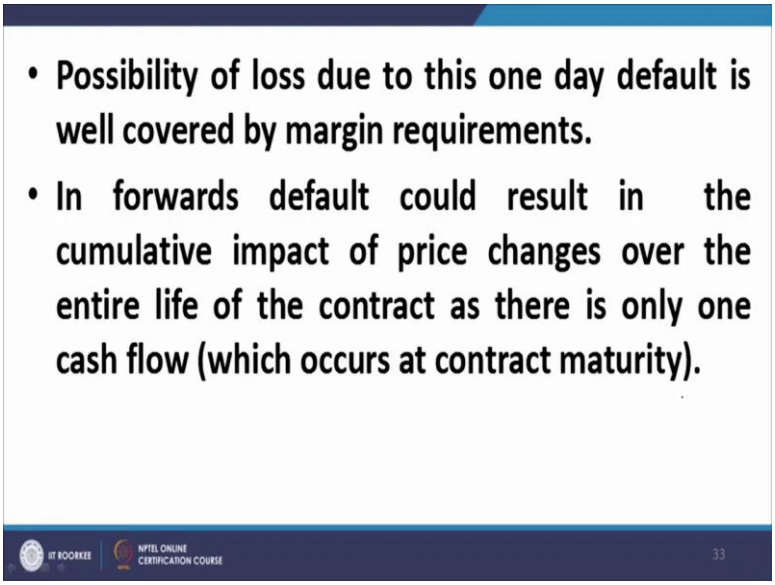

The possibility of loss due to this one-day default is covered by margin requirements. Now, that one day's loss that we talk about that marking to market may result in one day's loss and the party may default. Now, that portion is covered by the initial margin or maintenance margin that is maintained by the investor by the trader with the broker with the relevant broker.

So, in a nutshell, marking to market combined with the margining process literally ensures that defaults in the futures markets are nonexistent. The possibility of loss due to this one day's default is well covered by margin requirements. In forwards default could result in the cumulative impact of price changes over the entire life of the contract as there is only one cash flow, which occurs at contract maturity.

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Margining system, known as the three-tire margining system, I will briefly touch on this. You as an investor maintain a margin with your broker, your broker maintains a margin with the clearing house member and the clearing house member maintains a margin with the clearing house. So, it is a three-tire margining process that is invoked in most of the exchanges. The investor maintaining a margin with his broker, the broker maintaining a margin with the clearing house member, if he is not a clearing house member the broker is not a clearing house member and the clearing house member maintaining a margin with the clearing house.

Now, margin is of two types we have the initial margin the margin that is required to be set up that is required to be deposited by the investor at the point in time at which he takes a position in the futures contract and then there is another level which is either equal to or less than the initial margin level such that so long as that level is not reached the second level is not reached, the level which is usually slightly lesser than the initial margin, level is not reached, the broker does not trouble to make a margin call on the investor.

But as the debits in the account increase and that second level, second threshold is touched the broker then make the margin call and the investor has to on top of the margin up to the initial margin level.

Initial margin level is the margin at which the position in the futures can be initiated. And the maintenance margin is the margin that has to be maintained. So, long as you maintain a position in the futures contract. If you are due to the debits on account of their position, the margin amount falls below the maintenance margin level, then you are required to top up the

margin up to the initial margin level by virtue of a margin call that is given by the broker to you.

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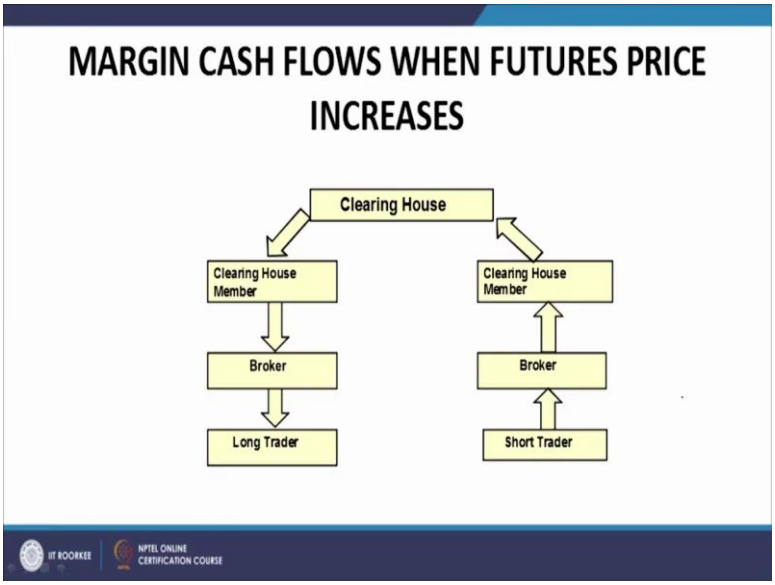

This is a sequence of the various steps in with the margin flows. For example, if margin cash flows, when future increases, this is center is the clearing house, the long trader will receive the margin because the price has increased and the short trader will pay the margin or the market differential from the short trader it will go to the broker, from the broker to the clearing house member to the clearing house. And then the same process will be repeated on the long party side.

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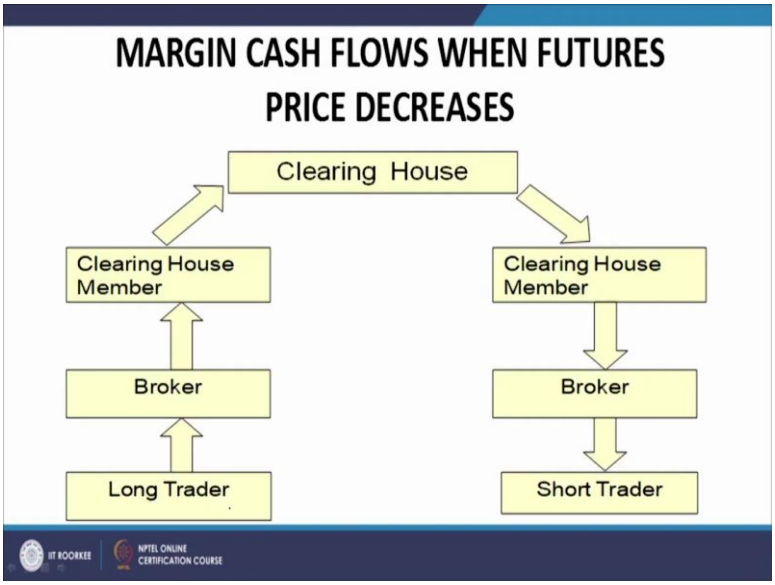

This is the inverse process when the price has gone down and margin flows from the long party to the short party.

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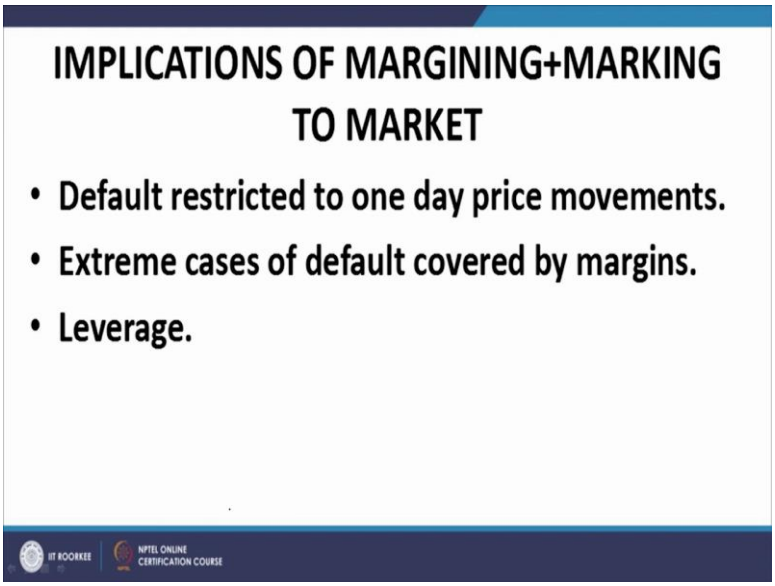

Implications of margining plus marking to market. As I mentioned, these are two fundamental implications. Default restricted to one day's price movements, it is detected immediately the next day, extreme cases of default covered by margining. And then we have the possibility of leverage.

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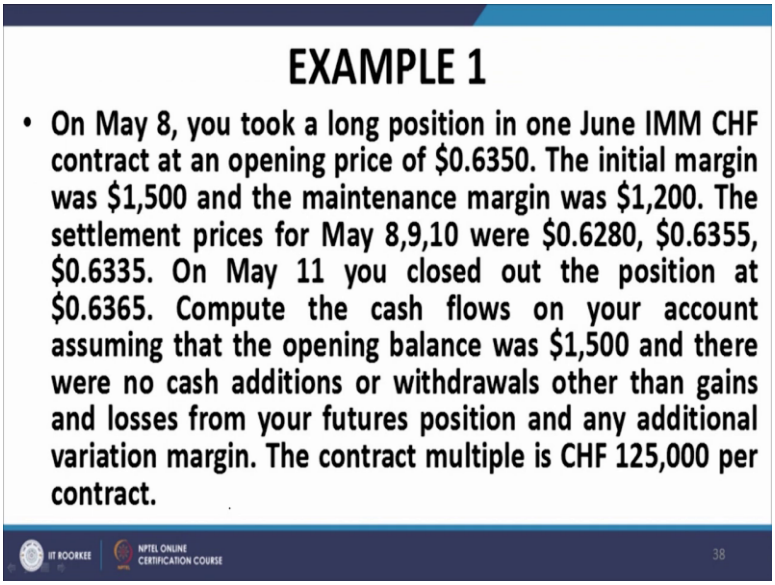

Let us take an example now. On May 8, you take a long position in one June IMM CHF contract at an opening price of dollars 0.6350. The initial margin was dollars 1500. And the maintenance margin was dollars 1200. The settlement price was for May 8, 9, and 10 were dollars 0.6280, 0.6355, and 0.6335. On May 11 you closed out the position at 0.6365.

Compute the cash flows on your account, assuming that the opening balance was dollars 1500. And there were no cash additions or withdrawals other than gains and losses from your futures position and any additional variation margin. The contract multiple is CHF dollars 125,000 per contract.

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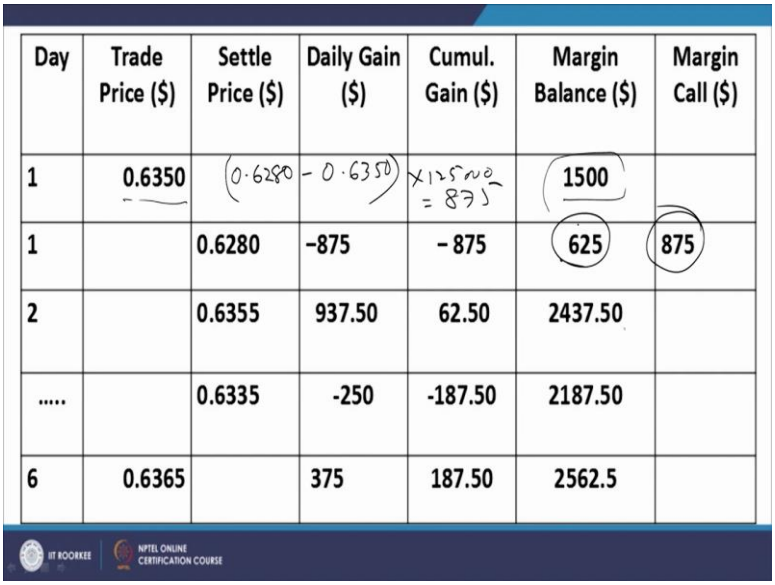

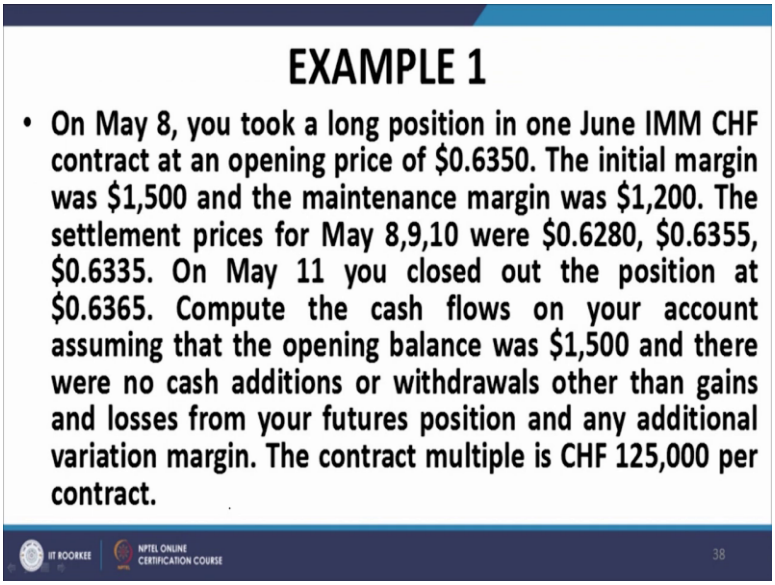

So, this is the table which shows the cash flows. The initial trade price is 0.6350, which is given in column number 2 at this rate is initiated at May 8 at this price and a margin amount that is the initial margin, please note, 1500 is deposited in the margin account. Now, at the end of day 1 that is again May 8, the settlement price is 0.6280. So, there is been a fall in price.

And since you are long in the contract, there is a loss for you, the amount of loss is equal to 0.6280 minus 0.6350 into contract size. What is the contract size? The contract size is 125,000. So, the loss is equal to 0.6280 minus 0.6350, this is multiplied by 125,000, this gives you 875. So, this is the total loss on the contract. And this is the cumulative loss as well because this is the first day of your holding and the margin is now wiped off.

Please note, please see this carefully, the margin which was 1500 to start with out of this 875 is wiped off the remainder is only 625 which you have here. And the maintenance margin is 1200, so you will get a margin call and you will have to top up the margin and you top up the margin by depositing 875 so that the margin again goes back to the initial margin level of 1500. That is how the margining takes place.

Now, at the end of the second day, there has been a profit and the settlement price is 0.6355 the profit for the day is 937.50 worked out in a similar basis as we walked out for this loss, today's settlement minus yesterday's settlement into contract size that is 125,000. And the cumulative profit is equal to 62.50 that is 937.50 minus 875 that is 62.50 and the cash balance available with you is 2437.50 that includes this 875 that is added on that is brought in.

And due to the margin call, that was there on at the end of May 8, that is the first day of the futures position. The rest of the figures are explained in the same way. And I leave it as an exercise for the learners.

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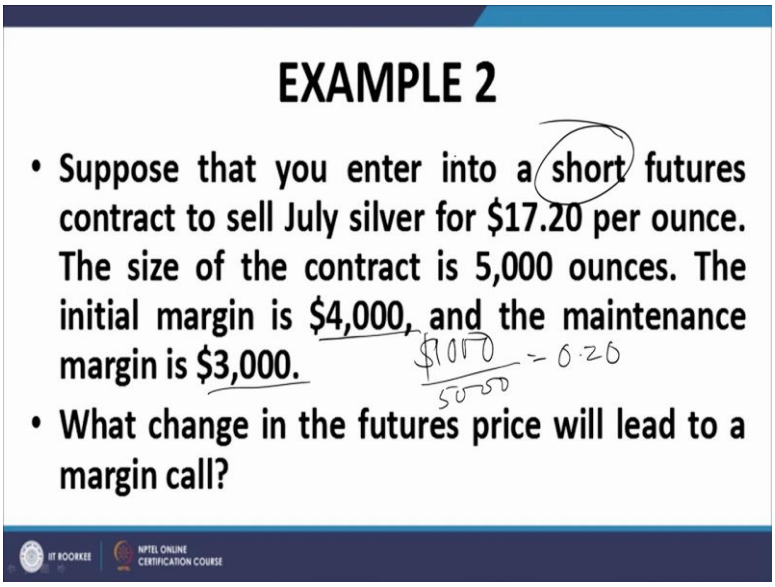

Let us do another example. Suppose, that you enter into a short futures contract to sell July silver dollar 17.20 per ounce. The size of the contract is 5000 ounces. The initial margin is 4000 and the maintenance margin is 3000. What change in the futures price will lead to margin call? Now, what is the margin call? When the amount debits in your margin account, as a result of the debits in your margin account the margin balance falls below a certain level which is called the maintenance margin, then you receive a margin call.

On receiving the margin call you are required to top of the margin up to the initial margin level. So, that is how the margining operates. Now, here what is happening here is the initial margin is 4000, the maintenance margin is 3000. In other words, the amount of debits that you can face without a margin call is equal to 1,000 dollars, 1,000 is a maximum amount of debit, 1,000 is the maximum amount of debits that you can face without a margin call.

If the amount of debits increase more than 1,000 then what happens then the broker will give you a margin call and you will have to top up the margin. So, because the contract size is 5000 the change in price that will result in a wiping of 1000 of margin is obtained as dollars 1000 divided by 5000 that is 0.20. Now, please note this is a short position. So, 0.20 wiping off in the price will operate when the prices increase not when the prices decrease.

This is because this is a short position. And therefore, up the price up to which no margin calls will be made is equal to dollar 17.20 plus 0.20, plus why, because this is a short position, so that is equal to 17.40. That is the answer.

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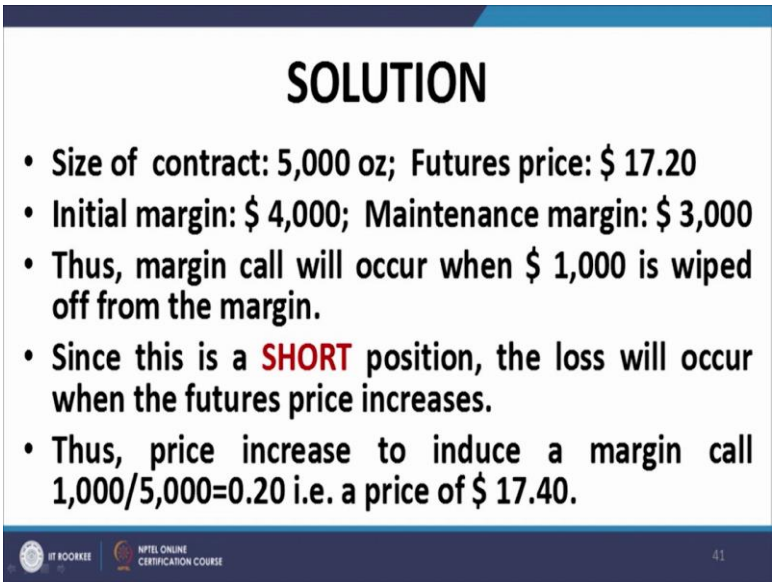

This is the solution given for the benefit of the learners in this presentation.

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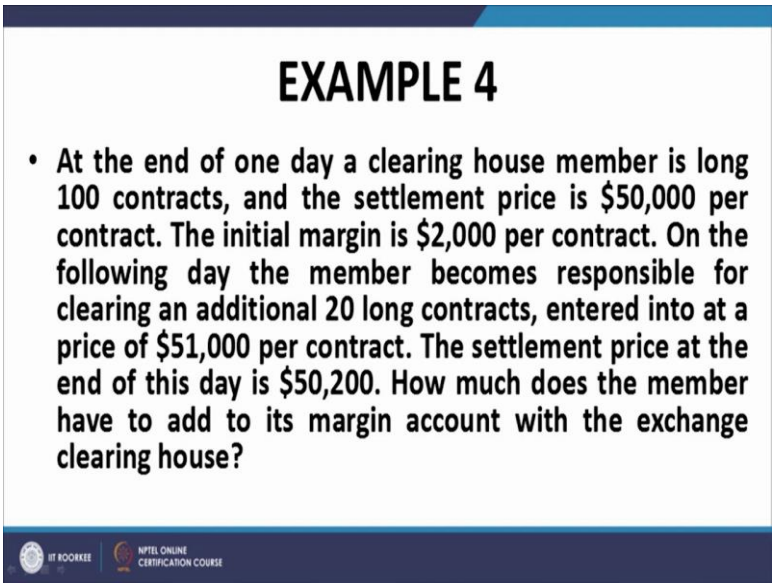

This is another problem. At the end of one day a clearing house member is long 100 contracts, and the settlement price is dollar 50,000 per contract. The initial margin is dollar 2000 per contract. On the following day that is the day one, let us call the initial day day 0, today is day 1, that is the following day.

The member becomes responsible for clearing additional 20 long contracts, entered into a prize of dollars 51,000, the settlement price at the end of this day is dollars 50,200. How much are the dues that the member has to pay? Let us start with day zero, day zero settlement price is dollar 50,000. And the price at the end of day one is 50,200. And the number of contracts is 100. So, he makes a profit as far as these contracts are concerned.

How much is the profit? The profit is 200 per contract. The number of contracts is 100, so he has a credit of 20,000 in his margin account on account of this. Now, on the next day, he enters into 20 more contracts who has to pay margin for this at the rate of 2000 per contract. So, that is 20 into 2000, that is 40,000. So, this 40,000 is that debit to his account, 20,000 credit for the previous day's profit, and 40,000 debit for today's margin on new contract.

Now, let us see what happens as far as the new contracts are concerned, the new contracts are entered into at 51,000. And the end of the day settlement is at 50,200. So, there is a loss of 800 per contract. That means there is a loss of 16,000 on this 20-contract. So, we have 40,000 plus 16,000, 56,000 debits minus 20,000 credit, so he has to bring in another 36,000 dollars.

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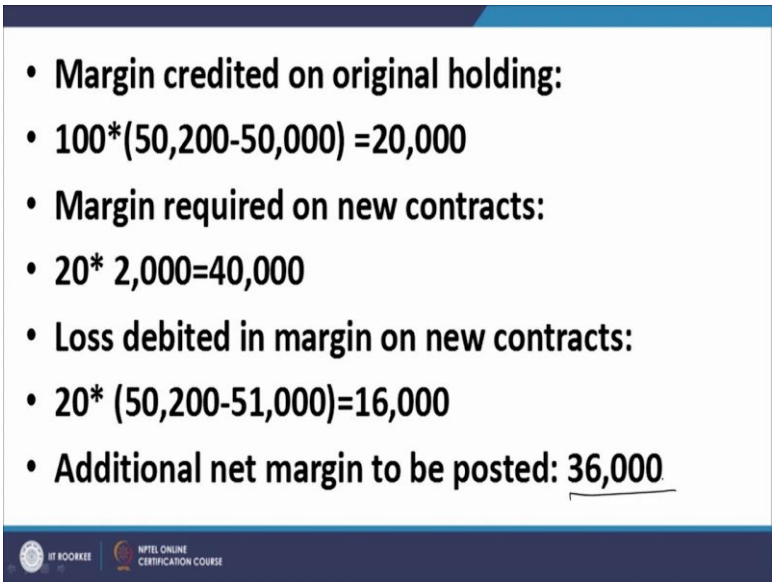

This is the solution. This is the answer here 36,000 dollars.

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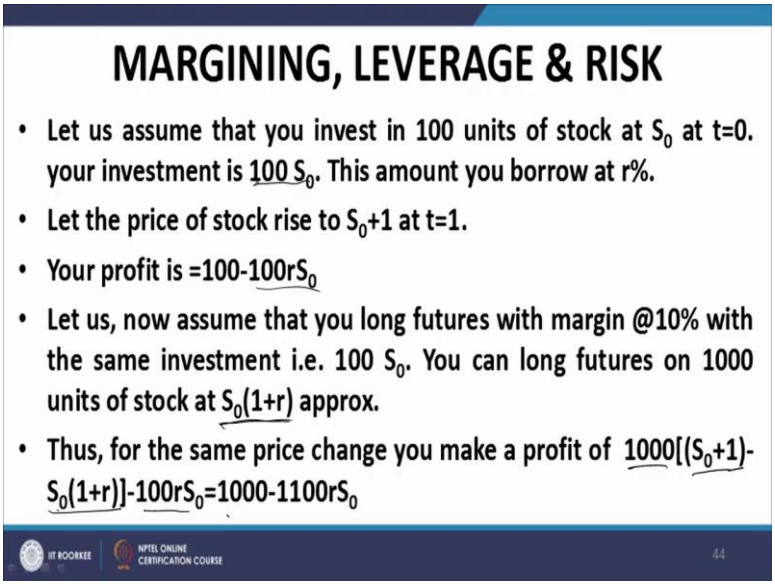

Now, you see if you take a spot position in a particular asset, if you buy an asset, if you buy a share in the market, you have to pay the entire price of the asset to start with. Now, and then of course the profit or loss whatever accrues on the basis of holding that asset with you. That goes to your credit, if there is a profit that operates as a credit to your account, and if there is a loss that operates as a debit to your account.

Now, by virtue of taking a futures position, you can take a position in that contract without indulging in any cash outflow at t equal to 0 at the point at which you enter into a futures position except for margin of course. So, the bottom line is that you can take a position in an asset, in other words, you can benefit from the profit or the loss as the case may be of the asset through a futures contract by depositing only a margin amount and that margin amount is obviously lesser than the total cost of the asset, which you would incur if you buy the asset in the spot market.

The result is that you can increase your exposure by taking position in the asset multi fold by using futures contracts rather than by taking spot positions in the underlying assets. This example illustrates this particular philosophy. Let us assume that you invest in 100 units of stock at S0 at t equal to 0, your investment is 100 S0. The amount that you borrow is at r percent let us assume that this particular (())(30:54).

Let us assume that the price rise is to S0 plus 1 another assumption at t equal to 1 at the end of one day or one year whatever the case may be, the price of the stock has gone up from S0 at t equal to 0 to S0 plus 1 at t equal to 1, then your profit is equal to 100 minus 100 r S0.

This is the amount you have borrowed, this is 100 S0, 100 r S0 is the amount of interest that you will pay for boring this amount.

And 100 is a profit because you are invested in 100 units of the stock and the stock price has increased by one unit per unit of stock, 1 rupee per unit of stock. So, your profit is equal to 100 minus 100 r S0. Let us now assume that you long futures with margin at the rate of 10 percent with the same investment that is 100 S0. Then you can take long positions on the 1000 units of the stock and the approximate no arbitrage price will be equal to S0 into 1 plus r. Therefore, for the same price change that is from S0 to S0 plus 1.

You now make a profit equal to 1000 because your exposure is at 1000 units of the stock, you will get 1000 units of the stock by paying at the rate of S0 into 1 plus r and then you can sell it in the market at S0 plus 1. So, this is 1000 into S0 plus 1, this is the proceeds that you will get by selling the 1000 units of stock that you get against the futures contract in the market, then this is the price that you will pay per futures contract.

So, 1000 into S0 plus 1 minus S0 into 1 plus r this is the futures price of the forward price. And minus the amount of interest that you pay for the borrowing of the margin amount which is 100 into S0 that is the amount you have borrowed. So, the amount of interest is 100 into r into S0 and this is equal to this amount.

So, you can see here that how the profits or losses get magnified due to this process of leverage, which can be facilitated by taking positions in the futures contracts at the margin amount only rather than taking spot positions at the paying of the full price. So, that is the one of the benefits or the one of the strategies that follows from the introduction of futures into our trading arena.

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So, a quick recap. Theoretical forward prices, no arbitrage over prices this was discussed a long time ago but this is pretty much there a part of the futures vocabulary as well, F0 t is equal to S0 exponential rT. Forwards the private contracts, futures are exchange traded. Futures carry no default risk, performance guaranteed by clearing house. Clearing house protects itself against loss due to default by marking to market and margining.

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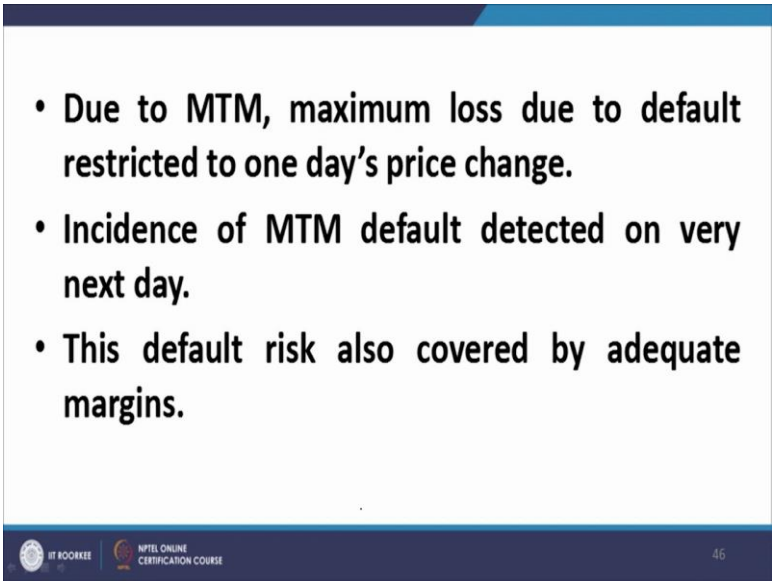

Due to marking to market maximum loss due to default confined to one day's price change. Incidence of marking to market default detected on the very next day. The default risk is also covered by adequate margins.

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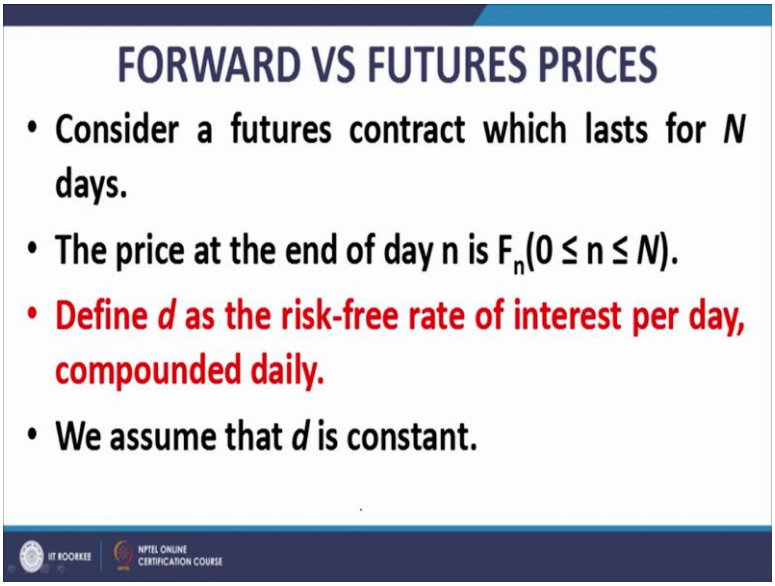

We shall continue from here in the next lecture. Thank you.