Financial Derivatives & Risk Management
Professor J.P. Singh
Department of Management Studies
Indian Institute of Technology, Roorkee
Module 1: Financial Derivatives & Risk Management
Lecture 5: Futures: Introduction & Salient Features

Welcome back all of you. In the last couple of lectures I have been talking about forward contracts. I have elaborated on the salient features of these contracts. These contracts are essentially privately negotiated contracts between the two parties. The contracts entail the delivery of the asset at a future date and the payment of the price at same date. However, the terms of the delivery including the price are determined at the time of the negotiation of the contract (a) at the time of the agreement. We, now, take up "futures" contracts.

What are futures contracts?

"Futures" contracts are absolutely similar to forward contracts. They entail delivery of the underlying asset and the payment of price at a future date t=T (maturity). However, the price to be paid, date of delivery & payment of price and other delivery conditions are agreed as on the date of negotiation of the contract i.e. at t=0. In other words, while the contract is negotiated and the terms of the sale e.g. price, date of settlement, delivery procedures etc. are agreed upon at an earlier date i.e. t=0, the actual settlement of the contract i.e. the transfer of asset and the payment of price takes place at a future (but predetermined at the date of negotiation) date t=T.

Additionally, "futures" contracts are tradeable at recognized exchanges constituted for this purpose. This additional feature of tradability of futures necessitates the following:

(i) The futures contracts must be standardized in terms of the value or units of the underlying covered by one contract; and

(ii) The futures must be stripped off of any default risk.

(Refer Slide Time: 4:52)

I, now, elaborate of each of these aspects.

Standardization of futures

The fundamental feature that distinguishes futures from forward contracts is that they are tradable, that is, futures are tradable on an exchange. Now, because futures are tradable on an exchange, sufficient counter parties must exist to facilitate buy-sell transactions. In other words, there should be sufficient liquidity. Liquidity can only be created and sustained only if these contracts have some kind of standardization. So the first thing that we need to look ensure with futures is that they have to be standardized. Standardized in terms of what? Well, at least the following features of these contracts must necessarily be uniform across a group of contracts being traded at any one time:

- **Nature/quality of the underlying asset;**
- **Size of the contract (Lot size);**
- **Settlement mechanism: physical vs cash;**
- **Delivery Arrangements;**
- **Delivery Months;**
- **Price & Position Limits.**

In contrast, forward contracts being private to two parties, may be tailor-made according to the requirements of the two parties and be settled accordingly.

Because futures are tradable, they have to be standardized to facilitate sufficient liquidity in the market of these instruments. You cannot find counter parties for a futures contract that is written on a unique index or other underlying or has a unique amount of underlying covered by it. Hence, futures have to be standardized in terms of the quality and quantity of the underlying asset, in terms of the delivery protocols and so on.

Risk Management

Now, unlike spot deals wherein payment and delivery is spontaneous and synchronized with the negotiation of the contract, forwards and futures have a time lag to settlement from the date of negotiation. Hence, the negotiating parties, on the date of negotiation and even thereafter, until the contract is finally settled on maturity are faced with the risk of default by the counter party. No such risk of default exists in spot deals because institution of the contract and its settlement are spontaneous.

Nevertheless, the important thing here is to keep in mind that forward is a private contract and being a private contract, both the parties to the contract have opportunities to assess the credit worthiness and the ability of the other party to honor his leg of the contract. Further, the outside world is not involved in any way into this private transaction. Therefore, not only are the parties to a forward contract placed to assess the default-risk of contract but are also in a position to impose such covenants or restrictions as they may deem appropriate or take suitable precautionary or remedial measures to mange this default risk at their mutual level. At the end of the day, the forward is private contract and the two parties will consent to the agreement only their interests are adequately served and protected. Whatever default risk is assessed by the parties has impliedly been accepted and acknowledged by it when it enters into the contract as a constituent of the contract.

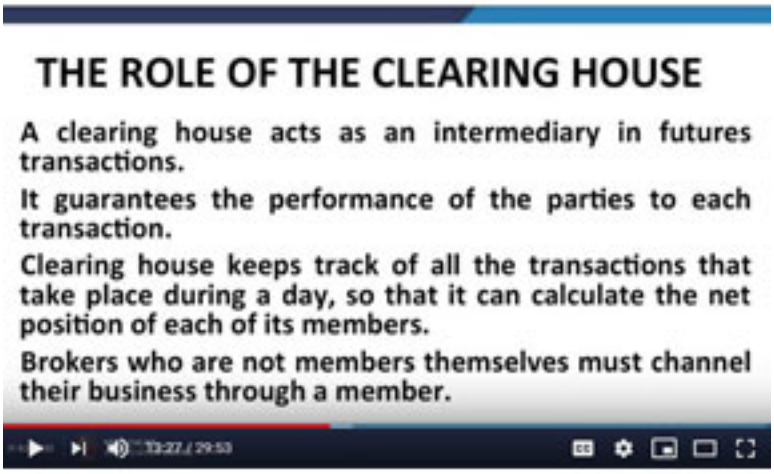
However, when we move from the forward contracts to the futures the situation changes radically because of the need to make these contracts tradable. If these contracts are traded, they change hands regularly due to the buy-sell transactions. It would seriously impede trading if these contracts carried an element of default risk since every buyer would be faced with the difficult proposition of assessing the default risk of the counterparty to the contract as per his perception

before he decides to take a position in the contract. Furthermore, because the contracts are freely tradable, the two legs of the contract may be transferred to other parties without the consent of the counterparties. Let us take an example. Suppose at a given instant a futures contract is initiated (negotiated) between A & B. It follows that A and B have both assessed the risk of default of the respective counter parties as per their perception, have take appropriate measures to protect themselves, as per their perception. However, when these contracts are traded, say A sells his leg of the contract to C, it becomes a contract between B & C. But neither B nor C have done any credit assessment of each other. Far from that, they would not even be known to each other, since the contracts are freely tradable and transfer would usually be made to the party with the best quote. This leads to an absurd situation, as B needs to bear risks that he had never bargained for, never anticipated or assessed and therefore never took any precautions against. Thus, free trading would not be possible unless that default risk factor is eliminated from the futures transactions. It is very necessary that, in order that the futures be freely tradable, they should be stripped off any default risk, so that parties who take positions in these contracts through trading do not have to worry about the creditworthiness of their predecessors. And this is done by the clearing house of the exchange at which these contracts are listed for trading. The clearing house guarantees the performance of both legs of the contracts to the parties who hold positions in such contracts. So far pretty simple.

In fact, it is one of the fundamental functions of the clearing house of the exchange that it guarantees the performance of both the legs of the contract. Once a futures contract comes into existence, the clearing house intervenes as a middle man and it guarantees the performance of both the legs of the contract.

As a result of this, both legs of the contract can be traded independently of each other without any issue in relation to default risk. This is one fundamental function of the clearing house. Additionally, it performs several administrative functions in relation to the settlement of trades of its members.

(Refer Slide Time 13:27)



We have different tiers of players in the \futures market just like in the stock market. We start with the investor at the lowest level. Investor transacts his trades through the brokers. Brokers,– either they are themselves clearing house members or, if they are not themselves clearing house members, they transact their business through some clearing house member with whom they are affiliated. These clearing house members are the final tier, who constitute the clearing house. So, the clearing house keeps track of all the trades of its clearing house members and the information percolates downwards from one tier to the other.

But how does the clearing house protect itself against the potential chance of default by the parties to the futures contracts. This is a very important and interesting question. It does so by the combination of:

(i) Marking to market (MTM); and

(ii) Margining.

Marking to market

Consider the case of a futures that is negotiated today (t=0) and entails delivery of one unit of the underlying at t=T at a price F^*_0. While the price F^*_0 is fixed today, the actual delivery of the underlying and payment of price will take place at maturity (t=T) of the contract. When the long

party receives the underlying at t=T, it can sell it in the market at the then prevailing spot price S_T, thereby achieving a net cash-flow of S_T-F^*_0.

Let us assume that the settlement prices of the above futures at the close of day 0,1,2,…,T-1 be respectively F_0,F_1,F_2,…,F_{T-1}. Further, let the final settlement of the futures be at F_T on day T. We can write:

S_T-F^*_0 =(S_T-F_{T-1})+…(F_1-F_0)-(F_0-F^*_0)

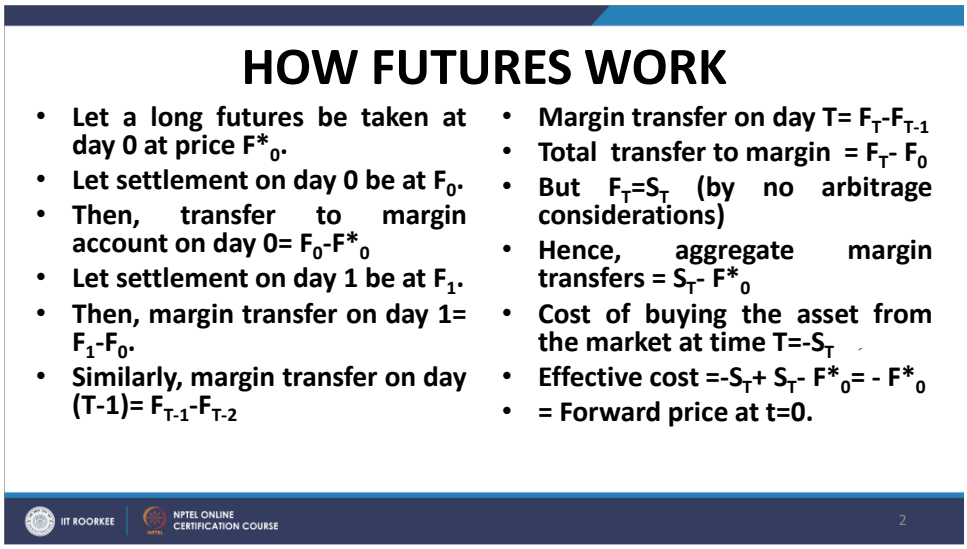
We, now, have a three step settlement program for futures:

(i) The difference between the settlement price on the date of acquisition and the acquisition price (F_0-F^*_0) is transferred to the margin accounts of the contracting prices on the settlement of day 0 accounts;

(ii) At the settlement of accounts at the end of trading on each subsequent day i.e. t^{th} day, the difference between the t^{th} day's settlement price and the $(t-1)^{th}$ day (F_t-F_{t-1})shall be transferred to the margin accounts;

(iii) The final settlement of the futures on its maturity shall be achieved by setting the T^{th} day settlement price equal to the spot price prevailing in the spot markets on the date of maturity of the futures i.e.S_T. Thus, final settlement of the futures is attained by setting F_T=S_T.

It is clear from the above equation and the following diagram that the payoff of S_T-F^*_0 is unchanged by this procedure.



The above process of settlement on a daily basis through the transfer of the daily changes in value of the futures to the respective margin accounts is called marking to market. Through this process:

(i) All futures contracts on a given underlying and given expiration irrespective of time of creation and past history are scaled to the current market price. Hence, this mechanism is termed as MTM.
(ii) The difference in price is carried to the margin accounts of respective parties holding long & short positions in the contract.
(iii) Thus, at the end of each trading day, the margin account is adjusted to reflect the investor's gain or loss for the day.
(iv) A trade is first settled at the close of the day on which it takes place. It is then settled at the close of trading on each subsequent day.
(v) Defaults are detected within one day of the occurrence of default.
(vi) Defaults are restricted to one day's price fluctuations. Hence, the motivation to default is much less.
(vii) 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).
(viii) Possibility of loss due to this one day default is well covered by margin requirements.

I, now, elaborate on these issues:

Let us assume that at the commencement of trade on January 1 (t=0), a contract on USD with maturity on April 1 is released for trading by the exchange and a party A takes a long position in the contract at the futures price of INR 75. This, in effect means that A will receive one USD on April 1 by paying INR 75 on that date. Further, let the settlement price at the end of the day's trading be worked out to INR 90 per USD 90. Thus, a party B who has taken a long position at this point i.e. close of day 0 trading will receive one USD on April 1 by paying INR 90.

Now, because A's holding entitles him to a USD on April 1 for INR 75 while B's holding gives him the same asset on the same date but for INR 90 i.e. A has to pay INR 15 less than B for the same asset acquired at the same point in time, it follows that A's position has a positive value. How much is this positive value? It is the present value of INR 15. If we ignore time value of money as we do in the case of futures, the positive value of A's position is INR 15 i.e. the difference in the futures prices at which they had respectively taken up their positions. Now, if the exchange rules direct B to pay INR 15 to A on settlement on January 1, what is the net amount that A will pay for acquiring one USD on April 1? Well, he has contracted to pay INR 75 but he will also return the INR 15 transferred to him by B on settlement on day 0. Thus, the net amount that A will, now, pay for getting one USD on April 1 is INR 90. But this is precisely what is payable under B's position. Remember, B had taken a long position when the futures price was INR 90.

Let us look at B's perspective. B has paid INR 15 to A on settlement of Day 0. It will, now, pay INR 75 on April 1 for receiving one USD on that date i.e. B's total payment against his long position is INR 90 as it should be. Thus, after this transfer of INR 15 profit from B to A, the positions of A & B have become exactly equivalent. Both positions will entail receipt of one USD on April 1 for INR 90. This is, precisely, what marking to market does. On settlement every day, all contracts of a given type in existence are marked to the day's settlement price (irrespective of their trading price history) by transferring the differences to the respective margin accounts of the parties holding long and short positions.

The above is equivalent to saying that the contract of A has now become identical to a fresh contract that is initiated at the exercise price of INR 90 per USD for delivery on April 1. And since, this is a fresh contract, its value is zero (recall: the value of a forward contract at inception is zero). It follows, then, that the value of A's contract after the settlement transfer to margin of INR 15 also becomes zero.

When we talk about marking to market, because the futures price fluctuates, at the end of each day's trading, a settlement price is arrived at, as per a pre-assigned formula. This settlement price is usually, the weighted average of the prices of the trades that take place during the last half hour of trading for the day.

So, on settlement, all the contracts in existence irrespective of the origin, the date of origin and irrespective of their previous history, are marked to the current settlement price. This process is repeated every day. In other words, at the end of trading every day, all contracts in the market pertaining to a particular maturity and a particular underlying are settled at a particular price. And this process is called marking to market.

The profits/losses on marking to market are computed as the difference between :

(i) The trade price and the day's settlement price for contracts executed during the day but not squared up.

(ii) The previous day's settlement price and the current day's settlement price for brought forward contracts

(iii) The buy price and the sell price for contracts executed during the day and squared up.

Now, even on the day that an investor takes a position, that is day 0, at the end of settlement, the difference between the settlement price and the price at which the position was traded is transferred to the investor's margin account. So MTM operates from day 0, not from day 1.

The clearing members who have a loss are required to pay the mark-to-market (MTM) loss amount in cash which is in turn passed on to the CMs who have made a MTM profit. This is known as daily mark-to-market settlement. Clearing members are responsible to collect and settle the daily MTM profits/losses incurred by the trading members and their clients clearing and settling through them. Similarly, trading members are responsible to collect/pay losses/profits from/to their clients by the next day. The pay-in and pay-out of the mark-to-market settlement are effected on the day following the trade day. Thus, the MTM settlement is transferred to the margin accounts of the clearing house members and thereby it percolates down to the investor's margin account with its broker.

In case a futures contract is not traded on a day, or not traded during the last half hour, a 'theoretical settlement price' is computed as per the following formula:

$F = Sexp(rT)$

After completion of daily settlement computation, all the open positions are reset to the daily settlement price. Such positions become the open positions for the next day.

Daily settlement price for MTM settlement on a trading day is the closing price of the respective futures contracts on such day. The closing price for a futures contract is usually calculated as the last half an hour weighted average price of the contract.

So what are the implications of this MTM settlement.

Now, because settlement takes place on a daily basis and at settlement on each day, these contracts are marked to market and the difference is transferred to the margin account, with the pay in and payout on the next following day, if a party commits default, there are two issues:

(i) That default will be restricted to one day's price change because the previous day's price change is already incorporated into the contract through the previous day's MTM settlement that has been transferred to the margin accounts. And if there is a shortfall in margin, the party would have brought the money by now. So, the worst case scenario is that the one day's fluctuation in price may be the default amount that arises because of this marking to market.

(ii) This default is detected immediately i.e. latest by the following day which is the pay-in/ pay-out day following settlement.

Let us compare this with the case of a forward contract. In the forward contract, the contract is instituted at t=0, but there arises only one cash-flow i.e. at the maturity of the forward contract i.e. at t=T. Hence, the effect of the cumulative price change over the entire life of the forward (t=0 to t=T) hits the investor at one instant, in one go. For example, consider a 12-month forward on USD @ INR 75. Let the spot price on maturity be INR 180 for one USD. Since, the maturity of the forward is quite long (12-month) such a price esx=calation may amterialize. Now, the short forward party is, therefore, faced with the issue of delivering an asset with market worth of INR 180 for INR 75 under the forward. Thus, the entire impact of INR 105 is felt by the short forward party on the date of maturity of the forward contract. In between, nothing happens because there is no cash flow, there is no actual physical movement of funds. But at maturity, the cumulative impact stares the parties tio the contract. In futures, this impact is deeply diluted because it is distributed piecemeal on a daily basis over the entire life of the futures due to MTM settlement. Each day's price change is absorbed in the contract on the same day through MTM.

It is usually the case that dispersion measures (e.g. standard deviation) scale in tandem with respect to timescales so that shorter the time periods, less is likely to be the fluctuation in prices over that time span. Simply stated, price changes over a day are likely to be much less than price changes over a week or a month etc.

In view of the above, when we have daily settlements, the fluctuations or the price changes, are usually far smaller and therefore the incentive to default becomes much less. When one is suddenly faced with the pinch of large loss, the motivation to default is far more.

And the second thing is, in the case of futures, one can easily exit one's position. One can close out one's position in the futures contract at any time by entering a reverse trade in the same contract. This flexibility is, obviously, not available for forward contracts by design.

Margining

Thus, in the case of futures, defaults are likely to be confined to one day's price change. Now, the exchange protects itself against the eventuality of such defaults by imposing am "margin" condition before players are aloowed to take positions in futures.

When a broker trades on behalf of an investor for a futures contract, the broker will require the investor to deposit funds in a margin account. The amount that must be deposited at the time the contract is entered into is known as the initial margin. The margin must be maintained so long as the investor retains a position in the futures.

All settlement transfers e.g. MTM & final settlements are made to this margin account.

If the balance in the margin account falls below a certain threshold, the maintenance margin, the investor receives a margin call and is expected to top up the margin account to the initial margin level by the end of the next day. The extra funds deposited are known as a variation margin. If the investor does not provide the variation margin, the broker closes out the position.

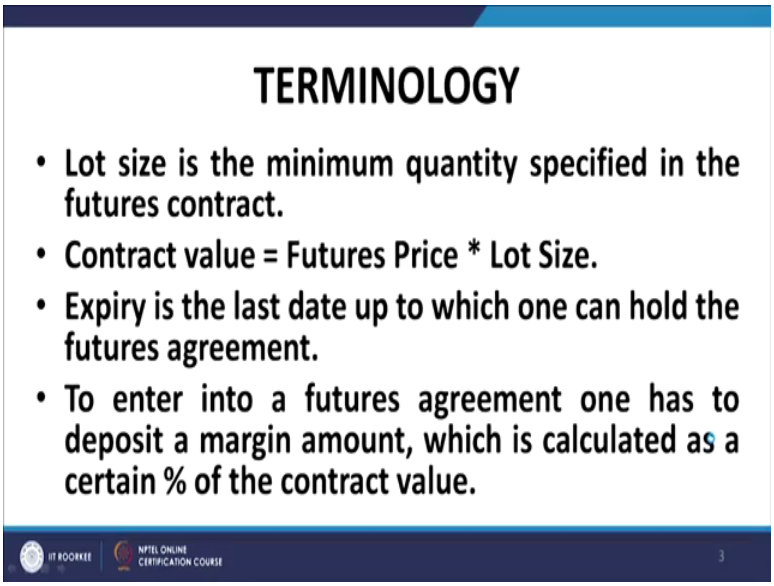
Minimum levels for initial and maintenance margins are set by the exchange. Individual brokers may require greater margins from their clients than those specified by the exchange. However, they cannot require lower margins than those specified by the exchange. Margin levels are determined by the variability of the price of the underlying asset. The higher this variability, the higher the margin levels.

Just as an investor is required to maintain a margin account with a broker, the broker is required to maintain a margin account with a clearing house member (BROKER MARGIN) and the clearing house member is required to maintain a margin account with the clearing house (CLEARING MARGIN).

Now, there is this concept called margin which is probably also embedded in forward contracts. But forward contracts being private, the margin component also was decided privately. The banks could require the borrower or the party that is long in the forward contract to deposit a certain amount of money so that it honors its leg of the contract. That margin amount is also decided after or through negotiation between the two parties. In the futures contract, of course, even the margin is standardized, there are different types of margins.

Terminology in relation to futures trading

(Refer Slide Time: 3:23)



As I said, futures contracts have to be standardized. The number of units of the underlying that are covered by one futures is also standardized and is called the lot size or the contract multiple.It is the same for a given contract type but varies for different types of contracts. Thus, the contract multiple may be different for futures on different stocks, indices, currencies or commodities.

Contract value of a futures at a given instant is the value of the entire contract i.e. the product of the lot size and the futures price. Expiry date is the date on which the futures mature for delivery.

Physical and cash settlement

By definition, forwards and futures are contracts that are instituted (negotiated) at a certain point in time e.g. t=0, entailing settlement by physical delivery of the underlying asset and payment of price at a future date (maturity, t=T). The price, quality and other issues relating to unambiguous

settlement like terms of delivery are all agreed upon when the contract is negotiated i.e. at t=0. This is called physical settlement, when the underlying asset is contracted to be physically delivered on maturity.

To facilitate or to encourage greater tradability and liquidity, the concept of cash settlement has also been evolved. In the case of cash settlement, the physical delivery of the underlying asset is done away with. Instead of delivering the underlying asset physically, a certain amount of cash is transferred to the margin accounts. How this "certain" amount of cash is computed?

The amount of cash is equal to the final settlement price less the settlement price on previous closing. Final settlement price is the closing price of the relevant underlying asset (not futures) in the capital market segment of the exchange, on the last trading day of the futures contract.

On the expiry day of the futures contracts, after the close of trading hours, the clearing house marks all positions of a clearing member to the final settlement price and the resulting profit/loss is settled in cash. Final settlement loss/profit amount is debited/ credited to the relevant CM's clearing bank account on the day following expiry day of the contract.

So there are two ways in which futures contracts can be settled. One is by actual physical delivery of the underlying asset and the other is when physical delivery of the underlying asset is dispensed with but a certain amount of cash is transferred to the margin account.

The logic of calculating the cash settlement amount by reference to the maturity spot price of the underlying stems from the "convergence" property of spot and forward prices i.e. that spot and forward prices of an asset tend to converge on maturity of the forward contract. This is mandated by no arbitrage arguments.

But whether a particular contract entails physical settlement or cash settlement must be embedded in that contract itself and hence, known to the contracting parties ab- initio. The settlement procedure forms an integral component of the contract and cannot therefore be altered after the contract comes into being. In fact, these are clearly specified by the exchange at which the contracts are listed.

Creation of futures contracts

Futures contracts are notified for trading by the relevant exchange. Futures contracts have a maximum of 3-month trading cycle - the near month (one), the next month (two) and the far month (three). New contracts are introduced on the trading day following the expiry of the near month contracts. The new contracts are introduced for a three month duration. This way, at any point in time, there will be 3 contracts available for trading in the market (for each security) i.e., one near month, one mid-month and one far month duration respectively.

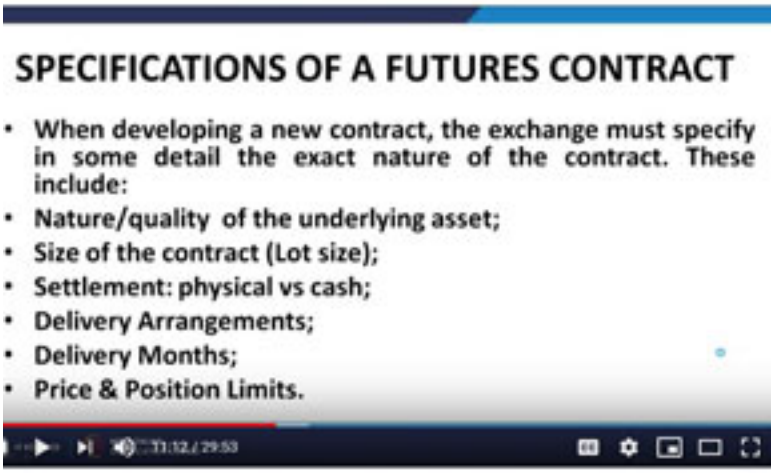
At any point in time, there are three contracts that are being traded. One is the near month delivery contract, the middle month delivery contract or the mid month delivery contract and the far month delivery contract. Now as and when trading in the near month delivery stops for final settlement, the exchange notifies a fresh contract with a three month cycle. This new contract replaces the existing near month contract which has now expired. The new contract's delivery will take place at the end of three months from today. Thus, again, we have a cycle where three monthly settlement contracts are available for trading. For example, in January we have traded contracts with January, February and March settlement. When the January settlement contract expires, a fresh contract with April settlement will come into play.

Usual specifications in a futures

When notifying a new contract, the exchange must specify in some detail the exact nature of the contract. These include:

- Nature/quality of the underlying asset;
- Size of the contract (Lot size);
- Settlement: physical vs cash;
- Delivery Arrangements;
- Delivery Months;
- Price & Position Limits.

(Refer Slide Time: 11:11)


SPECIFICATIONS OF A FUTURES CONTRACT
• When developing a new contract, the exchange must specify in some detail the exact nature of the contract. These include:
• Nature/quality of the underlying asset;
• Size of the contract (Lot size);
• Settlement: physical vs cash;
• Delivery Arrangements;
• Delivery Months;
• Price & Position Limits.
13:12 / 29:53