Commodity Derivatives and Risk Management
Prof. Prabina Rajib
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur
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Lecture 26
Commodity Options (Contd.), Put-Call Parity & Put-Call Ratio

Welcome to the 26th lecture on Commodity Derivatives and Risk Management. And today we are going to discuss commodity options which is going to be a continuation of the previous session. In addition to that we will also be discussing different aspects of put call ratio and put call parity. Now, please recall, in the previous session we had discussed that exchange traded commodity options have commodity futures as underlined. And, on the expiry of the option contract, the option position holders take position in the underlying commodity futures. It is very important to understand or take note here that exchange traded option contracts do not have the underlying commodities as the underlying, but futures contract as the underlying. Now, once the option expires the long and short position holders of the option get to take the position in the futures contract. And it is also important to understand that the option expiry date is always before the underlying futures contract expiry. And, on the option expiry date the daily settlement price of the underlying future contract is compared with the exercise price for each option to decide whether each of these options are in the money option or out of money option. Please note that out of money options expire and all in the money options are exercised into futures contract. As you can see this particular table which I have taken from the multi commodity exchange website is part of the silver option contract specification. As you can see the left side of the column indicates exercise mechanism at expiry that is option expiry what is going to be the exercise mechanism. Please note here all the in the money option contract should be exercised automatically and also it mentions all out of money option contracts will be expiring worthless. And which one is going to be in the money for call option, those call option whose strike price is going to be less than the settlement price that will be in the money option and which are going to be in the money put option, for put option the strike price has to be greater than the settlement price. And what do you mean by the settlement price? This settlement price is the daily settlement price of the underlying futures contract on the expiry date of the option contract. Please note that this due date rate or final settlement price is the price which needs to be considered on the day the option comes to expire and that price is nothing, but the daily settlement price of the underlying futures contract. Now, let us take a very simple example to understand how exactly this option exercise process happens in case of a commodity option. This particular diagram shows this process; let us say on day 0, there are various traders who will be taking long call, short call, long put, short put, they are

free to take any position. And, from day 0 till day small t, they are going to be entering into a new option contract, if they wish they can close or square up their contract. But on day t which happens to be the option expiry date on that date all long call, long put, short call, short put positions will be decided whether these options are going to be exercised or not exercised. And that decision will be based on the future price prevailing on that date, that is the daily settlement price of the underlying futures contract, let us call this one FT. In our simple example we have taken FT as 12 rupees. Now, on this date there could be a group of options which will be in the money option, there could be a group of options which will be out of money option. And please note that all out of money options will be expiring worthless, nothing will happen to these OTM options. Now, coming back to the ITM options, in this ITM option, we have taken the future price to be 10 rupees. So, please ignore this one this there is a mistake here this future price is going to be your10 rupees. So, let us assume that the future price on this date, that daily settlement price for the future price is 10 rupees. Now, let us say there is one party who has a long call position at an exercise price of 8 rupees. The moment one has a long call party there has to be a counter party who has taken a short call position on the same exercise price. Now, as you can see the exercise price is less than FT or FT is greater than the exercise price. So, it is going to be in the money call. The moment it is in the money call, this particular call is going to be exercised. So, what do you mean by exercising? In the meaning of exercising is that the short call position holder will be paying 2 rupees for the long call. Please note that when FT is greater than X the long call position holder benefits by 2 rupees and the short call holder loses by 2 rupees. So, short call position holder will be paying 2 rupees to the long call and both long call and short call will take futures position, but long call will take long futures position at the settlement price of 10 rupees. Similarly, short call will take a short futures position at a settlement price of 10 rupees. Now, similarly all long call and short call position whichever are in the money nature will be exercised in this manner. Now, coming to the other category of options which are put options. Let us say there are some traders. There is a trader who is holding a put option with an exercise price of 17 rupees. The moment somebody has a long put, somebody else also has to have a short put position. And with the exercise price of 17 with a FT as 10 this is going to be a in the money option. For a put option an option will be in the money when the exercise price is greater than the prevailing underlying price. So, in this case long put is benefiting, simultaneously short put is incurring loss, and this benefit or loss is to the tune of 7 rupees. So, short put position holder will be paying 7 rupees to the long-put position holder. And the short put position holder will take long futures position and long put position will be taking short futures position and both at a future price of 10 rupees. So, as you can see, the day option expires, one set of trader's option will expire worthless, another set of traders who are in the money option, they will be receiving money from the counter party positions and all of them will be taking long futures or short futures at the common settlement price of 10 rupees. And from that day onwards,

the option does not exist anymore. Now these traders will have a long futures position and short futures position and from day t to capital day T, that is the futures expiry these long and short futures position will be marked to market, the way we have already discussed. So, this particular table also shows various combinations of long call and long put position with the different exercise price to decide whether the option is going to be exercised or not going to be exercised. So, this in a nutshell explains the process of commodity settlement commodity option settlement on the expiry date. Now coming back to how exactly these commodity options which have futures as underlying how the call premium and put premium are priced. Can the same Black Scholes option pricing model be used to arrive at the call premium and put premium? The answer is no. In the case of a Black Scholes option pricing for model the underlying is a spot asset or a spot commodity. In the case of a commodity options for the underlines are futures. So, the Black Scholes option pricing model was modified to some extent by Professor Fisher Black in the year 1976 and he named this particular model as a Black 76 model. And as you can see you know this these two blocks compare the Black 76 model for pricing option on futures with Black Scholes option pricing model on pricing options on spot underlying. The formula remains almost constant with some minor changes in terms of in place of the underlying S 0 here we will be using the underlying future price. And x stands for your expiry, in this case x also stands for x stands for your exercise price in both cases x stands for exercise prices. And only difference here is that the sigma represents the volatility of the underlying future price return series. And in this case, sigma is based on the volatility of the spot price return series. Otherwise, the formula remains more or less same with minor changes to the Black Scholes option pricing formula to arrive at the call premium and the put premium. This particular slide shows some examples of Black Scholes option pricing calculator. The first block, I have taken from the multi commodity exchange website and the second block which I have taken from the Chicago Mercantile Exchange website in in terms of pricing options on futures. As you can see, this particular calculator takes the underlying asset, the expiry date, the underlying price, strike price and the underlying asset volatility and the risk-free rate of return and as well as your time to maturity. So, based on this information as you can see the call option price is 52.26 rupees and put option price is 462.94 or 463 rupees. Similarly, exactly the same parameters are considered by the Black 76 option calculator used by CME. As you can see, this strike it considers the strike price or exercise price, underlying asset price which is the future here number of days to maturity the risk-free rate of rate and whether the option is a call or put option and also the volatility vol percent is the underlying asset volatility. Based on these parameters as you can see the call price is 21.73 USD and, in this case, the put price is 52.42. Now coming to analyze one may ask why there would be so much of significant difference between a call premium and a put premium. Let us take this case where the call premium is only 52 rupees while the put premium is 462 rupees. So, this depends on whether the option is a

in the money option or out of money option and what is the extent of intrinsic value or time value associated with this option.

So, let us go and understand more on what you mean by intrinsic value and time value associated with the option contract. Please note that the option premium has two components and that is known as an intrinsic value and time value. In fact, time value is nothing but the option premium, what we are getting to see in the market what people are buying and selling in the commodity exchanges or stock exchanges. So, that option is premium minus the intrinsic value. So, let us first understand what we mean by the intrinsic value of an option. The intrinsic value of an option is the benefit or the instantaneous benefit the long position holder gets if the option is exercised. Please note that the European option cannot be exercised before the maturity. Assuming that if a long call or long put position holder is able to exercise on a given date what is going to be the instantaneous or immediate benefit from the exercising, that is defined as the intrinsic value of the option. So, how much is going to be the intrinsic value for a call option. So, this is going to be maximum of underlying asset price minus the exercise price or 0. Please note for in the money call option the intrinsic value will be always 0. Please note that for a call option it will be an in the money call option when the underlying asset price is higher than the exercise price. So, intrinsic value for a in the money call option is going to be greater than 0 or positive. For an out of money call option, the intrinsic value is going to be 0 because the long call position holder will never exercise the option if the underlying asset price is less than the exercise price. Similarly, let us come to what do we mean by the intrinsic value of the put option. So, the intrinsic value of the put option is nothing, but the maximum of exercise price minus the underlying price or 0. And please note that in case of a in the money put option the exercise price is always greater than the underlying asset price hence the intrinsic value is going to be greater than 0 or positive. Similarly, for out of money put option where the exercise price is less than the underlying asset price the intrinsic value is going to be 0 because the long-put position holder will never exercise the option if this condition happens, that is exercise price is less than the underlying asset price. With this, let us understand a very important concept that is even though the even though an out of money option has 0 intrinsic value this option will still command a premium. So, let us understand this concept what we mean by an out of money option which has a 0 intrinsic value will still command a premium and why this will happen. Please let us go to this option calculator, I have just plugged in different data points and as you can see the option premium for call option is 6.73 rupees and the option premium for put is going to be 299.37 rupees. Now in this case please note that the intrinsic value of a call option is going to be maximum of your underlying asset price underlying asset price is 6007 and the strike price is 6300 and when we are taking a function of Max [6700-6300,0], it is going to be the 0 intrinsic value. So, this particular option the call option, has a 0 intrinsic value, but still, it is trading at a positive premium which is your 6.73 rupees. So, the long call position holder will not be getting any benefit

by exercising, but still, it is paying a premium of 6.73 rupees and that comes to the time value component of the option premium. So, how do we calculate the time value component, please note the time value of the call option is nothing, but your option premium minus the intrinsic value in this case it is 6.73 - 0 which is coming to your 6.73 rupees. So, the full option premium, whatever the buyer sellers are transacting that full option premium is the time value component and it does not have any intrinsic value because it is an out of money option. Similarly, let us come to the put premium which is trading let us say at 299.37. Now let us find out whether it has any intrinsic value or not and as we know the intrinsic value for a put option is going to be maximum of the exercise price minus the underlying price comma 0. So, as you can see the exercise price is 6300 underlying price is 6007. So, the intrinsic value is coming to 293, but please note that even though the intrinsic value is 293 buyers and sellers are agreeing to transact at a higher price. So, this put premium minus the intrinsic value of 2.93 is giving the time value component of this particular option. So, let me summarize here what we discussed that in the money option will always have a positive intrinsic value out of money option will have a 0 intrinsic value. However, the out of money option will still be trading in a market with a positive premium because these options have a time value component. Now coming back to understanding by analyzing the option premium, can anybody guess or can anybody be able to understand what the option are traders expectation regarding the future price movement. So, this particular snapshot again I have taken from the multi commodity exchange. Let us say on trade date, 26 May 2023 this is a option on futures contract, the option is going to expire on 21st June 2023, this is a call option or call European and exercise price is 70000 and the first premium to be traded or first transaction to happen on that day started or opened at a call premium of 2000 rupees. That means, long call and short call position holder agreed to exchange each other with 200 rupees and take a counterparty position on the underlying silver option for exercise price of 70000 and on a trade date of 26 May 2023 for option expiring on 21 June 2023. Now, let us analyze these particular trade details to get a view, what is the expectation of this call position holder in terms of the future price movement. Please note that this is the payoff diagram for the long call position holder we have discussed this aspect also in earlier. Please note that 70000 is the exercise price and 72000 is the exercise price plus the premium. Now the long call position holder will be benefiting if the underlying asset price is more than 72000. So, by analyzing just these two components we can get a view that the long call position holder has a bullish or expecting that future price is going to be more than 72000 because he has bought the option has paid 2000 rupees in the hope that the underlying asset price could be anywhere more than 72000. Hence, it will be benefiting from this particular option. So, long call position holders are having a bullish or positive view about future price increases. Now, let us come to the counter party the short call. Please note that the short-call position holder will be incurring loss if the market remains in this range that is greater than 72000. In fact, the short call position

holder will be very happy if it remains less than 70000, because the long call position holder will definitely not exercise. So, he is very happy this particular trader is very happy if the price remains less than 70000. Even if the price remains less than 72000, it is an acceptable position, it is a worst-case situation for the party, but still an acceptable situation. So, this particular trader is expecting the price to remain in this range. So, we can say that the short call is having a bearish view about the market. Similarly, let us go to the long-put position. In this case, as you can see on 26 May 2023, some traders have taken a position on silver option expiring on 21 June 2023. PE stands for your put European exercise price is 70000 and the option premium traded in the first option to be traded is 1402 rupees. So, 1402 rupees so that means, let us come to the long-put position holder price expectation. Please note that this particular party will be benefiting from this particular option only if the price is less than 68598. This long put position holder will exercise the option any price below 70000, but if the price underlying asset price is less than 68598 this party will be benefiting. Hence this party is expecting the market price to be less than 68598. So, we can say that the long-put position holder price view is a bearish price view. Similarly, let us come to the counter party of position which is a short put position holder. This particular party will be very happy if the price remains more than 70000. If price remains more than 70000 long put position holder will never exercise. Even if he accepts a price decline which can be up to 68598. So, any price any price higher than 68598, it is acceptable to the short put position holder, but he is very happy he is going to be very happy if the underlying asset price remains more than 70000. So, you can we can see it that the short put position holder has a bullish view. So, just by barely analyzing these two contracts we are able to get a feeling that which trader has a bullish view about the market or a bearish view about the market. But on a given day we can have a substantial number of options trading at different exercises at different premiums. So, can we get a single view related to whether the market is expecting the underlying asset to price to go up or go down, that we can do it we can get an idea through a concept called a put call ratio. So, let us go and understand what exactly we mean by the put call ratio. Again, this particular detail which I have taken from the multi commodity exchange, and this is the snapshot of a silver futures traded on 26 May 2023 for option expiry 21 June 2023 for various combination of call put and for various combination of exercise prices. Now to get a feeling whether the market in general is expecting the underlying asset price to go up or go down we calculate a ratio called a put call ratio. And what exactly this put call ratio this put call ratio is a ratio of put open interest to the call open interest. We have discussed the concept of open interest in detail with respect to the futures contract, the same logic is applicable here. So, for put call ratio for 21 June 2023, 70,000 expiries as you can see this put call ratio for 70,000 expiries on 26 May 2023 for a contract which is maturing on 21 June 2023 is nothing, but the put open interest divided by the call open interest. So, as you can see put open interest is in 604 in number and 142 in number. So, that is giving your put call ratio of 4.53. Now this

is only the put call ratio associated with the given strike price and given expiry.

Now when we are talking about a commodity wise, we can calculate the put call ratio for commodity wise as a whole. So, what exactly will indicate, that how we will be able to calculate the same, this is the ratio of the total open interest for all put option to all call option for all exercises and all maturity. So, in fact, this is the snapshot of only a partial snapshot of the trades for silver futures. So, on that day if we download all the options traded and we will be able to find out the ratio of the open interest for all put position holders to all call position holder we will get a commodity wise put call ratio. And as you can see put call ratio indicates a bearish market as more number of traders have open interest input than a call. In general, please note that the put position holders are bearish as compared to the other position as compared to the long position holder. So, when you have a greater number of put traders in the market, we call that one a bearish market and that we measure through a put call ratio greater than 1. As you can see again this is a snapshot of the commodity put call ratio which I have downloaded from the multi commodity exchange. As you can see different commodity futures contract on the on that day you have different put call ratio and out of all these commodities, you can see the crude oil has the highest put call ratio of 0.77. That means, more people are bearish about price decline associated with the crude oil future price than the price increase as compared to other commodity. So, with this we will come to an end to today's session. So, today basically we discussed how the option contracts will be expiring and who will take long futures position and short futures position depending on whether the option is in the money or out of money. And whether an option is long call or a long-put option. We also discussed depending upon thepriceoption premium people are paying what is going to be their expectation related to the future price movement. We also very briefly discussed about the Black 76 model which is used to calculate the put and fall premium associated with the European commodity option. So, with this we end today's session. I again greatly look forward to interacting with you all in the next session. Thank you all of you.