Commodity Derivatives and Risk Management
Professor Prabina Rajib
Vinod Gupta School of Management
Indian Institute of Technology Kharagpur
Lecture 27
Hedging of Crude Oil and Refined Product Price Risk (Part 2)

Hi all. Welcome to the next session on commodity derivative and risk management and we will continue with our discussion on a different risk management products with respect to crude oil and refined products and if you recall in the last class we discussed about the swap contracts and with respect to how a crude oil refiner who is interested in buying crude oil and is fearing that crude oil price is going to go up, it will be entering into a swap contract. It will be as a part of this swap contract, it will agree to it will agree to pay fixed and similarly with respect to crude oil producer, who is fearing that the crude oil is going to go down, it will be entering into a swap contract where it will be agreeing to receive a fix rate and pay a floating rate so we took some numerical example with different prices of crude oil and we realize that with the swap contract, a crude oil producer will receive the fix price irrespective of whatever may be the future crude oil price.

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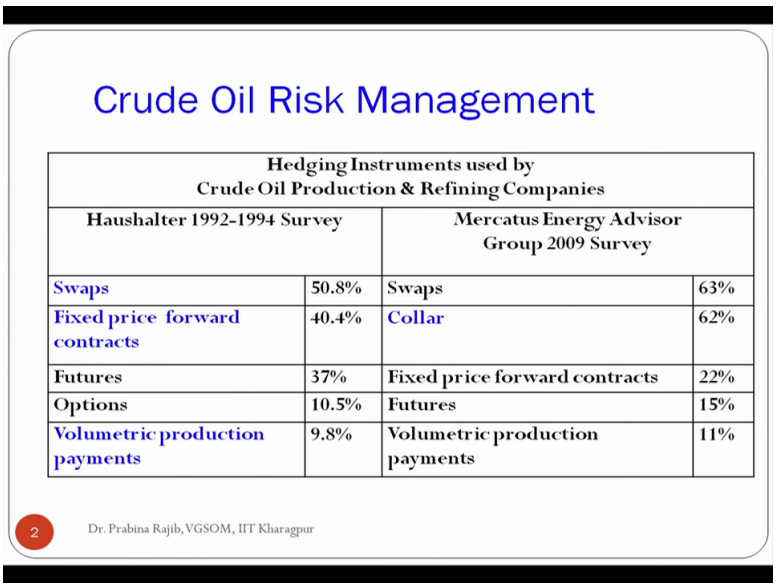

Similar a crude oil refiner who is going to buy crude oil is going to pay a fix price irrespective of whatever may be the price. Now does it happen quite often? Yes because if you recall we started discussing with this particular information that swaps are the one of the most often used derivative contracts by a crude oil producing and refining companies so 15.8% and 63% companies use swap and also the ATF Hedging Information Survey, which

was given by the Mercatus Energy group, that report also indicated that swaps to be one of the most common method of managing aviation turbine fuel risk.

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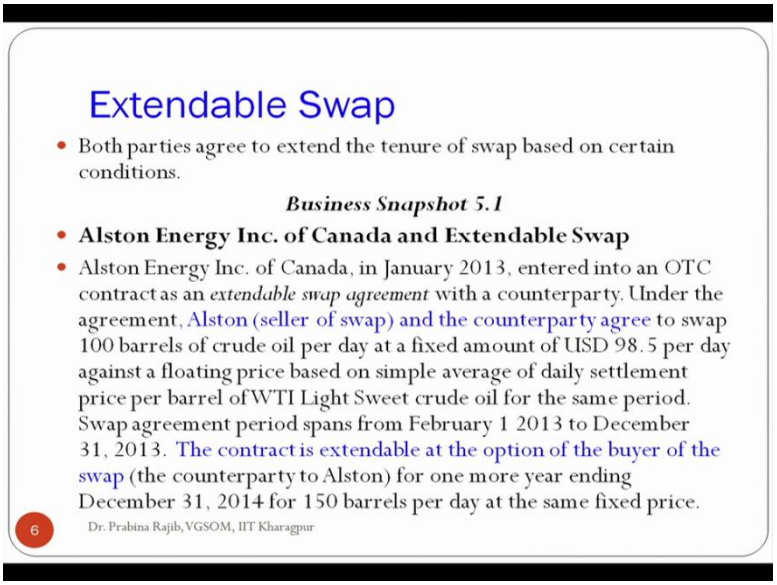

Now, let Us go to discuss about the swaps and let Us go to this one. This is a another interesting twist to the swap that is known as a extendable swap and please one thing I would like to highlight here that swaps are OTC contracts. It is entered in by 2 parties, so they have the freedom to modify the features of the swap and I want all of you to just spend couple of minutes understanding how Alston Energy Incorporation of Canada entered into a extendable swap.

So what is the meaning of extendable swap so Alston Energy Incorporation of Canada in January 2013 entered into OTC contract as an extendable swap contract with the counter party and under this agreement Alston who is a seller of the swap, so who is who is a seller of the swap so party who is fearing the price is going to go down so that party will receive fixed and pay floating rate. So Alston's fear is that if he does not do anything, it is going to end up getting less amount of revenue so it agreed to receive fixed and pay a floating rate and become seller of the swap.

And what was the price they agreed upon, they agreed upon the notional quantity is 100 barrels of crude oil a day so 100 barrels of crude oil a day. And what is the fixed amount which Alston is going to receive, Alston is going to receive dollar 98.5 per day and how much floating rate Alston is going to pay to the counter party? This is very interesting, this is not the one day price prevailing so this is the average of the daily settlement price per barrel

of WTI lights sweet crude oil for the same period so the floating price is not based on the closing price on a given day it is the average price over a period of time. So Alston is going to receive fixed price of dollar 98.5 per barrel and it will pay a floating price.

And standing today with respect to January 2013, if this contract is still valid then you can say in the high end side Alston Energy is making good amount of money because with the declining WTI crude oil price, Alston will be paying less price as compared to the fix price so 98.5 dollar per barrel is much higher than the prevailing price of crude oil. So what is the extendable part of it, the extendable part of it please see this one, this contract is extendable at the option of the buyer of the swap for 1 more year ending December 31, 2014. Okay so as as of today, this contract will not be valid because the buyer of the buyer of the contract would not have gone ahead and extended its exercise, its option to extend the contract because crude oil price has gone down but that's not the objective of the discussion.

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The objective of the discussion is that how swap contracts can come in different form and flavor as long as both parties are agreeing to have these innovative features incorporated into the contract. So the next set of contracts is futures and options. I have you now discussed quite often times so I am not going to discuss these contracts at this point of time anymore.

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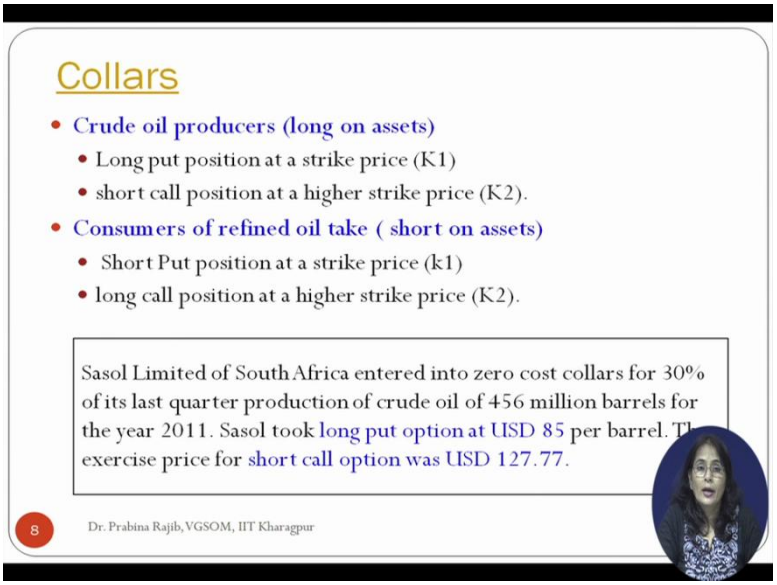

Now, let us go to what are the collars or collars whatever however you would like to pronounce that so what is the collar, collar is nothing but a combination of 2 option positions. So if you recall a crude oil producer who is fearing that crude oil price is going to go down, it will be mitigating that risk by entering into a long position in a option market or in a OTC market, it will identify a counter party with which this crude oil producer will enter into a long put position and the counter party will take a short put position and the crude oil producer will pay a premium for taking a long put position.

So that is typical plain vanilla put option, but in case of a put option, when the company is buying the put option, it has to pay a premium so instead of paying the premium simultaneously to match or not to pay a premium, the company can enter into a short call position at a higher strike price. So a crude oil producer who is long on asset or who is owning crude oil, its fear is that price is going to go down traditionally in a option market, it would have only entered the long put position and with but with in a collar, it will enter a long put as well as a short call position but the exercise price for the short call position is higher than the strike price for the long put position so K1 is your strike price for long put position and K2 is your strike price for short call position.

And similarly let us say the consumer of a refined oil so if you let us say a airline company which buys ETF, it fears that ETF price is going to go up so normal case with an option market, it would have entered into a long call position. It would have taken a long call position and with the long position, I had to pay, it has to pay a strike, it has to pay a premium but to not if the company it decides not pay premium or reduce the premium outgo. It can

enter into a short put position at a strike price of K1 so in this case, the long call strike price will be higher than the shot put strike price of K1.

So now, let us focus on the how crude oil producer can mitigate its risk so please this small information which is given in the text box Sasol Limited of South Africa entered into a 0 cost collar for 30% of its last quarter production of crude oil, 456 million barrels for the year 2011. Sasol took long put option at US dollar 85 per barrel and it simultaneously also took a short call option at a exercise price of 127.77 and when we are using the word 0 cost means the call premium and put premium are equal so the company does did not pay any long call long put premium and also did not receive any short call premium. Now, how is the payoff going to look like?

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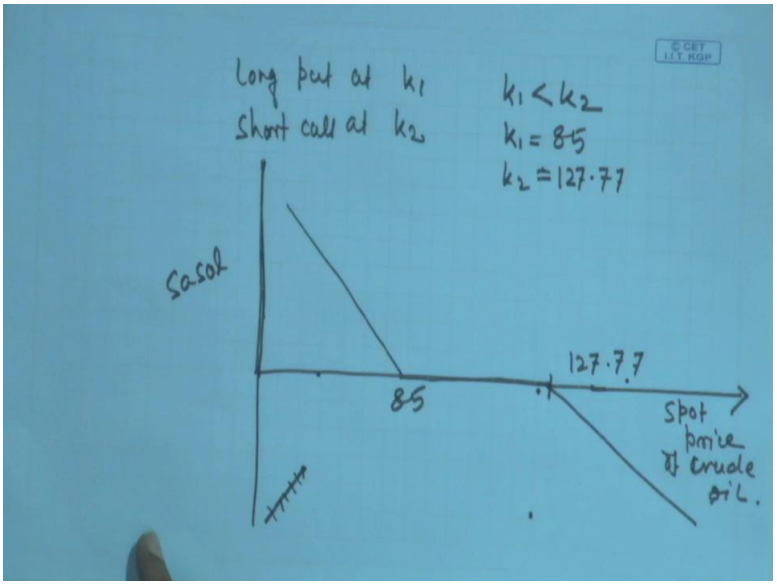

So the payoff is going to look like so this is going to be the let us say you have a long put at K1, short call at the K2 so how does a payoff will look like, payoff will look like and K1 is less than K2, Let us say K1 is in our previous in this case K1 is 85 and K2 127.77. So in that case so it will be the payoff will look like the payoff will look like from Sasol Limited so this is your 85, this is your 127.77.

This is your please ignore this so this is your spot price of crude oil, so any price less than dollar 85, the company is going to benefit from the long put position so without this short call option, it would be this payoff would be like this but with short call option, its payoff is going to be this so if price is a crude oil price is more than 127.77, if it is going to incur loss and if it is crude price is less than 85, it is going to get a benefit from the long put position.

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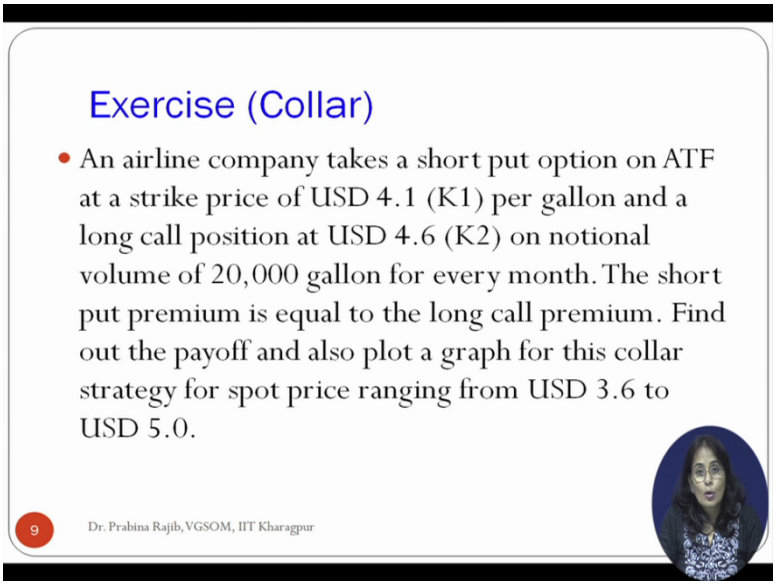

So this is a typical example of a collar strategy by a crude oil producer or the same thing can be extended to let us say a refiner who is producing let us say gasoline or diesel and fearing that price is going to go down. So it can simultaneously enter into a long put position and a short call position and depending upon the negotiated exercise price, the payment will have a similar structure. So this is another exercise I have given to you. You have Airline Company which is fearing that ETF is going go up and it enters into a long call position and simultaneously enters into a short put position so long call position as dollar 4.6 per gallon.

And you have short put position at a exercise of dollar 4.1 per gallon and the notional volume 20000 gallon every month, so you please find out what would be going to be the receipt and payment from this particular collar and this answer to this exercise, I am not going to upload so you please find out, use it in put all these details in excel file and you draw it, you will be able to find out what is going to be the, at what price point variation in the ETF price this company is going to make profit from the long put and going to incur loss from the short call option.

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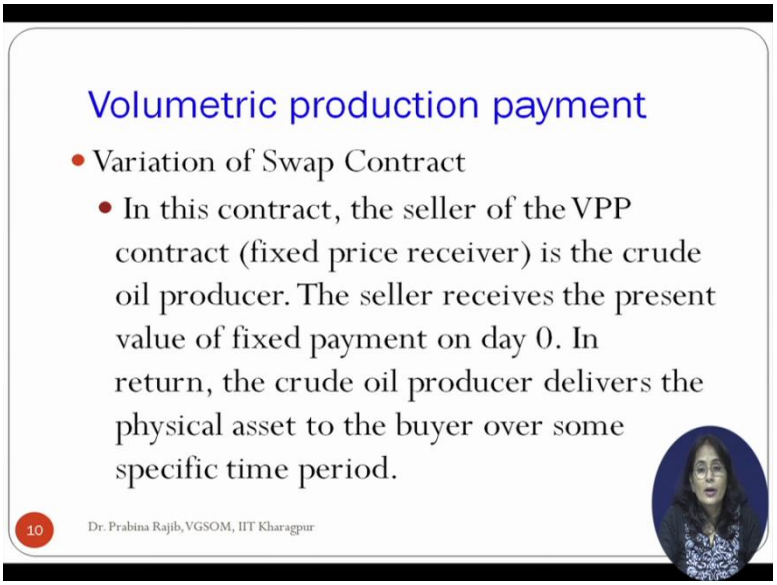

Okay now let us focus on a contract called a volumetric production volumetric production payment contract or VPP contract and this contract is this contract is nothing but a swap contract. In case of a regular swap contract, if you recall the crude oil producer receives the fix payment from every let us say 2 months 2 months 2 months, so if both parties has agreed for a contract of 3 year and payment is made on a payment is made on the notional volume every 2 months, so the payment or receipt happens at the end of every 2 months.

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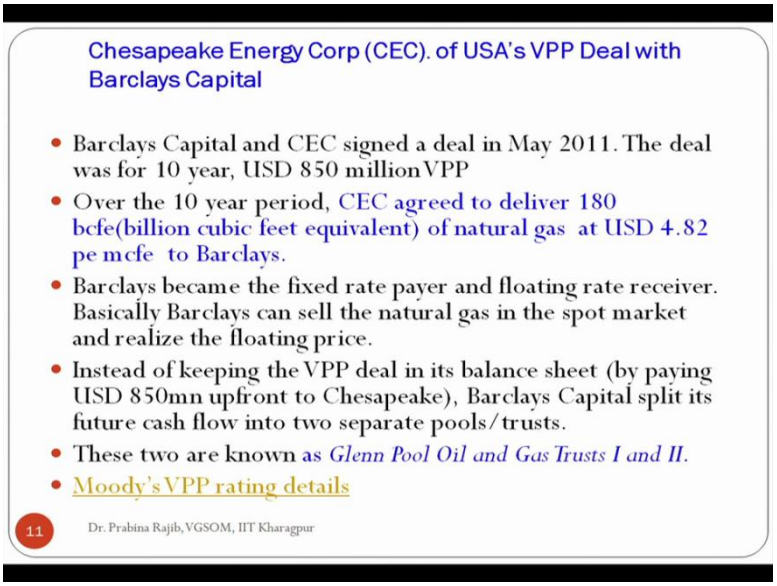

So in case of a volumetric production payment contract, the payment to the fixed party receiver 6 sorry, payment to the fixed price receiver happens at one go that is beginning of the contract, that is the discounted present value of the series of fixed price to be paid to the

counter party, to one counter party is paid by the other counter party. So let me take an example then only this concept will be clear so you have a company called Chesapeake Energy Corporation, CEC of USA which entered into a volumetric production deal with a company called Barclays Capital so Barclays Capital and CEC signed a deal on May 2011. The deal was for 10 years and dollar 815 million VPP so that means what over 10 years CEC agreed to deliver 180 billion cubic feet equivalent of natural gas at dollar 4.82 per million cubic feet equivalent to Barclays.

Barclays is going to pay a fixed amount of dollar 4.82 per dollar 4.82 per every billion cubic feet equivalent and CEC will deliver 180 billion cubic feet equivalent of natural gas to Barclays. So Barclays is going to pay fixed and CEC is going to receive fixed so instead of paying the fixed amount over 10 years, the discounted value of 850 million was given by Barclays to CEC at the beginning of the contract, so Barclays became the fixed rate payer and the floating rate receiver so basically Barclays what as part of the contract, CEC is supposed to deliver the natural gas to Barclays, not the floating rate but deliver the natural gas to Barclays in the spot market and Barclays can sell that natural gas in the in the spot market and realize the prevailing price.

So there is also another interesting dimension to this VPP contract. What Barclays did is that it did not keep this deal in its balance sheet so it paid 850 million up front to CEC and simultaneously, it did not wait for 10 years to receive the benefit from the crude oil sorry natural gas, it is going to receive from CEC so what it did, Barclays Capital split its future cash flow into that means whatever natural gas it is going to receive from CEC, it it issued 2 bonds or 2 pools and the investors who invested in these 2 pools will be getting benefit from the price at which Barclays is going to sell the natural gas. So these 2 pools un were known as Glenn Pool Oil and Gas Trust 1 and 2 and to sell this to debentures or trust to the individuals, this needed to be rated so this is Moody's VPP rating details so this got these 2 instruments got rated by Moody's.

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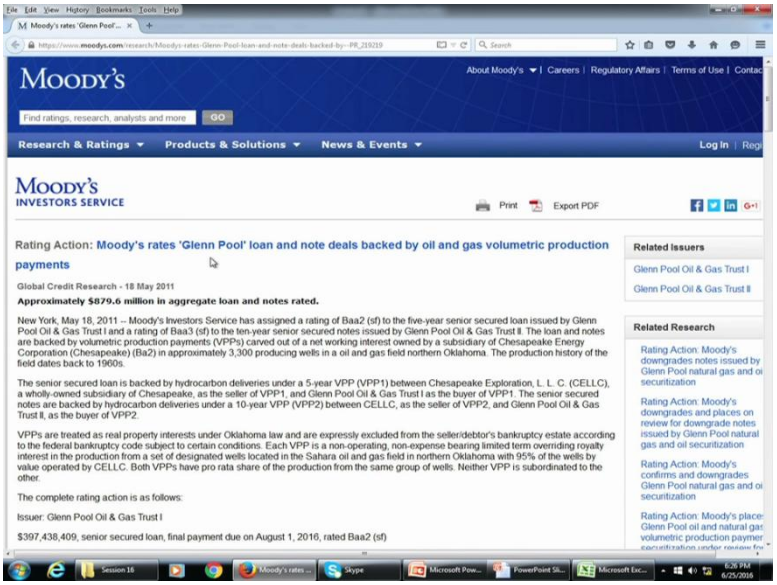

I hope you are able to see the see if you can see the screen rating action. Moody's rate Moody's rates Glenn Pool loan and notes deal backed by oil & gas volumetric production payment, so I do not want to go through this detail at this point of time so you do read this one and it is a very interesting way. The way the whole VPP contract was signed by signed and managed by the by both companies that is your CEC and Barclays Capital. Now, let us go to another interesting dimension of managing refining risk, let us say that is stand alone oil marketing companies are exposed to or stand alone refiners are exposed to price risk on from both sides. That is they are exposed to price risk from the input side as well as the output side.

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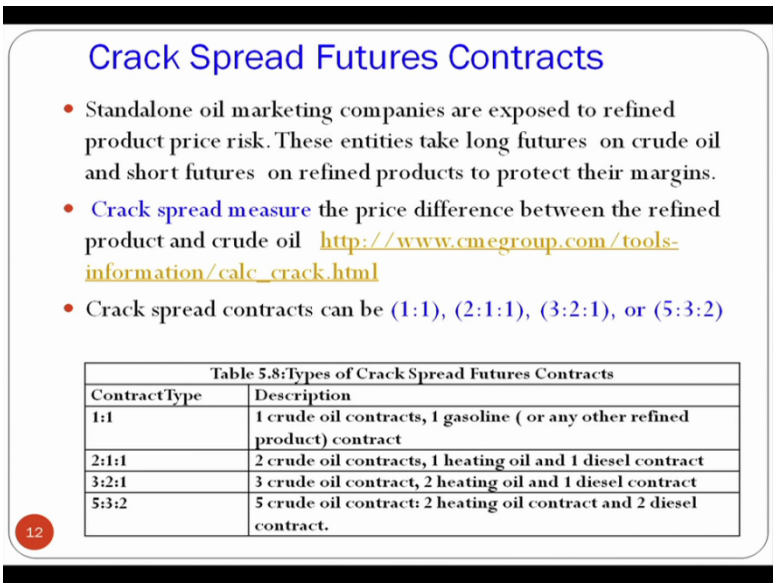

Let us say a refiner who does not produce crude oil and this company, refining company buys crude oil, refines it and sells the refined product in the market. Let us say when it bought crude oil, it it had to pay a higher price and by the time it refines the product and sells it in the market may be crude oil price has gone down so his input cost is higher and its revenue is going to be lesser at this when the refining product price goes down. So this company is exposed to price risk both input as well as output price risk, so how this refining company can mitigate the risk, on a standalone basis, this company would have entered into long futures contract crude oil as well as short futures contract on refined product or it would have taken a long call on crude oil and long put on refined product if the company would have gone for option contract.

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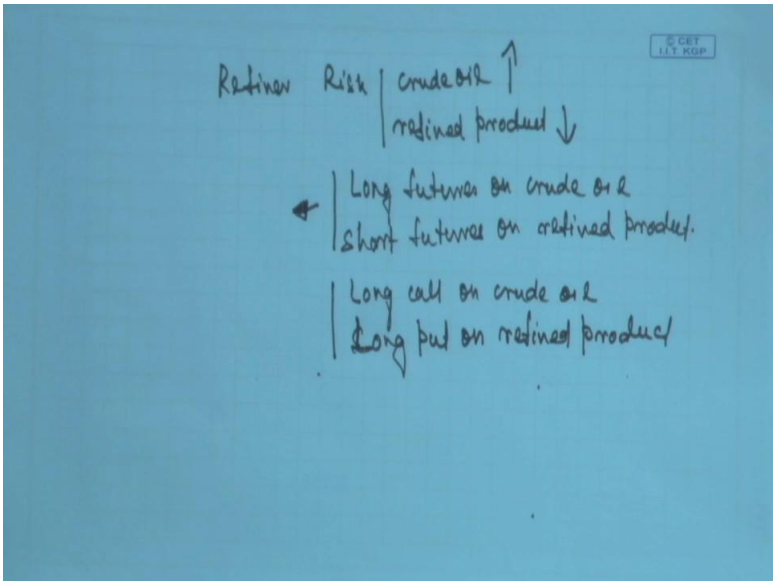

So let me repeat or let me write down a refiner risk is crude oil goes up and refined product price goes down so if this happens, this company, the refiner is going to incur loss so how it can mitigate that risk of it goes for a futures contract, it will be buying long futures on crude oil and a short futures on refined products, whichever refined product it is producing or using option contract, it would be going for long call on crude oil and short sorry long put on long call on crude oil and long put on refined products.

So with respect to this, now exchanges are offering crack spread contracts so that the refiner can enter into 1 contract instead of entering into 2 futures contract so what exactly is a crack spread, let us go and understand this so as the definition is crack spread measures the price difference between the refined product and crude oil product. So if you recall, we discussed when we were discussing about the soybean cross spread, we discussed about the we

discussed about the we discussed about the cross spread, exactly the same concept is applicable when we calculated the crack spread so what exactly is the crack spread, crack spread is the difference between the price of refined product and the crude oil. Let us take what are the different kinds of crack spread contract which is available at CME and how crack spread can be calculated. Just give me a couple of seconds, I hope this link opens.

This link would be taken us to calculate the crack spread. Let me try out. Let me take this link to the sorry let me take this link copied let us see whether it is working otherwise I can okay in the mean time its it seems taking a little longer so let us understand what do we mean by 1 is to 1 crack spread so crack spread contracts can be 1 is to 1 or 2 is to 1 or 3 is to 2 is to 1. Let us see let us take a let us we take 2 is to 1 is to 1 so that contract so how do we calculate the crack spread, let me check whether in case it has come in the mean time, no, it has not so it's still…

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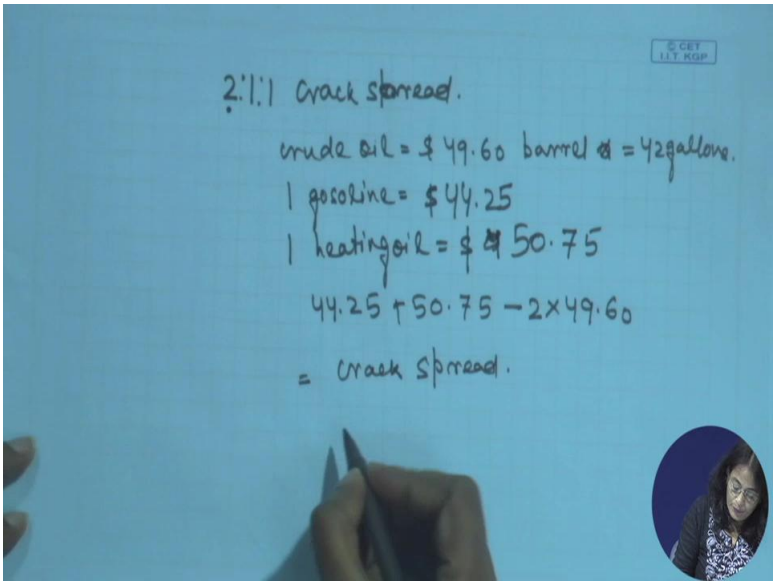

Okay there is some problems with the internet so let us not go into spending time. So let me show you how exactly this crack spread can be calculated so let us go to 2 is to 1 is to 1 crack spread so this how the crack spread can be calculated so if you see it says 2 is to 1 is to 1 means 2 crude oil contract 1 let us say 1 heating oil and 1 diesel contract or 1 gasoline and 1 diesel contract, so how do you calculate the crack spread so you will be so you will have let me give an example so let us say you have a crude oil which is quoting at dollar 49.60 a barrel, which is equivalent to 42 gallons and you have 1 gasoline so the price which is expressed in 42 gallons equivalent is let us say is coming to coming to let us say a gallon, it is coming to let us say 44.25.

And 1 heating oil heating oil contract which is equivalent to 1 equivalent to 42 gallons which is coming to let us say 40 let us say 50.75, so how can we calculate crack spread so it will be 44.25 + 50.75 - 2 into 49.60 so that is going to give us our crack spread.

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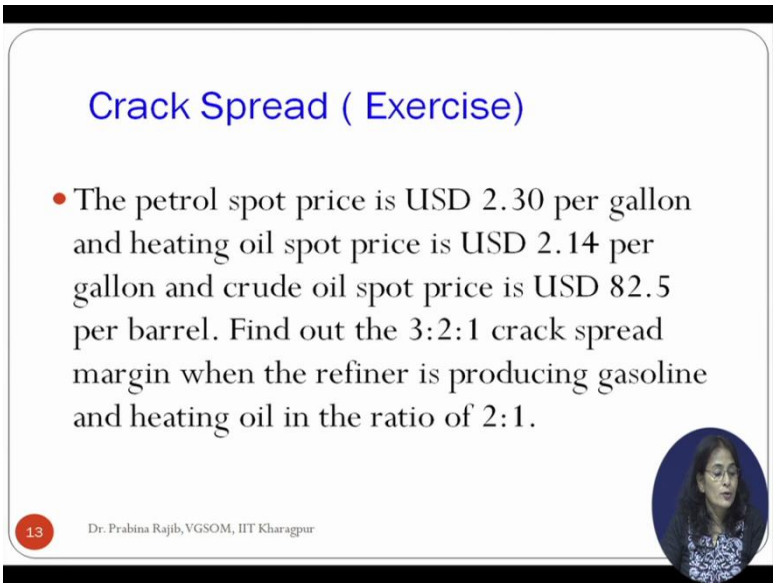

So let us this exercise which is you can work out a petrol spot price is dollar 2.30 per gallon, heating oil spot price is dollar 2.40 per gallon and crude oil spot price is dollar 82.5 per barrel so you will be able to when you are finding out the crack spread so 3 into let me let me write down it will be let us solve this exercise.

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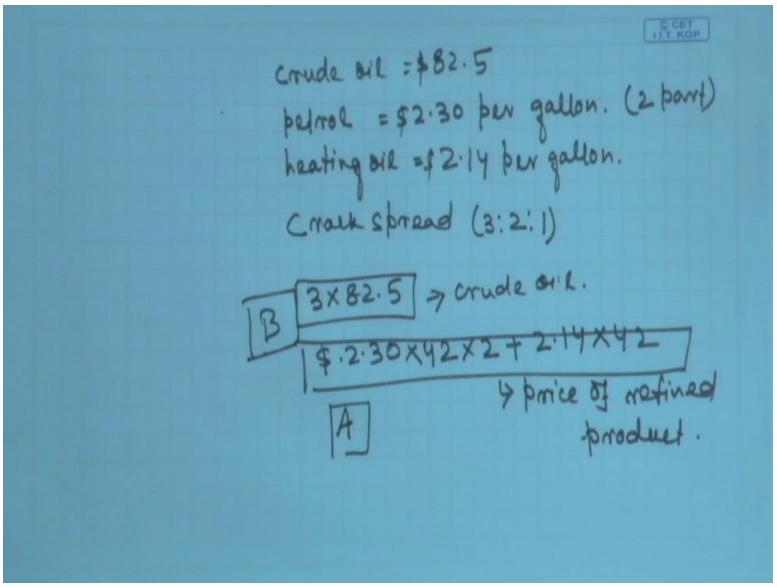

So you have crude oil price is 82.5 and petrol is 2.30 per gallon and heating oil is heating oil is heating oil is 2.14 dollar all these are in dollar terms per gallon so what will be our crack spread? For 3 is to 2 is to 1 so we have our 2 parts of petrol so when we are talking about so 3 into 82.5 is our crude oil so you will have dollar 2.30 into 42 into 2 + 2.14 into 42 is going to be price of the refined products. So let us call it A and this is our B so A - B is going to give us the crack spread.

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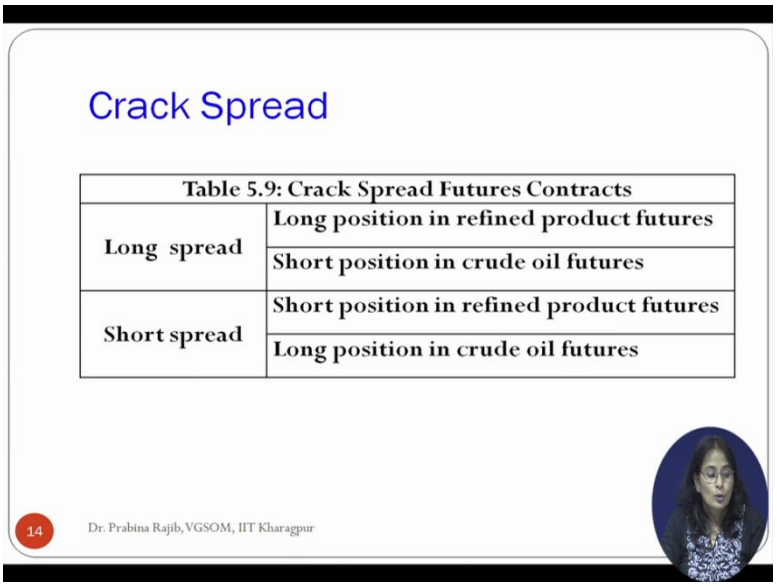

Now, how refiners can use this crack spread futures contract to mitigate the risk so if a refiner is expecting the crack spread to widen, it can enter into the long spread or if it is expecting the crack spread to narrow down, it will enter into a short spread position so in case of a long spread, when you are taking a long position, you are buying a futures you are buying futures contract in refined products and you are selling futures price in the crude oil contract and in case of a short spread, you have a short position in refined product contract refined product futures contract and long position in crude oil futures contract. And as I have mentioned, these contracts crack spread futures contract is not available in Indian exchanges, it is available in Indian exchanges, it is available at US exchange so if you want to learn more about it and how companies are using CME website, you can visit and you can learn more about it.

So with this with this we come to an end on today's session and this is also the session with respect to the crude oil and this particular commodity has taken little longer than the usual what I thought the amount I will be covering. Considering the variety of contracts available and the number of players so I think it is worth discussing this particular commodity in detail

Commodity and commodity derivative contracts with respect to crude oil and refined in detail.

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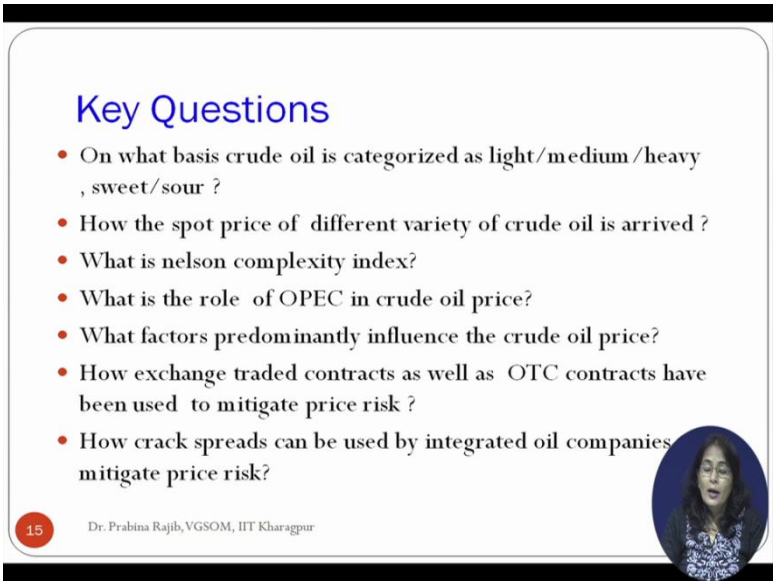

So what are the key questions so without taking much of a time, I am just highlighting what are different key questions at the end of this session which you should be able to answer so I am not going to discuss each and every key question because we do not have time today so I am winding up this session today and in the next session, we will discuss we will start discussing with different derivative contracts with respect to gold price. Thank you all of you and as usual I end all session looking forward to meeting with all of you, thank you all of you.