Commodity Derivatives and Risk Management
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Lecture 26
Hedging of Crude Oil and Refined Product Price Risk (Part 1)

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Ok, welcome to the next session on Commodity Derivatives and Risk Management and we will continue with our discussion on crude oil risk management. I am sure you recall this particular slide in which we had discussed about futures contract specification at crude oil futures contract specification at CME, futures contract specification at MXC, we also spent couple of minutes understanding a data which was published which was given by the multi commodity exchange India when the market was open, and we also discussed about a hedging policies of Indian Airlines in the last session and I also discussed about the survey finding of a understanding by marketers energy advisor with respect to Airline fuel hedging and risk management policies of global major commercial airline companies. Now, today we will be discussing different kinds of risk management strategies which are in generally used by crude oil producers and crude oil refining companies.

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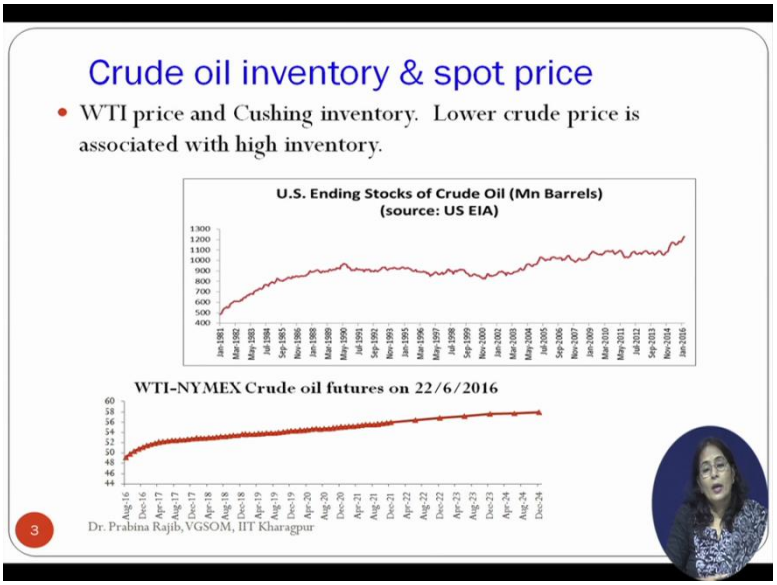

Now let us go to the today's agenda. Ok, I will start this session by asking a question do you think the available inventory has some relations with the Contango and backwardation structure of a commodity. Ok, the answer to my question is many a times we have already discussed, whenever there is a abundant supplier of a particular underlying commodity, that commodity tends to exhibit a Contango market. And we have also discussed in case of a backwardation market, when underlying commodity have commodity has supply constraint or not available enough then the market exhibits backwardation.

So at this point of time if you recall, this is the second graph which is there in front of you that is WTI, NYMEX crude oil futures contract which traded on 22nd June 2016, if you can see the near month contracts are lesser than the far month contracts. So this is a typical structure of a Contango market and the first picture which shows the US ending stock of crude oil and this particular picture this particular graph shows the availability of crude oil in I think 1000 million barrels, it is a million barrels in as per the eh USA eh IA data and I have converted into 1000 million barrels. So if you can see almost by June 2016 that is May 2016, it is at all time high and this panel this picture shows up to January 2016 but actually it is gone up to May 2016.

Now again we are just opposing both these pictures, so we can very well say that whenever there is a abundant supply of a particular underlying commodity, commodity market tends to exhibit Contango. And with respect to this commodity availability in abundant and the commodity market exhibiting Contango, in USA there are lot of Contango trade is

happening, so what do you mean Contango trade, let us go to the next slide to understand more about it.

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So the storage cost and Contango trade is well it is a they have a very clear relationship, so what exactly this relationship indicates that if the cost of crude oil buying crude oil today and storing this crude oil for let us say 6 to 12 months and paying the lease rental for this 6 to 12 months and pay also whatever other attendant fee is required to store this oil for 6 to 12 months and all this cost or fund all this is less than the future price prevailing at this point of time, then may people would be interested to buy the crude oil eh or the underlying commodity in the spot market leas it go to a storage location store these underlying commodity and simultaneously enter into a short futures contract.

So this is this is exactly what a Contango trade is all about, so if you recall in the earlier part of this lecture series we did discuss about the difference between pricing and valuation of commodity forward contracts contract and in that in those sessions I did discuss about cash and carry. Cost of carrying model and when the model deviates from the costs of carry relationship, you have cash and carry arbitress or reverse cash and carry arbitress, so this Contango trade is nothing but a cash and carry arbitress.

So what exactly eh currently people are doing, so they are buying and selling the crude oil and storing it in a storage locations and in USA as per the current information available per barrel per month cost comes around 30 cents and it has got maybe another 5 to 6 cents are required for pumping and insurance etc cost. So all this cost buying and storing and all

attendant cost if it is less than the prevailing futures price than people will be undertaking Contango trade. So how exactly this will happen let us take a numerical example to understand.

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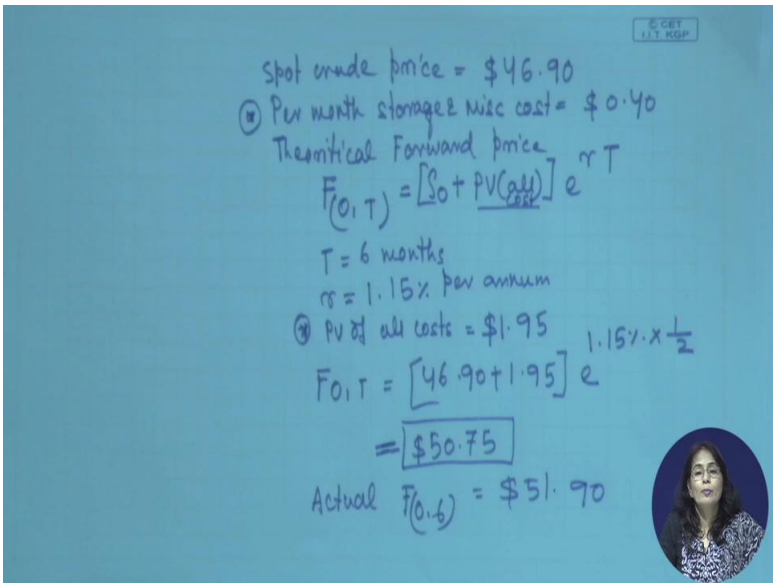

So let us say the spot crude price is let us say per barrel is 46.90 and suppose per month storage and miscellaneous all this comes to let us say 40 cents and let us say if so what should be the theoretical forward price that is F(0, T) if you recall this symbol that is forward price prevailing today for a maturity B with B is 0 spot price + present value of all costs into E to the power R T. Let us say T is equal to 6 months R let us say continuously compounded rate in USA let us we take it as 1.5 percent per annum, so if it is 6 months so let us say the present value of all costs so this storage and so present value of all other costs let us say it is one point let us say 95 dollar. So what should be our F0T? F0T should be 46.90 + 1.95 in to E to the power that is 1.15 percent into 1 by 2.

Let us say that comes to, let say that is coming to our 50.75 dollar let us say. I do not know, I have not done the calculation, so let us assume this is equal to this. Now if 6 month forward contract 6 months futures contract is trading at a price which is let us say actual F06 months as per this Contango graph. So suppose let us say it is quoting at dollar 51.90 then this gives a very clear cut indication to us or any trader for them to buy crude oil and store and simultaneously enter into a short futures contract.

So in fact there is a something very interesting happening at this point of time there is so much of demand for storing crude oil is that the crude oil in USA is that the storage cost is

increasing. So with the increase in storage cost so this benefit is not going to be available to a trader, so how this cost can be mitigated if at all this cost can be mitigated. Of course as and when if new storage tanks have been built then the price leasing price may go down, but it takes time to construct a new storage tanks and the pipeline and all that, so there is a time lap for it.

So in the meantime if the storage cost increases so what a trader will be able to do. So the moment there is any variability in a price obviously we can have a forward or futures contract available for that so you have a contract which is available for trading in at Chicago Mercantile Exchange that is that stands for loop futures contract, so what exactly is a loop futures contract, is the full from of loop is Louisiana Offshore Oil Port Crude oil storage future contract. So if you can see the slide this is let me repeat, loop stands for Louisiana Offshore Oil Port Crude Oil Storage futures contract specification.

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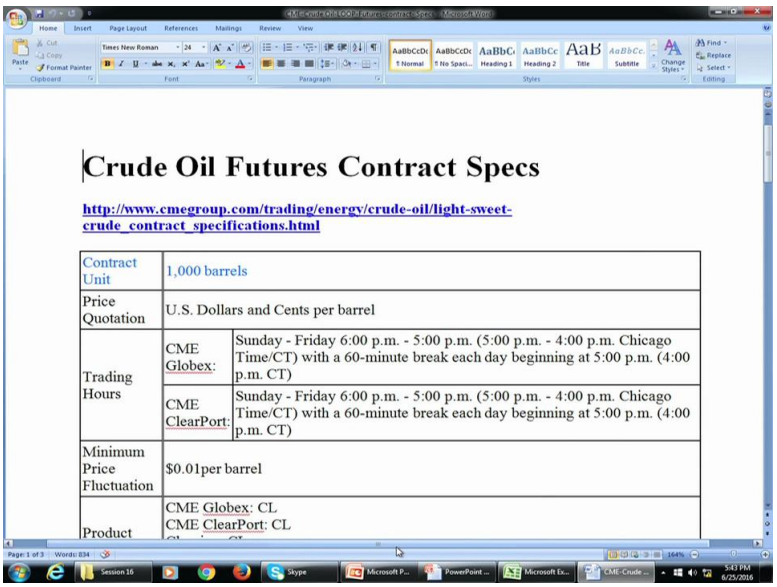

Now let us go to see what is the underlying for this particular futures contract. Let me make it little bigger, so this is traded at CME again I have downloaded this contract specification from the CME website, the link is available and what is contract unit, contract unit is for 1000 barrels but please note the buyer or seller the seller of this particular contract is not going to deliver 1000 barrel of crude oil. Sorry, this is the contract specification loop crude oil storage futures contract specification and this is again downloaded from CME.

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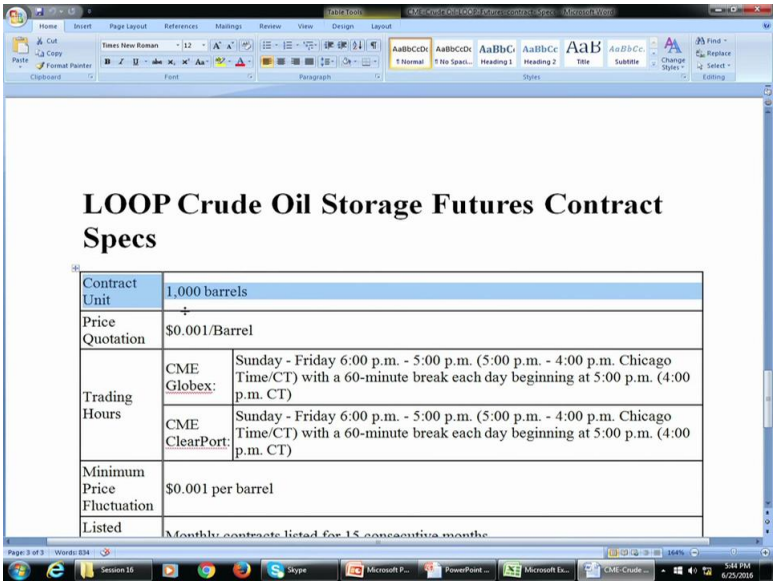

LOOP Crude Oil Storage Futures Contract Specs

Contract Unit	1,000 barrels	
Price Quotation	$0.001/Barrel	
Trading Hours	CME Globex:	Sunday - Friday 6:00 p.m. - 5:00 p.m. (5:00 p.m. - 4:00 p.m. Chicago Time/CT) with a 60-minute break each day beginning at 5:00 p.m. (4:00 p.m. CT)
	CME ClearPort:	Sunday - Friday 6:00 p.m. - 5:00 p.m. (5:00 p.m. - 4:00 p.m. Chicago Time/CT) with a 60-minute break each day beginning at 5:00 p.m. (4:00 p.m. CT)
Minimum Price Fluctuation	$0.001 per barrel	
Listed	Monthly contracts listed for 15 consecutive months	

So please see the contract unit is 1000 barrel but 1000 barrel does not mean that the trader is going to deliver 1000 barrel but what is the delivery what is the underlying to be delivered, please see the last row. The seller shall provide the buyer with capacity allocation contract which allows for the legal right to store crude oil for a calendar month at loop LLC storage facility in Louisiana. So by entering into this futures contract the buyer will have the right to store 1000 barrels of crude oil. So now you have a contract which is available for mitigating crude oil price risk, you have a contract which is available for mitigating your storage rental risk as well as I mean if you have if you have trade in your financial derivative, there is a derivative contracts with respect to interest rate future.

So if you are anticipating that interest rate is going to go up which specifically in the context of USA we are almost every time when whenever Mrs Janet Yellen who is the chairman of federal reserve back she at time submitting the first and foremost question who which is asked to our is that when the in USA interest rate is going to be high. So if US interest rate is high than the profit from the Contango trade will go down, so if somebody is interested to mitigate that risk that trader can also enter into a futures contract on interest rate.

So more about what is the loop card loop what is a loop contract that is available in this link called loop card, so this will be available you I can upload this one for you or it will also be available at the CME, if you just give a search and call loop fact card you will be able to download. So if you are more interested to know how this contract is used to mitigate the risk you can spend some time.

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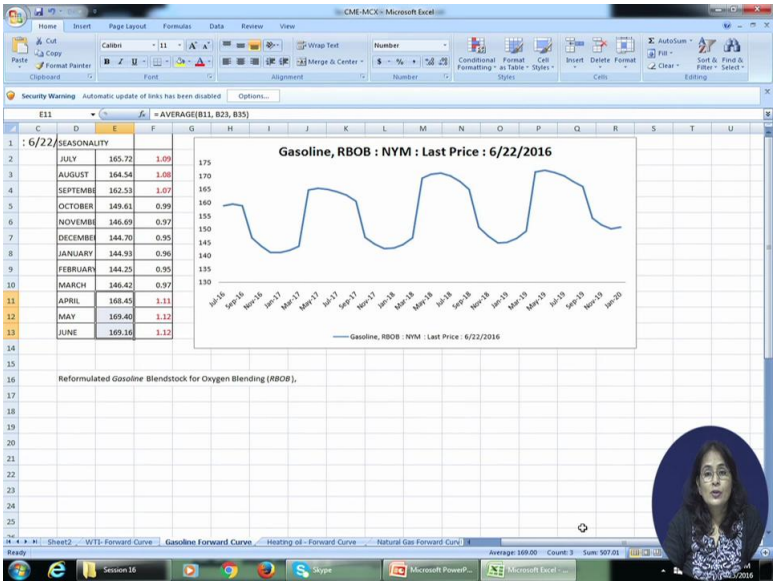

Now remember in the last session I had discussed about the commodity forward curve with a very clear cut seasonality so let me take you to that. Yes, this is the this is commodity forward curve I am talking about, if you can see this is a beautiful curve very eh sequentially at a specific time interval the curve has gone up and it has come down and this is a this is a clear cut example of a commodity forward curve which is influenced by the seasonality and we did discuss in the last class, last session that in the summer months the gasoline price or petrol price increases substantially and during winter months it goes down. Now my question to all of you is that is only seasonality is the only factor for such a substantial difference in summer month and winter month prices or is there anything other than that.

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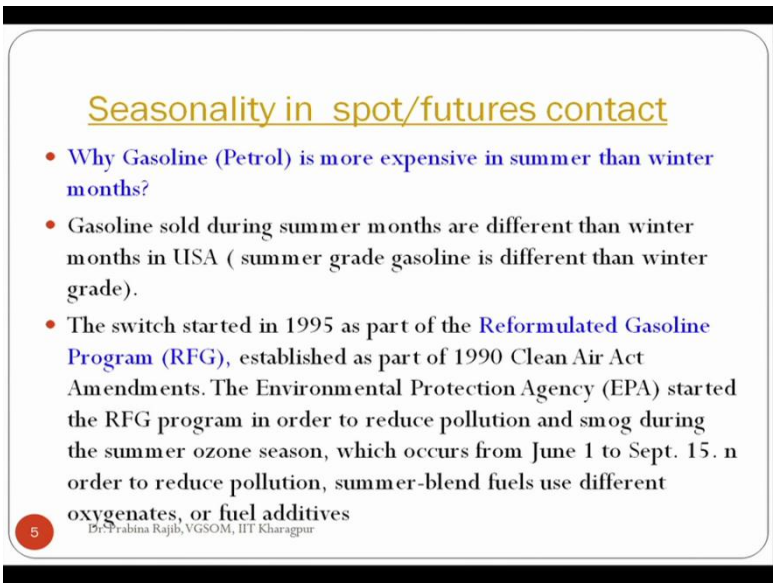

Ok, the answer to my question is there is some other another interesting factor which makes the price difference in the summer months and winter months with respect to gasoline prices in USA significantly different. So what is that reason? Let us go to this particular PPT slide, so you have why am I started this particular slide with this asking this question why gasoline is more expensive summer months than the winter months, of course in USA in summer months many people travel an so that is one of the reason why you have higher demand for gasoline during summer months.

Also another important and interesting factor is the quality of gasoline which is made available during summer months is of greater quality and people have to pay a higher price when they buy this kind of quality petrol. And all filling stations are mandated to keep this better quality petrol in their filling station; so that whoever any traveller or whoever is buying or filling in their cars they will be buying eh they will be filling it with better quality petrol. In fact as you can see as per the 1995 Reformulated Gasoline Program, which was established in the year 1990 clean energy act this act requires the better quality of gasoline to be available during summer months to reduce pollution and smoke and reduce its the impact of carbon emission on ozone layer.

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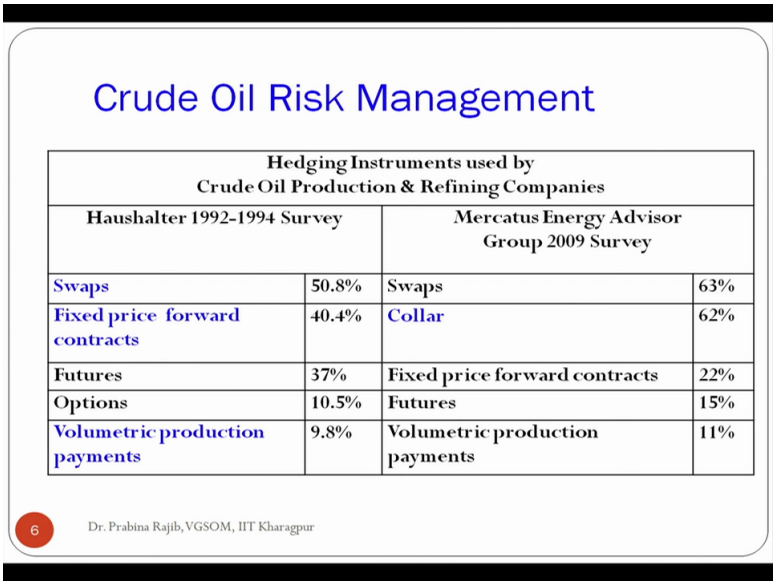

Now let us go to the, ok now let us start discussing about how exactly different hedging instruments have been used by crude oil production company and refining companies to mitigate the price risk. It is a little old survey nevertheless both these surveys indicate how many companies are using what kind of instrument to mitigate the price risk. So if you can see swaps both these survey indicates that commodity swaps contracts have been used by

most of them and followed by fixed price forward contracts you have collars, you have futures options and volumetric production payments. So we have already discussed about futures and options quite a few times, so I am not going to discuss much about it, so today I am going to focus on swaps, fixed price contracts, caller and volumetric production payments.

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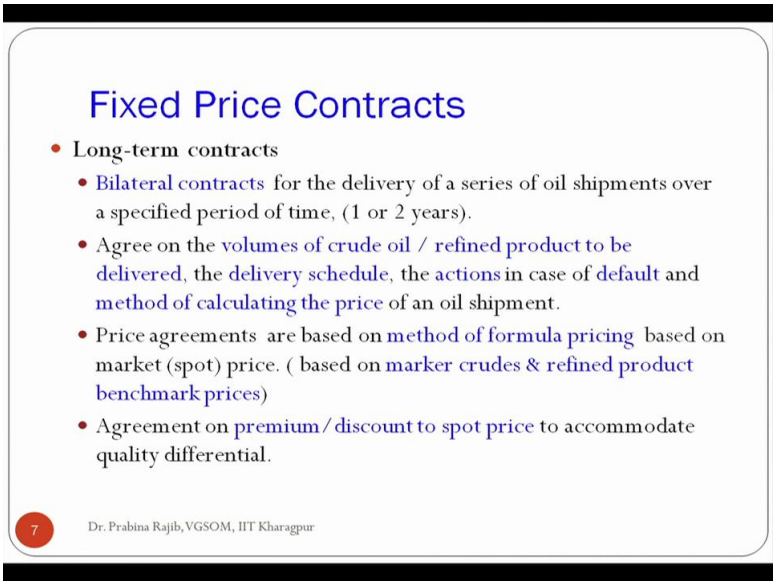

So let us go to swap, so what exactly is a swap? Swap is nothing but a ok let me first explain the fixed price contract and then we will go to the swap. So what exactly is a fixed price contract, fixed price contract is a forward contract, nothing more or less to it other than what we have discussed with respect to forward contracts, so it is a bilateral contract and delivery of crude oil or refine product, so buyers and seller enter into a contract, so delivery schedule, quality, premium, price everything is decided upon and both parties abide by both parties abide by this side of the bargain and the buyers pay money and sellers deliver the crude oil, crude oil or refine products so whatever maybe the agreement.

Now let us go to swaps, so what exactly is a swap? In a swap contact you have two parties which exchange a series of gas float based on a notional quantity of crude oil or refined product and one party pays a fixed price and other party pays a floating price, and what do you mean by the word notional quantity? Notional quantity means the price is exchanged based on this particular quantity, so this notional quantity does not mean that the seller is going to deliver crude oil or refine product for this for this quantity. This quantity is only used for calculating the payment and receipt. Now let us take some example so I will take

some examples to understand more about how swaps work but at this point of time I would like to say that swaps are nothing but series of forward contracts.

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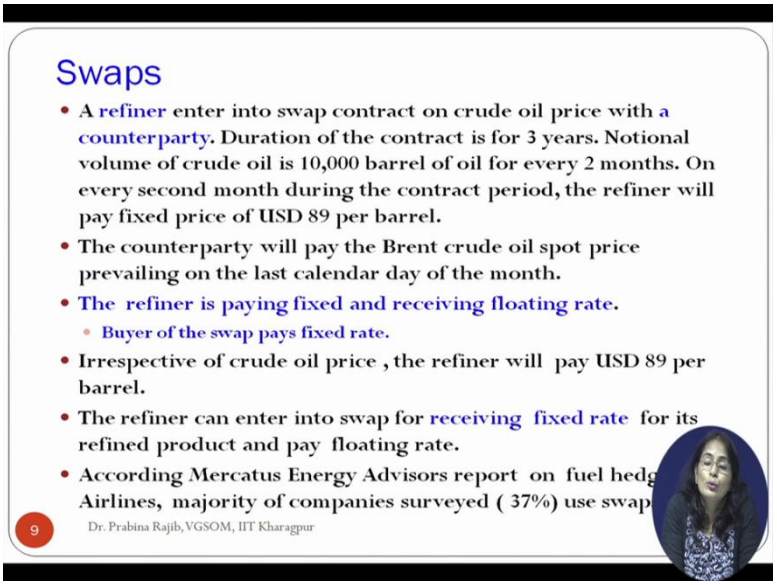

So let us take how exactly this swap will work, so you have a refiner, this particular example a refiner who is buying crude oil the refiners fear is that crude oil price is going to go up if he does not the refiner does not do anything and it is expecting crude oil price is going to go up for some time to come and it requires to if he does not do anything it will end up buying or paying higher prices for its crude oil purchase, so how it will mitigate this risk by entering into a series of forward contracts or swaps.

Let us take this example, so in this example the refiner is enter into the crude swap contract with a counter party and what is the duration of the contract, duration of the contract is for 3 years, notional volume is 10,000 barrel and based on this notional volume of 10,000 barrel, both this refiner and the counter party is going to be making payment every payment or receipt on every 2 months and what is the amount of fixed price which is negotiated upon that is your 89 dollar.

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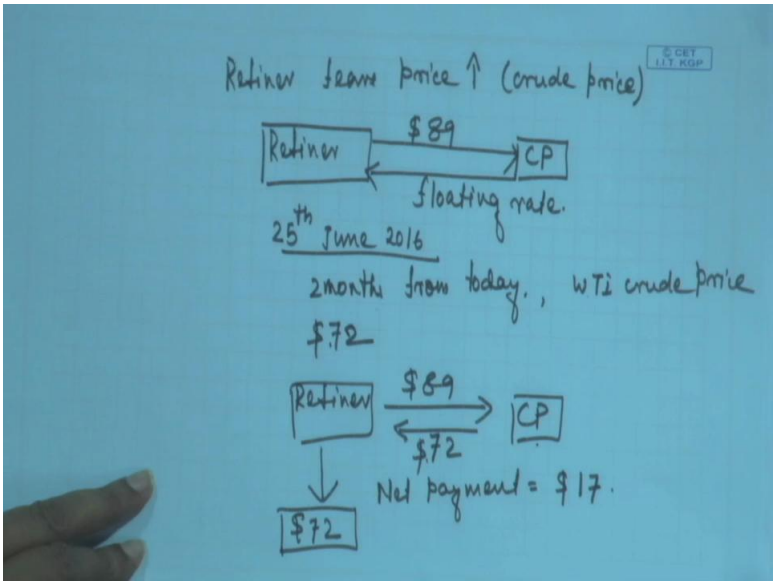

So let us take this example how it will work, let us say you have R you have your refiner here, refiner fears price to go up that is crude price to go up. So how it what it will do? It will enter into a contract with so refiner will be entering into a contract with a counter party, so it could be any so you have a refiner who is entering into a counter party, so refiner will pay fixed 89 dollar and refiner will receive floating rate. So let us take this is the contract which is signed on today so we are on 25th June 2016, so 2 months from today let us say the WTI crude price is let us say 72 dollar, so what will happen?

So 2 months from now refiner will pay 89, will receive 72 which is a floating price, so net payment you have a counter party is here so net payment is going to be so net payment of dollar 17 will be made by the refiner to the counter party and at the end of the 2 months, so 17 dollar into 10,000 so 170000 dollar will be paid by the refiner to the counter party and anyway refiner is going to buy crude oil at 72 dollar from the open market, however he will be paying additional 70 dollar in the 2 counter party, so his net payment is going to be 89 rupees.

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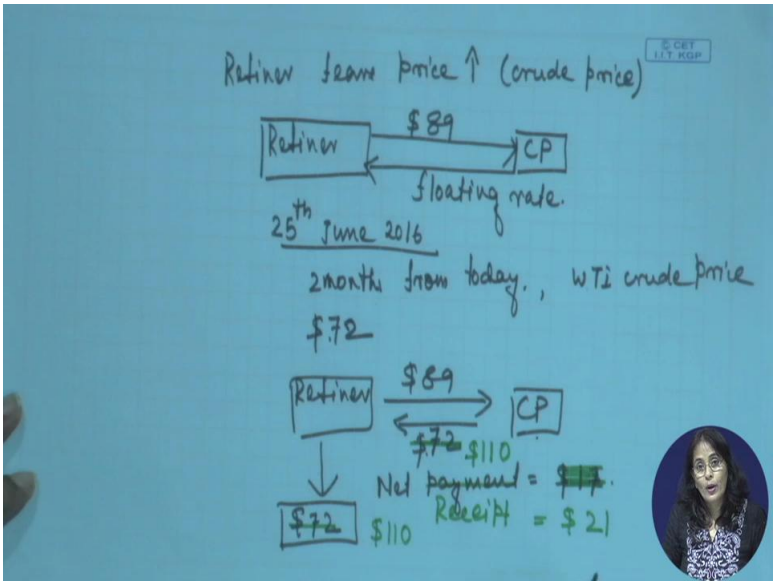

Let us take the other situation, instead of 89 let us make it instead of 72 let us make it this price would be this price would be let us say 110 dollar and the fear of the refiner comes to true come he is anticipating he was anticipating crude oil price to go up and it has gone up to 110 dollar. So in that case refiner will be buying crude oil no more at 72, 2 months from today, so he will be buying at 110 and in that case he will be paying 89 and he will be receiving 110, so it will not be net payment, it will be net received, net received to the tune of 21 dollar.

So the refiner is going to get a net receipt of 21 dollar, he will be buying crude oil from the spot market at a higher price, so a 110 dollar he will pay has simultaneously he will be receiving 21 dollar from the counter party and incurring a net payment of 89 dollar for its crude oil purchase. So irrespective of what happens to the crude oil price, during the coming 3 years, this party is going to pay on an average this party is going to pay 89 dollar for its crude oil purchase. So this kind every 2 months 2 months depending upon the prevailing spot price WTI spot price the payment it can the party can be a net receiver of from the swap contract or net payer from the swap contract. Let us quickly I will give an example, so let us go to this is a refiner but what will happen to a crude oil producer?

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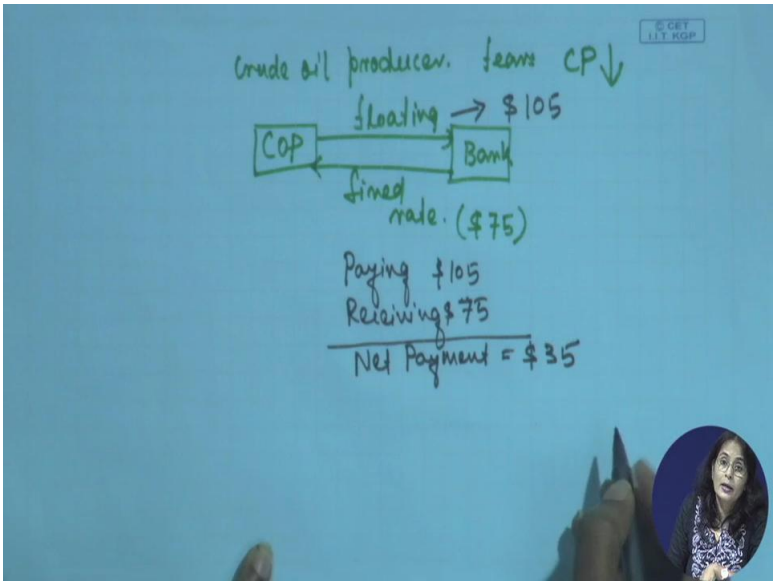

Crude oil producer fears crude oil price decline, he is fearing crude oil price decline so how he will mitigate that risk, so let me COP and certain engage crude oil producer, he will be entering into a let us say a counter party who is a bank and in that case, the crude oil producer a will pay floating rate and will receive fixed rate. So by receiving fixed rate irrespective of whatever is happening to the crude oil price this crude oil producer is sure of getting the negotiated fixed price.

Let us take an example quickly, let us take fixed price is let us say dollar 75. So let us take the example suppose floating rate increases to, so 2 months down the line this floating rate is 105 without this contract this particular crude oil producer would be selling this his crude oil produce at 105 so he will be receiving 75, he will be paying 105, so his net receipt is so he will be paying dollar 105 he will be receiving 75 dollar, so his net receipt is or net payment in this case, net payment is dollar 35. So he will be selling crude oil at a higher price 105 dollar per barrel but he will be also making 35 dollar payment to the bank, so his net receipt for every barrel of crude oil it will be selling it will come to 75 dollar.

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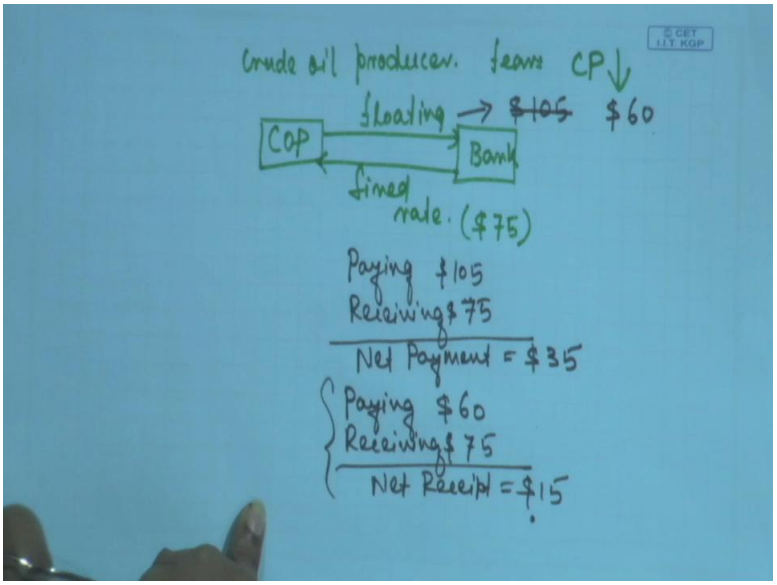

Now let us take instead of 105 let us make this one to be some other price let us make it dollar 60. So he will be paying dollar 60 he will be receiving dollar 70, so his net receipt is dollar 15. So in that case the company will be selling crude oil at 60 that is his fear has come true he was expecting the crude oil price to go down and his fear has come true, he will be selling crude oil at dollar 60 but he will be receiving 15 dollar from the bank as part of the swap agreement resulting in 75 dollar of receipt for every barrel of crude oil.

So this is a typical example of swap contract which a crude oil producer or a refiner a crude oil producer or a crude oil consumer will be taking and if you recall the refiner is paying fixed so he is a buyer of the swap contract and in this case the producer is paying floating, it is a seller of the swap contract. So with this we will be winding up this session we will be discussing about the other derivative contract such as caller and volumetric production payment contracts in the next session and looking for to meeting you all during the next session, thank you all of you.