Commodity Derivatives and Risk Management
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Week-10
Lecture 47
Weather Derivatives (cont.....)

Welcome to the 47th lecture on Commodity Derivatives and Risk Management. In this session we will continue with the discussion related to weather derivatives contract. And please remember in the previous session, we had discussed weather insurance contracts as well as weather derivative contracts. And with respect to weather insurance and weather derivative contract, there is a significant difference. Weather insurance contract helps a company in mitigating low probability and high-risk events. While weather derivative contracts help companies in mitigating high probability, but low risk events. We also discussed how Chicago Mercantile Exchange offers contracts on heating degree days and cooling degree days. And how the heating degree days value and cooling degree days value for a particular day or a particular week or a particular month can be calculated. And based on these HDD or CDD values, the futures contracts are available at Chicago Mercantile Exchange for companies to enter into this futures contract. Now, let us understand how exactly companies will be able to utilize this contract to mitigate the risk. Now, let us go to the concept related to the cooling degree days. And a week 1 the cooling degree days value for that week is 50 and cooling degree days value for week 2 is going to be16. And we calculate the CDD value based on this formula, which is max of 0 minus Ti, Ti stands for the average temperature for a given day minus the base temperature. And the base temperature as per the CME contract is 65-degree Fahrenheit. So, based on this particular formula we can see that week 1 CDD value is 50 while the week 2CDD value is going to be 16. Now, let us say during February 2023 an ice cream chain which is fearing that summer may not be hot enough for people to eat ice cream. Please note that in the summer months CDD contracts will be available. So, this particular ice cream chain is fearing that the summer month may not be hot enough or it fears that the summer is going to be mild summer. In fact, the ice cream companies fear is week 2 happening as compared to week 1. So, in the case of week 2, the month is a mild summer hence you have a CDD value of 16. Days have lesser temperature as compared to the first week, first week have a higher temperature and the in case of a second week the temperatures have gone down and hence the CDD value is lesser. So, week 2 or the happening of the week 2 is the risk which the ice cream company is fearing. Now how the company will be able to mitigate the risk? This company will be able to mitigate the risk by entering into a short futures contract on the CDD for the month of May 2023. Now let us see May 2023 contract is trading at 240. So, the value of

the May 2023 CDD futures contract as traded in February 2023 is 240. Now the contract will be expiring on the last calendar day of May 2023. So, on the expiry date so, let us say the CDD monthly value for May 2023 is 180 which is the fear of the ice cream company. The ice cream company was fearing that the summer is going to be milder, and people may not eat enough ice cream. In that case it will be incurring less revenue, or it will be generating less revenue. So, in that case because it has entered into a short futures contract and the same contract closed at a price which is less than the negotiated price of 240. So, 240 to 180 and every contract is equal to 20rupees. So, the total benefit this particular person is going to, or this ice cream company is going to get will be 1200 rupees on one contract. Similarly, let us go to the other option instead of CDD going down to 180 from 240 let us say the CDD increased to 270 basically the summer is quite hotter hence the cooling degree days value have gone up in that case this particular company will be paying 600 rupees to the counterparty. So, in this case this company had taken short futures position the counterparty will be the counterparty must have taken the long futures position. So, the concept related to the long and short futures position we have discussed many times the concept remains same only thing the underlying contract changes and, in this case, the underlying contract is the CDD value for the whole of the month of 2023 or month of May 2023. Now, let us go to the other situation let us say during April 2023 a movie hall operator is fearing that the summer may be too hot for people to venture out to come to see movies. Please note that in the previous case the ice cream chain operator was fearing that summer is not going to be hot enough milder summer was a fear for that particular company, but in this case the other side of the story is unfolding in the sense the movie hall operator is fearing that the summer may be too hot for people to venture out of the home to see movies. So, fears a very hot summer and lose business if CDD values are high. So, as we discussed 50 is the week 1 CDD value and 16 is the week 2 CDD value. In the previous case week 2 was a fear for the ice cream company, in this case week 1 is a fear for the movie hall operator company. So, to mitigate the risk it will enter into the long futures contract on cooling degree day contracts. So, standing on April 2023 let us say it is entering into a long futures contract for May 2023 which is at a future price of 300. Now on the contract expiry date that is on your 30th May 2023 let us say the CDD monthly values closes at 360 and in that sense its fear has come true, summer has become much hotter and hence it should receive money from the counter party. So, basically it would be receiving 20 into 60 that is 1200 dollars from the counter party which is in this case it will be a short future please ignore there is a mistake here the counter party will take a short futures position because the movie hall operator has taken a long futures position. Similarly, let us say instead of the CDD value closing at 360 let us say the CDD value closes at 250 in that case this particular party that is the movie hall operator will be paying will be paying about 1000 dollars to the counter party. So, this is an example of how futures contract on CDD will be used to mitigate risk associated with the loss of business volume because of the fluctuation in temperature.

Please note that these are not catastrophic change in the temperature these are changes in the temperature happening which may happen for whatever may be the reason these are not very significant change, but this mild change in temperature may lead to loss in business volume and hence this futures contract will be able to help companies to mitigate the loss in business volume. Now, coming to the heating degree day contract or HDD contract please note that HDD contracts are applicable for the month of winter months. So, it is not applicable, or it is not available for trading in the summer months. So, a day will be treated as a heating degree day if people would like to start their heating appliances to keep their home to make their home warmer. So, in this context let us understand which week is going to be what is the HDD value for 2 weeks. So, we have compared week 1 and week 2 and please note that the formula for the HDD is little different as compared to the CDD formula. So, the HDD formula is max of 0 minus base temperature minus daily average temperature. So, let us say in a week 1 different average temperature for Monday to Sunday is given and we calculated the CDD value. In this case the week 1 CDD value is 33 and similarly for week 2 the CDD value is going to be 71. So, as you can see the CDD value for week 2 is 71 while the CDD value for week 1 is 33 and the CDD value for week 2 is much higher compared to the CDD value for week 1. So, week 2 is a much cooler week as compared to week 1. So, now let us understand how different companies will be utilizing these contracts to mitigate the risk. Now let us say a natural gas distribution company is fearing milder winter. So, if winter is not cold enough that is the fear for the company because natural gas is used for heating homes residential complexes and commercial complexes. So, if winter is not colder than it will not be able to sell large amounts of natural gas. If winter is colder this company does good business. Now let us say in August 2023 the company is fearing that the month of November 2023 is going to be mild cold month. That means it will not be able to sell large quantities of natural gas. Now to mitigate that risk it will enter into a short futures position in cooling degree days contract. Let us say it is taking futures position at 120. Now on the contract expiry that is the end of November 2023 let us say the actual HDD value for the month of November 2023 is 90. Now it is because the week because this particular month is not cold enough that means, it is it is not able to sell large quantity of natural gas. Hence it will be receiving about 600 dollars from the counterparty. Now let us come to the next situation where the actual HDD value is 200. So, actual HDD value 200 means significant amount of a cold has happened. So, that is the reason why the CDD value for the whole week has gone up to 120. In that case it will be paying about 1600 dollars to the counterparty. So, let me repeat in the second situation the actual HDD value would be 200. Hence it will be it will be paying about 1600 dollars to the counterparty. So, this is one example of how HDD that is heating degree day contracts are used by a natural gas distribution company. Now, let us come to the next company let us say a Zoo owner. This Zoo owner fears that the colder winter will prevent parents to bring kids to visit Jew during the winter vacation period. So, if winter is milder the company does good

business, if winter is too severe the company loses the business. Please note in the previous case the natural gas company does good business if the winter is severe. In this case the Zoo owner will be losing business if the winter is severe. So, let us say in August 2023 the company is fearing that the month of December 2023 is going to be very cold, and it will not attract enough parents and kids to the Jew. So, it will be entering into the long futures contract on heating degree days for the month of December 2023 let us say at a price of 150. Now, on the contract expiry that is the end of 2023 let us say the actual HDD value for the month is 190. That means, the month of December is really cold hence it receives about 800 dollars from the counter party. So, we are calculating 18800 dollars, that is 190 minus 150 which is your 40 into every contract is worth 20 dollars. So, that is equivalent to 800 dollars from the counter party. If the reverse happens let us say if the actual HDD value is 100 it will pay about 1000 dollars to the counter party. So, this is also an example of how one particular company will be utilizing the heating degree day futures contract to mitigate the business risk. Now, coming to again another example let us say a woolen garment manufacture which fears the milder winter. So, the woolen garment manufacture will be very happy if winter is very cold, and it does good business. Now, let us say in August 2023 the company is fearing that the month of December 2023 is going to be milder in the sense it will be less cold month. So, obviously, takes short futures contract at heating degree days value of 120 and depending upon what exactly the HDD value it will either pay money, or it will receive money from the counter party. Now, let us understand some more interesting aspects related to HDD and CDD contracts. Please note that this heating degree day or cooling degree day contracts are available for a city. It is a location specific or a city specific. As you can see the CME offers HDD and CDD contracts for different cities in the USA as well as many important cities in the world. For example, CME offers a contract on Atlanta monthly HDD or CDD futures contract or for that matter it has contracts for Chicago and Houston monthly HDD and CDD futures contract. And for international cities it has HDD and CDD contracts for Amsterdam, London, Paris futures contract on these three cities are available. And when we are talking about whether a particular day is going to be a heating degree day or cooling degree day, the temperature will be measured by a independent party. Chicago Mercantile Exchange does not have any role to measure and report the actual temperature. So, please note that the temperature of a particular city is reported from a specific automated weather station. So, these automated weather stations are installed at different locations, mostly international airports. And airports these automated weather stations are installed the daily temperature daily high daily low temperature is recorded from these automated weather stations. And that particular temperature is compared with the base temperature of base temperature of 65-degree Fahrenheit to decide whether a particular date is going to be an HDD day or a CDD day. And similarly in the way this automated weather stations are installed in airports across USA, the foreign cities also this automated weather stations are installed at Amsterdam,

Sifol airport at Netherlands, London at Heathrow airport at UK and Orly airport at Paris. And this the weather or the weather station at these locations the temperature is major to decide whether a particular day is going to be an HDD or CDD day for Amsterdam, London and Paris. But one interesting thing I would like to also highlight here is that for these three cities which are not part of the US, that is Amsterdam, London and Paris, the base temperature is major as 18 degrees centigrade. In the case of the USA the base temperature is 65-degree Fahrenheit for London, Amsterdam and Paris the base temperature is 18 degrees centigrade. And the rest of the concept remains the same HDD for a given city on a given day would be max of 0 minus base temperature minus the actual temperature. And in the case of London, Paris and Amsterdam this base temperature is going to be 18 degrees centigrade. And also, please note that a particular company which will be entering into a CDD or HDD contract will depend its decision based on where it is doing business. Suppose for example, if a particular company has a business in Chicago, it will be entering into the HDD or CDD contract related to Chicago and not for any other location or the city. So, by default the liquidity in this HDD and CDD contracts are low as compared to let us say single futures contract on WTI crude. Please note that in the case of a WTI crude there is only one futures contract, but for a temperature contract in the USA there could be 30 to 40 major cities in which temperature contracts are available. Hence the liquidity will always be less or fragmented in the case of a temperature contract as compared to a standalone single commodity contract. Now in addition to the HDD and CDD contracts, CME also offers seasonal strip HDD or CDD futures contract. So, what exactly is a seasonal strip HDD or CDD futures contract? So, suppose if a company is fearing that winter is going to be milder in general, it is not a specific month in a winter, but suppose this particular company is fearing that winter is going to be milder in general it may take an HDD strip futures contract. In that case, please note that the HDD contracts heating degree day contracts are available for November, December, January, February, March 5 months in a year. So, the sum total of HDD value for November to March will be known as the seasonal strip HDD values. So, if a particular company is fearing milder winters, it will be entering into a futures contract for all 5 months rather than entering into an individual month futures contract. Similarly, CME also offers another contract which is known as a CAT contract or cumulative average temperature contract. So, the CAT contract is little different than the HDD or CDD contract in the way it is calculated. Please note that the CAT for a given day is the average of 24-hour contracts. So, the automated weather station will be capturing the temperature at every hour and the average of that particular 24-hour data is going to be the CAT for a given day. Similarly, CAT for a given month is going to be the sum total of the number of days in a given month and CAT for a given day. Now let us say how a particular trader will be able to utilize this CAT contract to mitigate the risk. Let us say for example, for the month of June 2023 CAT value for the New York is going to be the sum total of the CAT values for the 30 days. So, let us say on 10th May 2023 a trader

took short futures for June 2023 New York CAT futures contract at 2550. So, the trader took the short futures contract the underlying is CAT and the location is New York or city is New York and the month is June 2023. So, the futures value it took it at 2550. Let us say the actual value for the June 2023 CAT contract for New York is 2480. So, obviously, he has taken the short futures contract and this contract closed at a lesser value of 2480. So, the trader would receive about 1400 dollars which is 20 dollars into the difference between that is 2550 minus 2480. In the other way let us say the actual value of the CAT is 2650. So, the daily average temperature for the month of June 2023 is higher than 2550. Obviously, the trader would be paying 1100 US dollars to the counter party and the calculation is mentioned here. So, as we discussed, the CAT contract does not have any reference to the base temperature CAT value derives or CAT for a given day derives its value from the average of 24-hour temperatures. With this we will come to an end of discussion on the temperature contract or strip contracts and cumulative average contracts. We will be discussing more interesting aspects of snowfall, rainfall and other contracts in the next session.