Commodity Derivatives and Risk Management
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Week-04
Lecture 18
Hedge Effectiveness, Cross Hedge, Stack & Roll Vs. Strip Hedge

Welcome to the 18th lecture on Commodity Derivatives and Risk Management. And today we are going to discuss 3 to 4 related yet different concepts these are Hedge Effectiveness, Cross Hedge, Stack and Roll Hedge versus Strip Hedge. Now let us understand what you mean by hedge effectiveness. Hedge effectiveness is a measure which quantifies how much of price volatility or price risk of the underlying commodity is diminished when one uses futures contract to hedge. In the previous sessions we have discussed an umpteen number of times how commodity producers, consumers who are exposed to price risk undertake risk management strategy by buying or selling futures contract.

Now is there a way or major which measures the effectiveness of the strategy and this hedge effectiveness is the quantifiable major through which we can judge whether the hedge has been effective or not. And hedge effectiveness is a ratio as you can see the numerator of the ratio is variance of the unhedged portfolio minus the variance of the hedged portfolio divided by the variance of the unhedged portfolio. And why are we ah subtracting the variance of an unhedged portfolio? It is expected that after hedging the risk or the variance associated with the portfolio ah will be going down. Hence the hedge effectiveness is major through the you know in the numerator we have unhedged portfolio variance minus the variance of hedged portfolio divided by the variance of unhedged portfolio.

And as you can see the same formula has been represented as 1 minus the variance of hedged portfolio divided by variance of on hedged portfolio. Now let us take the numerical example. This particular right-side table shows the calculation of the hedge effectiveness, but before we proceed to the actual data from the turmeric futures contract. Let us understand a hypothetical situation where we have an unhedged portfolio and 4 combinations of the hedged portfolio. Let us say we have a commodity A the variance of unhedged portfolio is 20, but when we are creating a future as well as a spot position that hedge portfolio variance is also 20.

So, even after hedging there is no reduction in the variance of the portfolio, hence your hedge effectiveness becomes 0. Similarly, let us go to another ah case where the portfolio variance is 20, but after entering into futures contract the variance of the portfolio is 10.

Hence your hedge effectiveness is 0.5 as you can see, as the variance of hedge portfolio goes down your hedge effectiveness is increasing. Now let us go to the actual data.

This is the data, shows for the futures contract as well as the spot contract for turmeric. And as you can see over these 25 days the spot price is varying and the variance of the spot price is coming to your 64138. Now when a hedger is going to hedge the risk that hedger will be entering into a short futures position because the hedger is long on turmeric. The farmer who owns turmeric fears that price is going to go down, hence it will be entering into the short futures. Now how many units of short futures the farmer will be entering that is governed by the edge which is your 0.35 or 35 percent. And that h comes from the minimum variance hedge ratio which we discussed in the previous session in greater detail. Hence the earn hedge portfolio when we are talking about the earn hedge portfolio this spot is our earn hedge portfolio. And the portfolio earn hedge portfolio risk is basically the standard deviation or a variance here that is coming to your 64,138. And the hedge portfolio which is a combination of a spot position as well as h units of futures position that particular portfolio risk is 34,555 and going by this formula, we can calculate the hedge effectiveness is a 46 percent.

Now how do we make any judgment or understand about the hedge effectiveness? A hedger should try to you know identify that many units of that many units of h such that the hedge effectiveness is the highest. So, with this let us go to the next concept called cross next concept called a cross hedge. So, what do we mean by cross hedge? In the case of a cross hedge, the hedger takes futures position in a different commodity which is positively related to the underlying commodity of the hedger. Now let us take an example suppose a farmer Indian farmer would like to hedge the spot price position of a ragi or finger millet. I have taken this particular image from Amazon.in the image source. So, this is an example of a this is a image of the finger millet or which is popularly known as Ragi. Now the farmer is exposed to the price risk the farmer produce farmer is producing Ragi. Now Ragi futures contract is not available in the in a commodity exchanges. So, how the farmer will be able to mitigate that risk? Now available futures contract which are comparable kind of a commodities futures contract on rice, bajra and wheat are available in NCDEX for trading.

Now which one the farmer will choose because it wants to hedge the risk and it will choose that particular commodity which will have a highest positive correlation with the Ragi prices. So, if a futures contract in the underlying commodity is not available then the farmer or the person who is interested to take a hedging position or a futures position that particular person or a trader has to identify another commodity which will have a very strong positive correlation with the commodity it wants to hedge. So, based on the analysis, let us assume that wheat has the maximum correlation. So, the farmer will choose to hedge the price risk of Ragi with the wheat future. Now as you can see, cross hedge farmers are also exposed to basis risk.

In fact, in the case of a cross hedge the farmers farmer is exposed to a greater amount of basis risk we will be understanding what you mean by a higher or a greater amount of the basis risk. Before we go to the discussion related to large larger amount of basis risk these are some of the notations which we have of used in you know quite a few times without you know spending lot of time I would like to just quickly take you through S_0 is the spot price of the underlying commodity and F_0 is the future price of F_{0t}, F_0 wheat is the future price of the wheat on the contract initiation date or the spot date. Similarly, we have S_t wheat, S_t ragi, F_t wheat, and B_t, B_0 are your basis values this this this concepts we have discussed in a greater detail let us move on to the calculation of the actual you know actual receipt a farmer is going to get when he is hedging the risk of the ragi with the wheat futures contract. And there is a nice article by the Chicago Mercantile Exchange on cross-hedge effectiveness on agricultural commodities, the web link is given here, again I would urge each of you to spend some time going through this article to understand more on cross hedge effectiveness. Now coming to our cross hedge and basis risk associated with the ragi price please note that the farmer is going to sell ragi on the day t and farmer is going to receive some amount and what is that amount farmer is going to receive the spot price prevailing for ragi on the contract closure date hence the word small t.

In addition to that the farmer is also going to get the price difference between the future price of wheat on the contract initiation date and the future price prevailing on the contract closure date. And this particular first equation can be rewritten by adding spot price of wheat minus spot price of wheat. So, when we are adding the same adding one unit as well as subtracting the same unit. So, this equation remains unchanged. However, when we are re you know organizing this particular equation, we can reorganize this equation as F_{0t} F_0 wheat that is future price prevailing for wheat on day 0 plus S_t wheat minus F_t wheat and you know that this particular component is nothing, but the basis prevailing on day t for wheat contract and the third component is the added risk.

This is the new component when a farmer is entering into a cross hedge. In normal kind of a hedge farmer or a trader or hedger are exposed to this part of the you know basis, but when we are talking about the ah crosses this is the new component which the farmer will be getting exposed and that is nothing, but your spot price of ragi prevailing on the contract closure date minus the spot price of the wheat. Again, as I said that in the hedging requirements for different traders are very wide and very diverse exchanges do not offer futures contract on all kinds of commodity or all varieties of commodities. Exchanges offer you know contracts for some number of commodities and if a particular farmer or trader wants to hedge the price risk of one commodity vis-a-vis another commodity the farmer has to find out which commodity is significantly related and go ahead and use that you know that that particular commodity futures to hedge the prices. However, in case of a cross hedge a new component gets added to the you know the

future price plus the basis and that is the ah you know risk greater risk faced by a farmer who is cross hedging.

With this we will come to the next concept of today's discussion called stack and roll hedge versus strip hedge. Now, let us take an example to understand what you mean by stack and roll hedge versus strip hedge. Let us say on 19th May 2023 a gold mining company fears that in the coming 4-to-5-month gold price is going to go down. So, the gold mining company is long on gold, and it is fearing that price is going to go down. So, it would like to take the short futures position on 10000 ounces of gold per month.

Let us assumption that the company produces the mining company produces about 10000 ounces of gold per month and it would like to enter into short futures position to mitigate the price risk. Now, the company has a option to choose to go for strip hedge or go for stack and roll hedge. So, what is the difference between a strip hedge or stack and roll hedge? Now, strip hedge or on in strip hedge on 19th May 2023 which is the spot date the company will take 4 strips of stock short futures contract and these 4 strips will be the futures contract maturing on June July August September. And each for each month it will enter into short futures contract for 100 contracts and why are we mentioning the 100 contracts because each future contract has 100 ounces as underlined, and company wants to mitigate the price risk of 10000 ounces per month. Hence for each of these 4 months, the company will enter into 100 contracts 100 short futures contract that is what the company will do if it goes for a strip hedge.

Now, let us come to the next type of hedge that is known as your stack and roll hedge. So, what do you mean by stack and roll hedge? On 19th may company will enter into short futures contract for only June maturity, but for 400 contracts. Basically, it will be stacking all futures contracts for a given month hence the word stack and roll. Now, when the June contract expires the company will again take a short futures contract for July maturity, but only for 300 contracts. Similarly, when the July contract matures the company will take short futures for August maturity, but only for 200 contracts.

Now, let us take a take a graphical way of understanding what do you mean by strip hedge versus stack and roll hedge. This particular diagram shows the difference between a strip hedge and stack and roll hedge. So, let us understand, go to the left column. So, in case of a short in case of a strip hedge the gold mining company will enter into spot short futures contract and what is the date that spot date is 19th May 2023 it will enter into June July August September futures contract of each contract having 100 100 100 units. And on this date the company will be depositing initial margin for each of this contract and also will be paying or receiving mark to market margin for all 4 contracts for the you know remaining period.

Now coming back to the stack and roll hedge on the contract initiation date the company will enter into short futures contract for June 2023 maturity, but for 400 contracts. It will be paying the initial margin for all 400 contracts it will also be receiving or paying the mark to market margin for one contract maturity, but for 400 contracts. Now, let us move to 20th June 2023, the date on which your June contract matures. So, when 20th June 2023 spot date June future contract matures and on that day the company will have us 3 strips of July August September short futures contract. And from 20th June onwards it will be paying or receiving mark-to-market margin for 3 contract maturity periods.

Now, let us move to the stack and roll hedge on 20th June. On 20th June spot date the June futures contract will expire, and the company will take short futures contract for July expiry, but for 300 contracts. Now, on a phase of it these 2 contracts look similar, but there is a major difference with respect to the strip hedge and stack and roll hedge. Now, let us come to a numerical example to understand what the difference between these 2 types of hedging strategy is. This particular table shows the difference between the stack and roll hedge versus strip hedge. As you can see let us say on 19th May spot price of the gold is 1970 dollar per ounce and similarly June 23 July 23 August 23 and September 23 gold future prices are given.

Now, the company has an option of entering strip hedge if the company enters into strip hedge it will enter into short futures contractor contract for all 4 months 100 units at these price points 1982, 1991, 2003 and 2007. This is the price at which the company entered into the short futures contract. Now, on the same day the daily settlement prices are also mentioned and based on the daily settlement price there will be a mark to market gain or mark to market loss. As you can see for 19th May settlement price the company is going to receive a total mark to market margin of 400 units 400 rupees or 400 dollars. Similarly, let us say the price changes on 20th May and the daily settlement price is mentioned and based on again the daily settlement price the company is going to receive 100 dollars as total mark to market receipt.

Now, let us move to stack and roll hedge. In the stack and roll hedge the company will have no relevance to the July August and September price it will only be concerned with the price prevailing for June 23 expiry. And as you can see mark to market mark to market gain is a negative 3 rupees here also it is the same thing in the previous case mark to market gain is negative 3 this is also negative 3. But what is the difference here because the company has taken 400 units the total mark to market margin will be negative to 1200. Similarly, the total mark to market margin for the next day is going to be 1600.

 So, as you can see, the total mark to market margin receipt is going to be 1200 negative and 1600 positive and if one you know compares these two mark to market receipt some total is 500 this also some total is 500. So, on the face of it one may argue that there is no

difference between stack and roll hedge versus strip hedge, but there exists a significant difference because on this day the company has to pay a significant amount of mark to market margin. Negative 1200 receipt means the company will be paying significant amount of mark to market margin and if the company does not have that amount of cash or liquidity available with itself then it may inform the exchange or it may inform the exchange that it is not able to pay the mark to market margin and it will have its own repercussion. Hence, there you know though over a long period of time strip hedge and stack and roll hedge may perform in a similar manner, but on a short duration these two contracts or these two-risk mitigation strategy are significantly different. Now, coming to the importance of these two strategy in the year 1993 a German conglomerate called Metallgescellschaft this particular company revealed to the regulator that is CFTC commodity market regulator of USA that it has lost about 1.5 billion dollar due to large oil forward contracts it had written as well as its inability to pay daily mark to market margin on long futures because it had taken a huge amount of stack and roll hedge. And the company faced a significant amount of risk there are lot of you know the company faced also fine. So, it is a very interesting case of how a hedging strategy created a major problem for a company. And there are many research papers, newspaper articles YouTube video on the failure of Metal Gesellschaft with respect to the stack and roll hedge. But personally, this particular article which is titled as the collapse of Metallgescellschaft unhedgable risk poor hedging strategy or just bad law this is a research paper this is an article which is available at this particular website.

Again, I would urge each of you those of you are interested to hedge be part of the hedging desk of any company or personally be interested into entering into futures or option contracts or derivative contracts it is a must have read for any one of you know to know what went wrong with the Metal lgescellschaft hedging strategy. Now, coming to another interesting aspect of futures trading that is known as your trading at settlement contract. Please note that this trading at settlement contract is the way people enter into futures long or short futures contract. It is not a hedging strategy, but it is a pricing strategy. So, what do you mean by a TAS contract? This TAS contract is a contract in which traders do not specifically bid for any explicit price when they are placing an order.

Please note that in the last couple of sessions we have discussed how traders use cash and carry model use cost of carry model to find out what should be the price at which they will be entering into long or short futures contract. And they may modify or tweak their trade, or their views related to the future price with respect to the you know cost of carry model depending on their understanding of how the underlying spot market is going to change. But every time, whenever somebody is placing a buy or sell order to enter into futures contract the traders will give a price. And if somebody else is willing to take that price then the trade gets executed and rest of the you know daily mark to market margin

initial margin all these concepts flow from there. But in the case of a TAS contracts traders do not give any price.

Traders buy or sell futures contract during the course of the trading day at a price which is equal to the daily settlement price of the contract. And such orders are known as TAS 0 or TAS flat or TAS par. And you know all of us know that daily settlement price is arrived at the end of the trading day. And I may be able to enter into a TAS contract at eleven o'clock. I do not know what price I am going to be actually buying or selling the futures contract. But if my trade gets executed that means if I am interested to take long futures position at TAS there has to be somebody who is willing to take a short futures position also in the TAS.

If that happens, I know that my trade got executed at TAS. Now exchanges also allow traders to enter few trades enter trades few ticks above or below the TAS order. So, let us understand what you mean by tick size. Tick size is the minimum price fluctuation between two trades. For example, turmeric tick size is 2 rupees so that means, if somebody is entering into a contract for buying or selling turmeric futures, he or she can give up any price which is multiple of 2.

It could be 100 rupees, 102 rupees, 104 rupees, 106 rupees, but nobody can give a price of 101 or 103 or 103.50 and so on so forth. So, what do you mean by a TAS order which is few ticks above or below a TAS order? Let us say a trader who is you know who is interested to place an order TAS minus 3 ticks he does not know what the TAS is, but he can place an order TAS per minus 3 ticks means he is interested to take futures contract at a price which is 6 rupees below the daily settlement price. So, these are you know these are some innovative way of buying or selling futures contract available in some international exchanges. To best of my knowledge this trading at settlement facility is currently not available at Indian commodity exchanges, but major global exchanges offer this TAS order facility to buyers and sellers.

However, in this context there is also a very interesting aspect related to the trading at settlement contract. Many a times traders specifically high frequency trading firms have tried to manipulate the daily settlement price after their TAS order has been executed and this manipulation strategy is known as the banging the close. So, traders will be entering into TAS contract, and they would be interested to manipulate the TAS price by you know giving lot of orders to change the daily settlement price. In this context in 2012, commodity finance CFTC which is the regulator of USA, it fined 14 million US dollars to a company called Optivar for manipulating the daily settlement price for crude oil, heating oil, gasoline future contract traded at NYMEX. And how the CFTC went about identifying what Optivar was doing, what kind of a trading strategy it was employing so as to manipulate the daily settlement price and the trading at settlement price.

This detail is available also in the website link which I have given. Again, I would urge each of you to understand how the company went about manipulating the TAS and how and more importantly how the regulator went about identifying what kind of manipulation this particular company was undertaking. With this we will come to the end of today's discussion. So, let me summarize what we discussed today. We discussed the concept of hedge effectiveness and how one would go about measuring hedge effectiveness.

We also discussed the concept of cross hedge and we also discussed significantly the difference between a stack and roll hedge vis-a-vis strip hedge and how metallgescelschaft as a German conglomerate face significant amount of difficulty by entering into stack and roll hedge. We also discussed the concept of trading at settlement and how trading at settlement is a different way of buying or selling futures contract. With this I end today's session and I greatly look forward to interacting with all of you in the next session. Thank you all of you.