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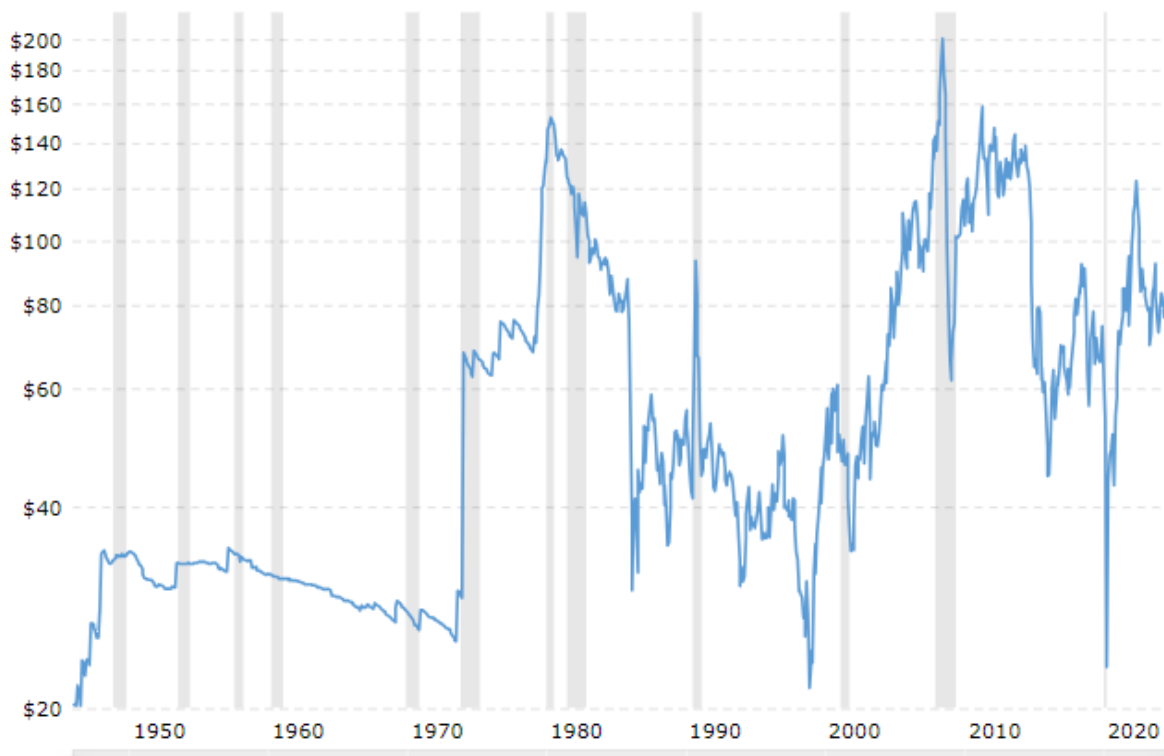
Spread Trading in Energy Sector

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Energy Market

An *energy market* is a type of [commodity market](#) in which crude oil, the refined products from crude oil like gasoline, heating oil etc., natural gas, electricity and various other products are traded. Energy markets are highly volatile since consumers are generally unable to substitute their fuel requirement when prices go up. As an example, consider the Crude oil price chart since 1950 presented below.

Crude Oil Price Chart since 1950



Source: Macrotrends

The factors which affect say, the crude oil prices are: OPEC output or supply, changing scenarios in oil demand from emerging and developing countries, US and other countries' crude and products inventories, refinery utilization rates, global geopolitics, speculative buying and selling, weather conditions etc.

The fundamental analysis for say crude oil price becomes quite challenging due to unpredictable nature of some of the factors as mentioned above.

Traders and investors use "Spread" trades for hedging purposes and purely for trading (arbitrage) as well. This

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involves using price differences in commodity derivative securities based upon differences in time, location and inter-commodity relationships.

In this article, I first discuss the Profit model for Spread trading and then elaborate on various spread trades undertaken in the crude oil and natural gas derivative markets.

Profit Model in Spread Trading

Hedge funds often use “Pairs trading” as a market-neutral trading strategy. This strategy is also referred to as “Spread trades”. Gatev, Goetzmann and Rouwenhorst (2006) provide empirical evidence in stock market that such strategies are profitable even after taking into account transaction costs.

This strategy requires identification of two securities with history of high correlation (± 0.80 may be considered as a measure of strong correlation). This strategy is essentially a statistical arbitrage and convergence trading strategy with property of mean reversion. Profits are generated when the long under-performing security gains value and sold later at a higher price, and the short over-performing security loses value and bought later at a lower price. However, there may be potential losses if the expected mean reversion does not occur and/or the strong correlation between the paired assets changes due to external events.

Such spread trading strategy is also used in energy futures markets. This strategy essentially requires identification of two highly correlated prices. Crude oil and its derivative products like gasoline, fuel oil etc. have high degrees of correlation in their prices. Gima and Paulson (1999) report historical risk-arbitrage opportunities in petroleum futures spreads.

Spread trading considers 1) purchase of one lower-priced financial instrument and 2) simultaneous sale of another highly correlated higher-priced financial instrument. The objective is to earn profit from the movement of the spread between the two instruments and not from the movement of the absolute values of the two prices. The trades are closed as and if the two prices converge during the trading period. This will result in a profit equal to the amount of the spread at the initiation of the spread trade. If the prices do not converge during the trading period, the two positions are forced to close at the end of the trading period. This may result in a profit or loss at the end of the trading period.

Rachev, Kanamura and Fabozzi (2009) empirically study the spread trades using WTI (West Texas intermediate) crude oil and heating oil and natural gas futures traded in the NYMEX (New York Mercantile Exchange). They show that such spread trades in energy futures markets produce a relatively stable profit They

also study the impact of the major features of the energy market like seasonality, mean reversion of price and volatility, and observe that such features of price spreads characterize the total profit. The mean-reverting process assumed by them for the price spread, S over time dt is as follows.

$$dS_t = \kappa (\theta - S_t) dt + \sigma dW_t$$

where κ and θ refer to the mean reversion speed and the long-term mean price spread, and dW_t is the Weiner process. The authors assume the price spread to follow Stochastic and Markov processes.

Energy Sector Spreads

Types of Spread Trades

1) Inter-market (inter-commodity) Spread:

- a) Crack Spread
- b) Frac Spread

2) Intra-market (intra-commodity) Spread:

- a) Calendar Spread
- b) Locational Spread

Crack Spread

In the petroleum industry, oil refiners' profits are directly related to the Crack spread, which is defined and calculated as follows.

A *crack spread* is the overall pricing difference between a barrel of crude oil and the petroleum products refined from it. The “crack” is an industry term for breaking apart crude oil into the component products, including gases like propane, heating fuel, gasoline, light distillates, like jet fuel, intermediate distillates, like diesel fuel, and heavy distillates, like grease.

Calculation of Crack spread

Suppose, the spot prices of crude oil, petrol and heating oil are \$82.5 per barrel (1 barrel = 42 gallons), \$2.30 per gallon and \$ 2.14 per gallon respectively.

A refiner produces petrol and heating oil in the ratio of 2:1.

Hence, 3:2:1 crack spread margin for the refiner

$$= 2 \text{ Petrol} + 1 \text{ Heating oil} - 3 \text{ Crude oil}$$

$$= 2 * 2.30 * 42 + 1 * 2.14 * 42 - 3 * 82.5 = \$35.58 \text{ for 3 barrels of crude oil}$$

$$= \$11.86 \text{ per barrel}$$

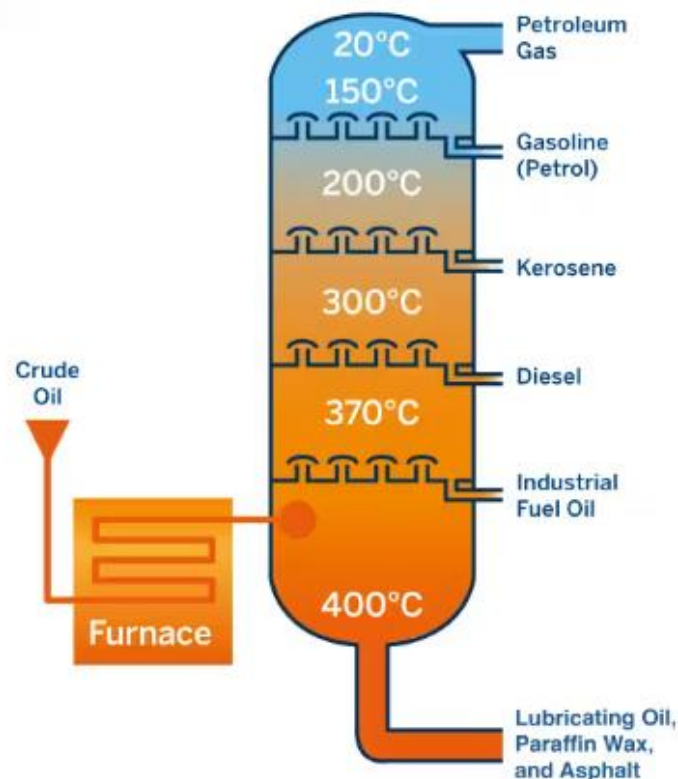
Crack Spread Futures

Long crack spread means long position in refined product futures and short position in crude oil futures while

Short crack spread means short position in refined product futures and long position in crude oil futures.

If a refiner is expecting crude oil prices to go up without commensurate increase in the prices of refined products, the refiner should set up *Short crack spread futures*.

The contract type can be 1:1, 2:1:1, 3:2:1, 5:3:2. For example, 5:3:2 crack spread futures will mean contracts for 5 crude oil futures, 3 heating oil futures and 2 diesel oil futures if crude oil is cracked to heating oil and diesel oil. The following diagram shows the products manufactured by cracking crude oil.



Source: CME Group

This strategy can be followed if exchange-traded futures contracts are available in all the refined products and input crude oil.

Frac Spread

Natural gas processors gather wet natural gas from wellheads containing shale gas etc., then separate the methane to produce NGLs (natural gas liquids) like propane, butane, isobutene, and condensates. These NGLs are sold in the market to earn revenues and the profit.

For gas processors, the profit margin is equal to the value gained from the sale of NGLs (revenue) minus cost of natural gas used (COGS). This profit margin is called the Frac spread (short for Fractionation spread, or NGL spread). The conversion of natural gas into NGLs is known as fractionation.

Calculation of Frac spread

Natural gas (NYMEX) is quoted in USD per MMBTU (Metric Million British Thermal Unit) and one contract comprises of 10,000 MMBTU.

Propane gas (NYMEX) is quoted in US Cents per gallon and one contract comprises of 1,000 barrels i.e. 42,000 gallons. One gallon of propane contains approximately 91,500 BTUs or 0.0915 MMBTU.

Suppose, the spot prices of natural gas and propane are USD 1.978 per MMBTU and USD 0.73 per gallon respectively.

Now, Spot price of Propane = USD 0.73 per gallon = $\text{USD } 0.73 / 0.0915 = \text{USD } 7.978$ per MMBTU

So, in case of 3:1 spread (3 Propane with 1 Natural gas),

Frac spread = $3 * \text{USD } 7.978 - 1 * \text{USD } 1.978 = \text{USD } 21.954$ per MMBTU.

Frac Spread Futures

Natural gas processors and midstream firms can hedge their price risk by buying natural gas futures, and selling propane futures at a predetermined ratio. The popular ratios are 3:1 and 5:2.

The outputs from processing natural gas are isobutene, butane, and natural gasoline apart from propane but their market trading is not very liquid and, in many cases, not cost effective for traders.

Intra-market (intra-commodity) Spread: Calendar Spread

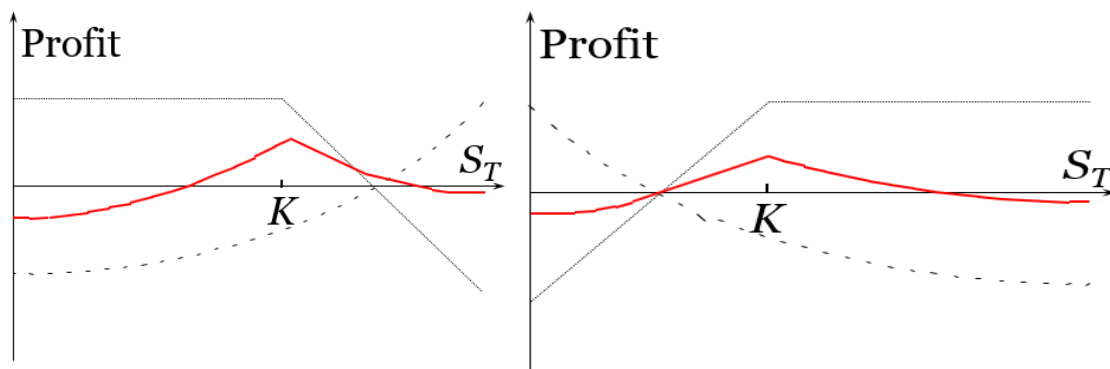
A Calendar spread (also known as Time spread) is used to profit from the differences in prices of two contracts on the same commodity but with different maturity dates.

A trader/investor takes a long position in a futures or option contract with a later expiration date and simultaneously takes a short position in another contract with an earlier expiration date.

In the oil market, a trader could buy a futures contract for crude oil expiring in six months and simultaneously sell a futures contract on the same commodity expiring in three months, resulting in a calendar spread position. The two contracts in the calendar spread get closed on the earlier expiration date. The trader/investor earns a profit if the price of the longer-dated contract increases more than the shorter-dated contract and may lose money in case the reverse happens.

Calendar spreads can be used in the oil trade for hedging against price fluctuations in the oil market and also, for taking advantage of seasonal patterns in the market.

Option markets can also be used to create a calendar spread to generate income by selling an option with a shorter expiration date and buying an option with a longer expiration date.



Calendar Spread with Call Options Calendar Spread with Put Options

The above diagrams show the profit position from calendar spreads using calls and puts. The profit is earned in case the commodity price (denoted by S_T) remains relatively stable around the strike price (K). The profit diagrams are drawn at the first expiration date of the short option.

However, if the asset market price surges and makes a significant move in either direction before the near-month option expires, profit can still be generated by setting up reverse calendar spread. This spread is set up

by buying a call / put option with an earlier expiration date and selling a call / put option with later expiration date, and closing the contracts at the earlier expiration date.

Intra-market (intra-commodity) Spread: Locational Spread

Both WTI (West Texas Intermediate) and Brent (North Sea) crude oil futures are traded on NYMEX. Usually there is a price difference between these two contracts. For example, as on August 5, 2024, September 2024 (9-00 pm IST) WTI futures were selling for USD 73.11 per bbl and Brent crude oil futures for USD 75.93 per bbl. So, a trader can earn profit (probably net of transaction charges) by going long on NYMEX crude oil (WTI) futures contract and short on NYMEX Brent (North Sea) crude oil futures contract.

Similarly, Henry hub natural gas is traded on NYMEX and AECO hub natural gas is traded on Natural Gas Exchange (ICE NGX) in Alberta, Canada. Henry Hub is a natural gas pipeline located in Erath, Louisiana, USA that serves as the official delivery location for contracts on the New York Mercantile Exchange (NYMEX) and AECO Hub is a commercial natural gas storage and delivery location in Alberta, Canada.

So, one can buy (sell) NYMEX Henry Hub natural gas / sell (buy) AECO hub natural gas to earn a profit from the basis value between the prices at the two locations, possibly net of transaction charges.

Conclusion

Energy traders and investors use spread trades as mentioned above to earn profits that depend on the difference in price between the securities being sold. The spread as a unit is traded on futures / option exchanges and the two legs of the transaction are not traded independently.

They earn the profits if the spread gets wider or grows narrower. They are not looking for direct price movements of the constituent transactions used for the spread trades. Spreads are either bought or sold because they are executed as a unit. The crucial part in deciding the spread trades is the prediction whether the spreads will get wider or narrower.

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