Volatility and spreads

An analysis of transatlantic gasoline arbitrage.
In this study by Cynthia Kase, the IPE and NYMEX gasoline futures contracts are used to illustrate basic points on volatility and spreads.

Those who trade spreads in the energy markets have an easier task, for example, than the bond traders. All the former need to adjust, to enter a spread trade, is density and contract size. In contrast, bond traders need to account for currency-exchange rates, widely differing maturities, "cheapest to deliver" considerations and tax laws, which impact on profits differently from country to country. The list also includes a consideration of relative volatility.

Energy spread traders may not have to adjust trades for relative volatility, but it helps to have a fuller understanding of the volatility characteristics of markets being traded and the impact of relative volatility on the risks and rewards. This article outlines how volatility can be measured, and how differing volatilities in two markets can affect the success of an arbitrage trade. Finally, these techniques will be applied to the unleaded gasoline contracts of the IPE and the New York Mercantile Exchange, NYMEX.

Defining volatility

Three alternate definitions of volatility are used in this analysis.

First, a means to measure high-low volatility is chosen.

An average of the high minus the low of each day can be measured. If market behaviour is thought of as the sum of a series of sine waves, then the high-low average can be thought of as a measure of the amplitude of the sum of waves which are below the threshold of trading significance. More simply, the high-low volatility can be viewed as the degree of blur around a (primary) market trend.

For the study, the following definition, which enhances a simple high-low calculation by scaling it relative to the underlying market price, will be used.

Volatility(high/low)=100(high/low)/(high+low)/2.

Close to close volatility can be thought of as a measure of the rate of change, or a measure of the gradient of a primary market trend. This analysis looks at the closing price, or the midpoint in the case of cash market data, relative to the closing price five days earlier, to understand the average weekly change in price as follows:

Volatility (per cent. close to close)=100 (absolute (1-(C_0/C_5)).

The formula is simply based on the ratio of the close divided by the close five days ago. If the close today is greater, then the ratio is greater than 1, such as 1.05. In this case, the change is absolute 100 (1-1.05), or 5 per cent. If the close is lower, for example when the ratio is 0.95, the calculation is 100 (1-0.95), or 5 per cent. In either case the close is 5 per cent changed from a week ago.

Finally, the article examines a measure of volatility which incorporates both high-low and close-to-close volatility, called "the true range". This volatility measure can be considered the "futures traders' volatility" as it expresses how much money can be made or lost between one day's close and the next. It is measured in the same terms as the currency in which the futures contract is traded, that is, in dollars and cents. Futures traders thus may find this volatility measure easier to relate to than percentage measurements.

True range is defined:

Volatility(TR)=maximum((high-low),absolute (high-previous close), absolute (low-previous close)).

How volatility affects spreads

Differing volatility characteristics can have an impact on the profit potential and risks of entering a particular spread trade.

Four basic cases in spread trades can be considered, and it is assumed that the market is trending higher:

1. Long the contract which is both the more volatile close/close contract and the more volatile high/low contract.
2. Short the contract which is both the more volatile close/close contract and the more volatile high/low contract.
3. Long the more volatile close/close contract, short the more volatile high/low.
4. Short the more volatile close/close contract, long the more volatile high/low.

The first two cases will be the most typical as the two volatilities tend to be related.

Case 1 is directionally correct because in a rising market the high close-to-close volatility contract is rising faster, and gaining on the other. The higher high-low volatility will mean that spikes may be favourable, briefly, allowing profits to be taken at inflated values. It also means that upon any reversals, which all markets experience, larger than usual contractions will take place. Risks are also inflated at those times.

Here is a hypothetical example: Chart one shows the price bars of the more volatile contract of which we are long. Chart two shows the prices of the less volatile contract of which we are short. Chart three shows the daily spread range. Spikes in the high-low volatility give enhanced opportunities to take profit as in point a, corresponding to bar 5. At the same time, we need to make sure

Cynthia Kase is an advisor to energy and commodity derivative clients. After ten years in project engineering, she joined Chevron's international trading group, and managed refined product trading in New York. In 1990, she joined Chemical Bank, as vice president of commodity risk management, to manage the institutions' commodity book, and advise clients. She now advises clients on trading and risk management strategies and designs systems to support her work. Cynthia Kase, a resident of Staten Island, is a member of the International Federation of Technical Analysts and the International Association of Financial Engineers.

we do not enter the spread at similar points. Contract one's bar 8 is a typical key reversal (higher high, lower low, lower close). This has the effect of depressing the spread as the market turns, shown in chart three, point b.

Case 2 is simply the inverse of case 1. In rising markets, one is on the wrong side of the trade. Spikes which allowed for profit taking in case 1 are now inversely proportional to profit, increasing the pain.

Case 3 is a good situation for the conservative trader who is on the right side of the trade. As the market rises, the spread might contract from time to time as downward spikes draw the spread in, but the spikes will work in one's favour on reversals.

In case 4, as in case 2, we are again on the wrong side of the trade. However, the upward spikes in our assumed rising market case will allow opportunities to bail out at a slightly reduced pain.The logic can be turned upside-down in falling market scenarios.

These techniques can be applied to the IPE and NYMEX unleaded gasoline contracts.

In addition to evaluation of volatility's average magnitude, its distribution and skew are also important. A volatility distribution having a higher average, but a much narrower distribution, may, on a discrete basis, carry lower risks, so we have noted the standard deviation of our sample for review.

In this context, skew is defined as the manner in which actual sample distributions vary from a normal distribution curve. Actual historical market volatilities have particular shapes which exhibit characteristic skews. (see side-bar).

Mean volatility is usually lower than might be expected based on a bell curve. However, the curves tend to cross above the 85th percentile. A very simple measure of how much a particular sample varies from normal is to calculate a ratio based on an observed value to the value expected using a normal distribution. The value shown in table three, SQ 100, shows the ratio of the maximum observed value versus the 99.9% cumulative probability value.

The higher the observed SQ 100 value, the greater the actual risks were, relative to the normal. Any veteran chart watcher is familiar with the long, outsize bars and gaps which often occur when markets reverse and run. These long bars are akin to "stray bullets" which can catch an unwary trader off-guard.

A conversion factor of 8.4 bbls/metric ton has been used and Platts and Argus price assessments for the US unleaded gasoline, NY cargoes have been averaged. The period studied is January 27th to July 20th, 1992, which, to put it into perspective, saw overall historic volatilities very slightly lower than the average.

The correlation (R-squared) between the NYMEX futures contract and published cash market data, 0.90, is about the same as the IPE's 0.88.(The IPE's contract has reached this level in just eight months.)

The NYMEX price averaged $1.7/MT below the IPE price. However, as shown in chart four, the spread, NYMEX less IPE, trended up from lows early in the year, peaked in the spring, and has been declining to date. Its low, based on the close, was -$19/MT and the high was $13.8/MT.

On about 40 per cent of days, the IPE's closing price was outside the actual high-low range because no trades took place during the closing time period. When the actual low was higher than the close, the low has been set equal to the close. On two days, no trades took place, so the high and low were deemed equal to the closing price. Armed with an understanding of volatility and how relative volatility affects spreads, the reader may now study the charts and tables. Note that, although the example of the NYMEX to IPE gasoline spread has been used, a similar evaluation will be helpful when entering into cash to futures spreads. Thus, data pertinent to the related cash markets is provided as well.

Table 1

High-low volatility
% range

	IPE 1st nearby	LOR gasoline	NYMEX 1st nearby	Platts/Argus gasoline
Average	0.83	0.96	1.87	1.8
One std dev	0.59	0.33	0.71	1.5
Minimum	0.00	0.42	0.52	0.0
Maximum	2.20	1.98	3.94	5.4

Table 2

Close -to-close volatility
weekly % change

	IPE 1st nearby	LOR gasoline	NYMEX 1st nearby	Platts/Argus gasoline
Average	2.0	1.9	3.0	3.1
One std dev	1.6	1.5	2.2	2.2
Minimum	0.0	0.0	0.0	0.0
Maximum	7.2	7.3	9.4	11.4

Table 3

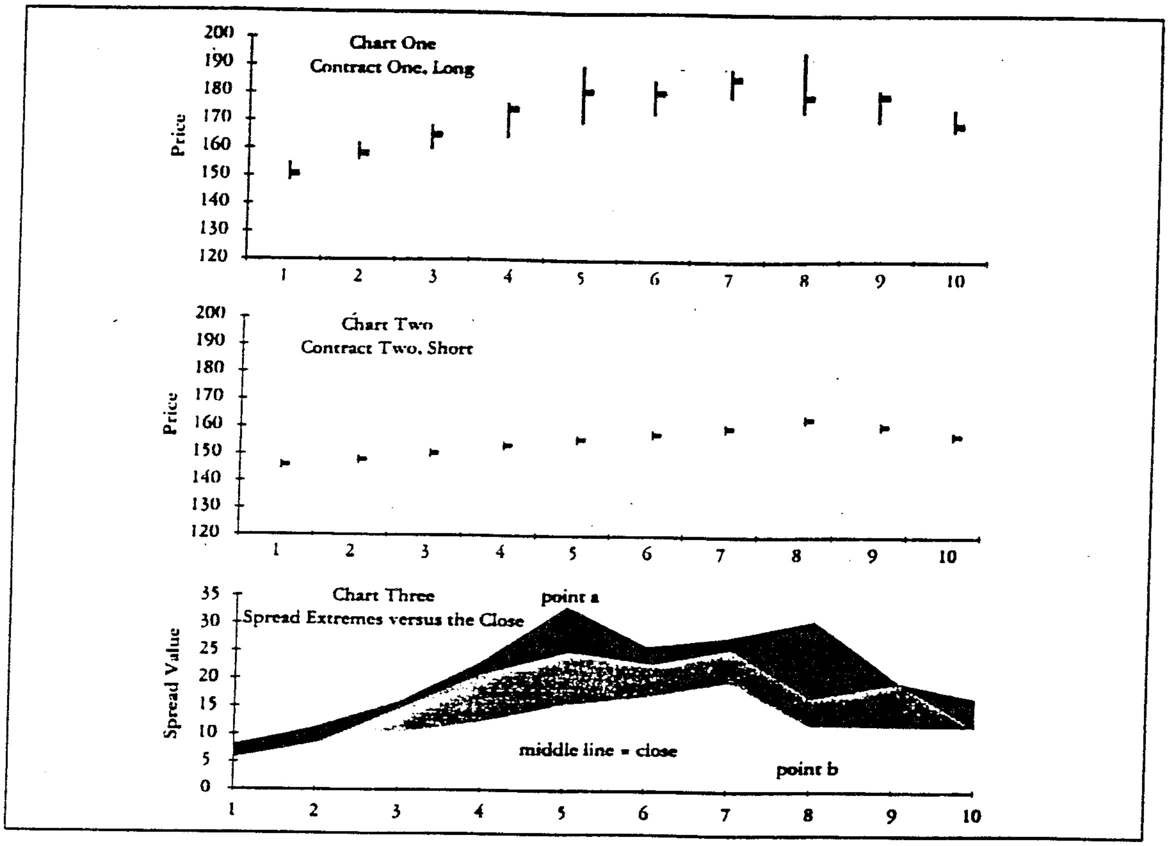
True range
US $ per MT

	IPE 1st nearby	LOR gasoline	NYMEX 1st nearby	Platts/Argus gasoline
Average	2.9	2.8	4.5	5.5
One std dev	1.7	1.3	2.1	3.4
Minimum	0.3	1.0	1.6	0.5
Maximum	9.5	9.0	15.4	14.7
SQ 100	1.2	1.3	1.4	0.9

Table 4

Cash to futures differentials
US $ per MT

	IPE 1st nearby	LOR gasoline	NYMEX 1st nearby	Platts/Argus gasoline
Average	2.1	5.4	(2.5)	5.1
One std dev	6.4	4.0	5.7	2.4
Minimum	(11)	0.0	(9.3)	0.0
Maximum	15.5	15.5	8.0	9.3



Summary

In the period under review, the high-low volatility of the NYMEX contract was about double that of the IPE contract, while the close-to-close and the true range volatility were about 50 per cent greater. The NYMEX contract, for the purpose of applying the guidelines relative to the cases above, would be considered to have both the higher high-low and close-to-close volatility. The significance to the high-low volatility being twice as great as close-to-close would imply that greater swings, and thus in the spread, would occur on an intra-day basis that would be experienced if viewing the relationship on a close only basis.

The IPE gasoline contract showed correlations to the physical market of similar quality to the NYMEX contract, despite the much lower volume. The R-squared values as noted above are about the same. The volatility relationships are similar also. For example, the minimum true range in both cases are about a third that of the physical market and maxima are about the same as the physical.

Thus, if the IPE contract continues to exhibit this high level of correlation, not only of price but of a stable volatility relationship to the physical market, it should serve as an excellent cash-market example for trans-Atlantic arbitrage trading.

The writer's research has shown that the mean shape of the volatility curve, when measured over a high number of observations, is fairly constant, that is results of varying samples exhibit a high degree of repetition. The following results, calculated from a sample of 3,000 one-hundred bar sets of consecutive five-minute WTI bars, are typical. The test results are expressed as the ratio between an observed percentile value and the value calculated from use of the standard deviation value against an assumed bell curve. Ratio 85 is the ratio of the 85th percentile value and calculated value at or below which 85 per cent of these observations would be expected to fall, calculated as follows:

Cumulative 85=Mean (sample data)+(1.0348 x STDEV (sample data))

The first column shows the mean observed value for a given measure, and the second shows the value one standard deviation above the mean observed.

Results of skew test 5-minute bars, West Texas Intermediate		
1st position 6/87 to 6/90		
	Mean observed	Value 1 std dev over mean
Ratio median to mean	0.77	0.88
Ratio 85	0.84	0.95
Ratio 90	0.88	0.99
Ratio 95	0.96	1.08
Ratio 98	1.06	1.22
Ratio 100 (3 std to max)	1.22	1.50