Six Guidelines to Effectively Manage Your Commodity Risk

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Introduction: Commodity and Energy Markets

There is a lot of recent excitement around the commodity markets, particularly energy, as evidenced by the amount of press and editorials while oil prices reached record highs, leading many industry experts to predict that energy trading will become an integral part of broader financial markets in the near future. In just the last 18 months, it is estimated that assets under management (AUM) for commodity hedge funds alone increased from $8B to $14B and the number of funds increased by 60%. This trend is anticipated to only accelerate in 2006 as number of banks, Futures Commission Merchants, and hedge funds that are entering, or considering entering, the potentially lucrative commodity markets continues to increase.

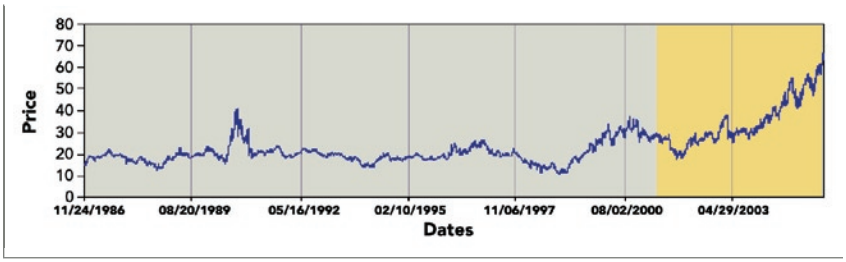
There are, however, some fundamental differences between commodity markets and other markets such as interest rates, equity prices and exchange rates. This paper is an introduction to some of the fundamental characteristics of commodity and energy markets for those who are less familiar with these markets. This paper will highlight those differences by outlining six operational guidelines which should be part of a firm's best practices when trading commodities as well things an investor should know before investing in commodity trading firms.

The data and conclusions presented in this paper are drawn from the author's experience advising commodity trading firms and builds upon a SunGard Kiodex case study surveying best practices among three top commodity trading firms.

1. Do not be fooled by mean reversion.

In the current market, absolute mean reversion, defined as the tendency of the commodity's spot prices (front month contract) to revert to a long term average price, is a myth. The historical price chart below for WTI shows that over the past three years, the front month contract on NYMEX WTI has *not* reverted to a long term average.

NYMEX WTI Spot Price (1986-2005)

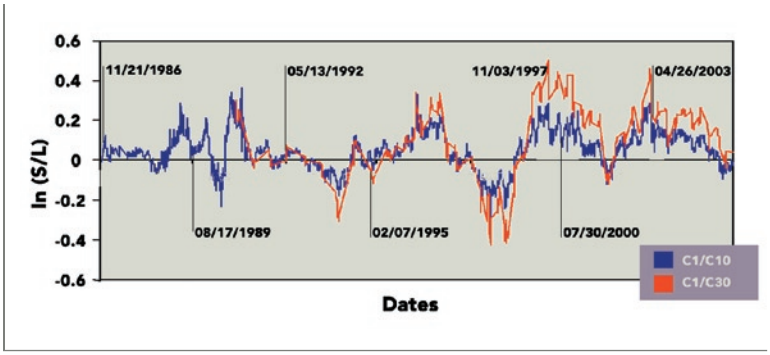


Source: NYMEX

Fig. 1.

While absolute mean reversion is not something that exists in commodity markets, prices do, however, revert to an average level. A phenomenon called "relative mean reversion." The next graph illustrates the difference, in relative terms, between the prices of the front month contract and a long dated NYMEX expressed in relative terms (to be specific, natural log). The blue line in the graph represents change between the front month and the 10th month contract while the red line simply represents the relative change between the front month contract and the 30th month contract.

NYMEX WTI



Source: NYMEX *Fig. 2.*

As seen in the graph, the front month contract does not revert to an absolute level of a long term average price, but the movement of the curve is not unrestrained either. As the graph illustrates, the price of the commodity, in this case WTI, is constrained by its relative position to the long dated contract on the same commodity.

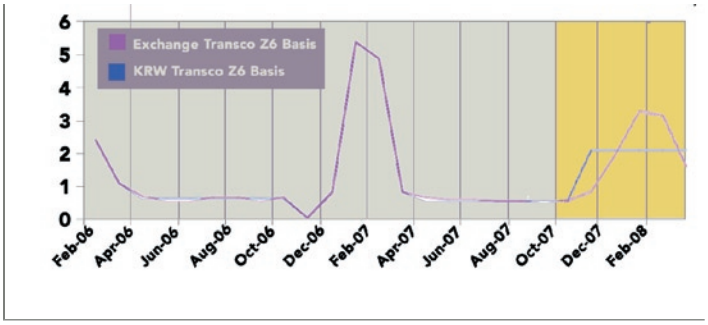
Lesson Learned: A risk management system that does not value and compute risk for trades using a relative mean reversion model, runs the risk of misrepresenting the firm's risk and producing incorrect value at risk reports.

2. Mark your net asset value accurately.

Since the majority of commodity trades are done over the counter (OTC) -contracts traded through a network of brokers and dealers- commodity markets are notoriously opaque. Consequently, since OTC data is not available through exchanges it is difficult, if not impossible to accurately mark your book and know precisely what the market is trading at any given time. Even if OTC contracts are cleared through an exchange such as NYMEX ClearPort, derivatives are often valued using forward curves that are often not traded on exchanges. As such, the value of these derivatives depends on the OTC forward prices of these contracts. In order to independently value positions, it is imperative as a risk manager and investor, to have access to accurate and independent forward curves. Using exchange traded contracts or NYMEX cleared prices as a proxy to the OTC market can lull investors and risk mangers into a false sense of security believing that they have the market data to price OTC derivatives and obtain an accurate net asset value.

To illustrate the danger of not incorporating relative mean reversion into your risk management practices, note the differences in the graph below between exchange data and an independent source, in this case SunGard Kiodex. The forward prices shown are for IF Transco Z6 (exchange data) versus OTC broker data on the same natural gas location provided by SunGard Kiodex. The discrepancy between the curves is due to the fact that the exchange data does not provide seasonal variations in winter 2007 (November 2007 to March 2008). Even if you assume a similar average price for a winter strip coming from the exchange and broker data, but with different seasonal shaping from the Kiodex curve, the firm taking unequally weighted positions in winter months, would cause a different net asset value. A volume weighted average price in a shaped curve will differ from a flat curve when trade quantities are uneven.

Exchange Vs. Kiodex Market Data: Transco Z6 Basis Forward Curve



Source: Exchange Data and Kiodex Global Market Data *Fig. 3.*

The following table shows the difference in the net asset value that would be reported using hypothetical volume positions contrasting exchange prices with Kiodex market data.

Month	Position in MMBtu	Net Asset Value Clearport Prices	Net Asset Value Kiodex Market Data
Nov-07	300,000	$ 630,000	$ 254,752
Dec-07	620,000	$ 1,302,000	$ 1,202,796
Jan-08	620,000	$ 1,302,000	$ 2,041,658
Feb-08	280,000	$ 588,000	$ 881,944
Mar-08	310,000	$ 651,000	$ 496,579
	Total	**$ 4,473,000**	**$ 4,877,729**

Fig. 4: Difference in net asset value given hypothetical volumes.

Getting the right data is paramount to ensure an accurate net asset value. A firm may underreport its net asset value if it were long winter spreads at Transco Z6 with uneven volumes as shown above.

Lesson Learned: Without high-quality independent market data, a commodity trading firm will not accurately know its net asset value and maybe be over or understating its risk.

3. One "event" can liquidate your firm: what can you do about it?

Event risk, defined as a catastrophic unforeseen event, often leads to unusual market anomalies. One of these anomalies, seen during hurricane Katrina, was the breakdown of inter-commodity correlations. Basic economic relationships between commodities, i.e. crude prices and refined prices (crude is a major input to the refinery process), ensure that certain commodity markets generally correlate with each other. Similarly, one would expect power and natural gas to be closely correlated since natural gas fuels power plants. But after hurricane Katrina moved through the Gulf in August 2005, power and natural gas prices, which usually move in tandem, became "unhitched."

The effect of this type of event is illustrated in the following example. Assume that a fund had a short position on 500 MW/Hour spark spreads between PJM Western Hub and NYMEX HH on August 26, 2005 (3 days before hurricane Katrina hit the Gulf) and this position with a $13 MM notional would require 10% margin or economic capital, which is $1.3 MM of cash investments. Katrina caused an unusual breakdown in the NYM natural gas and PJM power price correlation for a few days around August 29, 2005.The graph below shows that the daily movement of PJM prices was not matched by corresponding movement in NYMEX natural gas prices causing the spread position to take an unusual level of stress.

NYMEX and PJM Daily Movement, 08/29/2005 - 08/31/2005

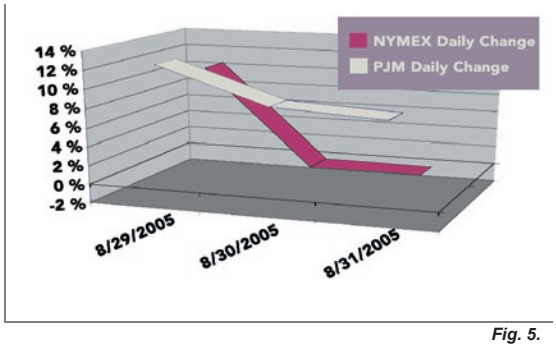


Fig. 5.

The change in P&L below shows that there was a net loss of around $2.8 MM within three days to the fund. This caused more than 2 times the loss of total capital invested in the endeavor.

Notional:	$ (13,023,920)
Capital:	$ 1,302,392

Date	PJM	IF Tran Z6	MTM	P&L Change	PJM Daily Change	NYM Daily Change
8/26/2005	$ 77.52	$ 10.3210	$ (47)	———	———	———
8/29/2005	$ 87.20	$ 11.4120	$ (256,166)	$ (256,119)	12.48%	10.57%
8/30/2005	$ 94.76	$ 11.4120	$ (1,522,560)	$ (1,266,393)	8.68%	0.00%
8/31/2005	$ 102.41	$ 11.4095	$ (2,806,972)	$ (1,284,412)	8.07%	(0.02)%
Loss As a Percent of Capital:		(215.52)%				

Fig. 6: Loss As a Percent of Capital Calculation.

Lesson Learned: It is impossible to predict these occurrences, but it is possible to measure their impact on a portfolio. By measuring the impact of such events on the portfolio, a firm can keep track of its liquidity situation should such an event occurred. The next section will detail what you can do to test the effects of events on your portfolio.

4. Do not rely solely on value at risk (VaR) to stress test your portfolio.

Many risk managers consider running VaR the sole measure for managing a commodity firm's risk. This is a mistake. Although necessary, VaR cannot identify unforeseen catastrophic events like hurricane Katrina. VaR is necessary to quantify the amount of "risk capital" needed to support a fund. As an application to the credit management process, it is used to identify the maximum potential credit exposure due to a commodity derivatives operation. VaR can also be used as a way to allocate risk capital via limits to different traders within a firm.

Commodity markets are exposed to the effects of "events" than other asset classes. The VaR approach that identifies the 5% worst case scenario to a firm's risk does not account for events when historical correlation patterns break down. The only way to address such issues is to conduct stress tests. There are three ways to stress test a portfolio. First, shift forward curves arbitrarily and see the resulting change in the net asset value. Second, simulate price movements to mimic a historical event like a hurricane. Third, use the Front Month Equivalents (FME) of each commodity and create a matrix of price movements with different correlations.

FME is a statistical measure that defines the entire position of a commodity in an equivalent front month contract. It uses relative prices, correlations, and standard deviation to value the FME. The FME equivalent distills all the positions in different months into an equivalent position in the front month contract. It can then be shocked with different assumptions of inter commodity correlations. For example, consider the FME of NYMEX Heating Oil and NYMEX Unleaded Gasoline in the report below:

Energy | Volume

basis: Volume

		report description:		external id:	all	inco terms:	all
report id:	20905733	trade type:	all	external id2:	all	MOT:	all
report name:	Basis	market:	all	counterparty ext id:	all	transport:	all
portfolio:	WP(USD)	commodity:	all	group id:	all	physical M2M:	all
data source:	Official	counterparty	all	trade id:		loading location:	all
run by:	moazzam.khoja@kiodex.com	run on:	01/12/06 2:19 PM	trader:	all	discharge location:	all
as of date:	12/02/05			trade date:	- - -	event type:	
granularity:	Monthly			term date:	- - -	event date:	

month	NYMEX WTI		NYMEX HO		NYMEX UNL		Total	Total
	delta (bbl)	position (bbl)	delta (bbl)	position (bbl)	delta (bbl)	position (bbl)	delta (bbl)	position (bbl)
Total	**366,507**	**500,000**	**11,813**	**11,905**	**(11,813)**	**(11,905)**	**366,507**	**500,000**
FME	**366,507**	-	**11,813**	-	**(11,882)**	-	**366,438**	-
Jan-06	366,507	500,000	11,813	11,905	0	(11,905)	378,320	500,000
Feb-06	0	-	0	-	(11,813)	-	(11,813)	-

Source: SunGard Kiodex Risk Workbench

Fig. 8: Basis Report

The FME of long Heating oil 11,813 BBL equivalents and FME UNL is short 11,882 BBL can be shocked in a matrix below to see the resulting changes in the net asset value.

Price Change Scenario:	**$**	**3.00**	
Underlying	**FME**	**Correlation 1**	**Correlation -1**
NYMEX Heating Oil	11,813	35,439	(35,439)
NYMEX Unleaded Gasoline	(11,882)	(35,646)	(35,646)
Change in the Net Asset Value		**$ (207)**	**$ (71,085)**

Fig. 7: Price Changes Affecting Net Asset Value

In the above test, assuming a drastic $3.00 per gallon change in prices for both heating oil and unleaded, one can see the resulting change in the net asset value of the firm using two different drastic correlation assumptions. A correlation of -1 is highly unlikely; it assumes that the price of heating oil and unleaded gas will move in opposite directions. But if such an event occurred one could see the impact on the value of the portfolio and measure liquidity constraints if any.

Lesson Learned: Conducting stress tests should be considered best practices for any risk management process in order to identify the potential impact of a catastrophic event to the portfolio. This should be done with a view to identify a firm's liquidity needs in such a scenario.

5. Know how you made money.

Is your P&L is a function of strategy or chance? A report below illustrates how different strategies can produce a P&L attribution based on changes in forward curves, volatilities, time, interest rates, and foreign exchange. A risk manager must be able to attribute the P&L into its components as shown below. It is important to know which strategy made money, whether the firm made money adhering to their style, or there was a style "drift".

portfolio	total quantity	trade id	underlying	total p & l	forwards	fx	volatility	time	interest rates
WP	n/a		-	(916,171)	(893,599)	0	4,131	(17,596)	(1)
WP Outright	500,000		-	(339,833)	(339,994)	0	0	203	(2)
WP Spread	500,000		-	(10,779)	(10,774)	0	0	(4)	0
WP Vol Strategy	500,000		-	(565,559)	(542,832)	0	4,131	(17,795)	0
Total:	n/a		-	-	-	-	-	-	-

CONFIGURE REPORT

VIEW MARKET DATA SOURCES

Source: SunGard Kiodex Risk Workbench

Fig. 9: Mark To Market Report

Assume a fund invests in three strategies: outright speculation, speculation on spreads, and speculation on implied volatility. Hypothetical positions in each of the strategies for January 2006 contracts are shown below. For each of the strategy, the change in MTM for different days is calculated. For the volatility strategy, the change in MTM is further broken down between changes in the forward curves and changes in the implied volatilities. The returns are calculated on capital invested (the margin required) to take these positions on NYMEX.

	Changes due to forwards		Changes due to forwards and volatilities	
Date	Outright	Spread	Option Forward	Option Volatility
11/29/2005	$ 50,780	$ 1,587	$ (202,446)	$ 13,782
11/30/2005	$ 423,697	$ (14,776)	$ 192,070	$ 871
11/29/2005	$ 219,334	$ (3,576)	$ 335,869	$ (9,365)
11/29/2005	$ 450,427	$ (2,036)	$ 291,891	$ (21,653)
11/29/2005	$ ———	$ ———	$ ———	$ ———
11/29/2005	$ ———	$ ———	$ ———	$ ———
11/29/2005	$ (135,004)	$ 12,651	$ 227,057	$ (19,636)
11/29/2005	$ (85,197)	$ (7,542)	$ 12,173	$ (333)
11/29/2005	$ 105,138	$ (12,754)	$ (288,079)	$ (14,633)
11/29/2005	$ 644,860	$ (7,544)	$ 605,416	$ (1,900)
11/29/2005	$ (339,833)	$ (10,770)	$ (642,832)	$ 4,131
11/29/2005	$ ———	$ ———	$ ———	$ ———
11/29/2005	$ ———	$ ———	$ ———	$ ———
11/29/2005	$ 263,751	$ (943)	$ 879,378	$ 23,937
11/29/2005	$ 267,772	$ 32,329	$ 34,152	$ 2,480
11/29/2005	$ (348,594)	$ 11,473	$ (256,211)	$ 3,976
11/29/2005	$ (447,890)	$ (14,057)	$ (424,184)	$ ———
Total P&L	$ 1,069,241	$ (15,967)	$ 864,254	$ (18,343)
STDEV	36,48%	7.98%	41.52%	
Capital	$ 810,000	$ 145,238	$ 847,500	
Return on Capital	**132.01%**	**(10,99)%**	**99.81%**	
Return on STDEV	**3.62**	**(1.38)**	**2.40**	

Source: Kiodex Global Market Data and Multifactor Model

Fig 10: Forward and Volatility Strategies

A few interesting insights are drawn from the analysis above. The volatility strategy that should have shown P&L due to the volatility changes is, in fact, showing most of its profits due to the changes in the forward curves. Although, it is a very good return on investments, investors and risk managers should be wary of this performance since the return was due to the change in the forward curves and not volatility.

The spread and outright strategy also shows interesting dynamics. Although the spread strategy lost money in the period, its standard deviation was very low. If the investor wanted to allocate a portion of the fund in a less volatile strategy, it indeed achieved the objective. Return per unit of standard deviation is a good measure to show a strategy's efficiency post facto.

Lesson Learned: You need to be able to explain your PnL. If you do not know how your firm is making, or losing money, you do not know if your strategy is working. If you can explain your PnL, you can take corrective measures to ensure that you are allocating resources to the winning strategies.

6. Mitigating operational risk.

Many firms that have lost money attribute the losses to lax operational controls. One area that is particularly prone to operations mistakes is the accurate setting of energy commodity attributes. There are thousands of energy commodities (defined by product or location) and most of them have unique settlement mechanisms, holiday calendars, and OTC averaging conventions. Due to the sheer number of variables at play, the risk of a transaction risk materially increases. To mitigate this risk, the firm needs an auditable process of trade recording. This process should include reconciliation with the primary broker and OTC confirmations. Trade recording and confirmations or reconciliations should also be done by different people with-in your organization to ensure objectivity and to serve a gate keeping function. All amendments to trades must also be recorded and documented. Excel is not an adequate risk management system.

Lesson Learned: A risk management process needs to include a auditable risk management reporting system into which all trades are entered. The separation of trade entry and confirmation process may cause the firm to misreport its risk and net asset values to its stakeholders. ■

Moazzam Khoja, CFA is the Kiodex product specialist at SunGard. He presents SunGard's Kiodex risk management solutions to enterprises that take commodity risks. He has worked for the past eight years in the commodity risk management area including structuring of complex derivatives in energy and credit products. He obtained his MBA from the Columbia Business School in 1996 and his chartered financial analyst designation in 2003. Contact him at moazzam.khoja@kiodex.com.