Portfolio Risk Measurement in Commodity Futures Investments

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Commodity futures investing has only recently entered the mainstream. As recently as 2001, there was only $10 billion invested in commodity indexes whereas during the fall of 2005 this figure had increased to over $70 billion, according to Rodger (2005).

Once an institution has obtained its core commodity exposure through a commodity index investment, the next logical step is to include active commodity managers for further value-added. This is analogous to the evolving nature of institutional equity management whereby active management is being unbundled from passive index investments. A number of institutions are now getting core equity exposure through equity index funds, exchange-traded funds, and/or futures and then investing in long/short equity hedge funds for further value-added.

The risk management expectations for an investor's passive exposure to commodities differ greatly from what is expected of active managers.

When an investor elects to invest in a commodity index product, that investor realizes that he or she will earn the inherent return of the asset class, will be able to do so cheaply, but will not be provided with any downside risk protection. It will be the responsibility of the investor to either time their investments in commodity indices, *or* create a properly balanced overall portfolio, so as to avoid downside risk.

Instead, when an investor chooses to invest in an actively managed commodity program for further value-added, then that investor expects the potential downside of the active investment to be carefully managed.

This chapter will cover the crucial elements of an active commodity manager's risk measurement process. We will specifically discuss what should be included at both the strategy and portfolio level.

RISK MEASUREMENT AT THE STRATEGY LEVEL

VaR

If a portfolio of instruments is normally distributed, one can come up with the 95% confidence interval for the portfolio's change in monthly value by multiplying the portfolio's recent monthly volatility by two (or 1.96, to be exact.) The portfolio's volatility is calculated from the recent volatilities and correlations of the portfolio's instruments. This is the standard Value-at-Risk approach. Now, this approach alone is obviously inadequate for a commodity portfolio, which consists of instruments that have a tendency towards extreme positive skewness.

That commodity price distributions are positively skewed has been observed by a number of researchers, including Deaton and Laroque (1992). They attribute this empirical feature to the impossibility of the "market as a whole to carry negative inventories." When there is too much supply of a commodity, there are two levers that can balance supply and demand: the price can decrease and some of the commodity can be held in storage. When there is not enough of a commodity, only price can adjust to balance supply and demand, leading to the asymmetry in commodity price distributions.

Exhibit 1, for example, illustrates how the price of corn rises exponentially as the amount of inventories (normalized for recent consumption) decreases.

We would conclude that while the Value-at-Risk measure is useful, it has to be used jointly with other measures and actions, given the potential for violent price explosions in the commodities markets. Nonetheless, VaR is useful since one wants to ensure that under normal conditions, a commodity position has not been sized too large that one cannot sustain the random fluctuations in profits and losses that would be expected to occur, even without a dramatic event occurring.

Worst-Mark Evaluation

Using long-term data, one can directly examine the worst performance of a commodity trade under similar circumstances in the past. In practice, we have found that such a measure will sometimes be larger than a Value-at-Risk measure based on recent volatility.

If the loss on a particular commodity futures trade exceeds the historical worst case, this can be an indication of a new regime that is not reflected in the data. This should trigger an exit from a trade since one no longer has a handle on the worst-case scenario.

This may be counterintuitive advice for investment professionals who have been schooled in the financial markets of the past 18 years. Since 1987, market professionals have been rewarded for either staying with investments or even increasing the size of their investments in the face of financial market dislocations. But in the commodity market it is different.

Akey (2005) explains why this is the case:

"When a currency weakens, … the Federal Reserve has a variety of tools available to manage valuation and promote stability. Similarly, central banks can massage interest rates to address economic concerns like inflation and deflation. Companies, also, can address many near-term over- or under-performance matters through a variety of corporate actions. *When a drought damages a grain crop on a large-scale basis or a hurricane destroys a key energy distribution channel, however, governments, banks, and companies often have limited options to encourage short-term stability in commodity markets. Even Alan Greenspan can't make more corn.*" [Italics added.]

There are two reasons that previously historically reliable commodity strategies can fail. One reason is that fundamental structural changes may occur in a commodity market's supply or demand situation. Another reason is that one may have inadequate historical data to understand the full range of possible outcomes for a market. Examples of each of these scenarios are given below.

Structural Break Monitoring

During the summer of 2005, a very good example of a market undergoing fundamental changes has been the petroleum complex. A historically reliable strategy had been to enter into the gasoline versus heating oil spread. Until this year, traders had expected gasoline to outperform heating oil coming into the U.S. summer driving season. The market historically provided large monetary incentives to refiners to maximize the production of gasoline at the expense of heating oil to sufficiently service summer gasoline demand.

This year was different. Fusaro (2005) reveals that in the summer of 2005, "the big Wall Street houses and some other hedge funds lost many … hundreds of millions [of dollars] on gasoline/heating oil spreads. They could not imagine that heating oil would go higher than gasoline in June. It just never happened before."

Exhibit 2 shows the gasoline versus heating oil spread differential as of the beginning of June since 1985. Indeed, it had been unprecedented for heating oil to be priced at a premium to gasoline during that time of year.

What happened? One hypothesis is that Chinese demand patterns are creating structural changes in the commodity markets. According to Stein (2005), "This is the first business cycle where Chinese demand is having a global effect on prices, notably of energy and other raw materials."

In the specific case of petroleum products, Farivar (2005) states that "in China, diesel demand has been rising rapidly, because power shortages have forced many companies to use stand-alone generators. Diesel accounts for a significant portion of the overall rise in Chinese oil demand over the past year." Because diesel and heating oil have similar compositions, heating oil futures are frequently used as a proxy hedge for diesel inventories, which means that a rise in diesel prices tends to lead to a rise in the value of heating oil futures.

It appears that the Chinese demand for diesel trumped the American consumer's demand for gasoline, a scenario that was historically unprecedented.

This unusual demand for diesel also led to other historical petroleum complex relationships breaking down.

For example, one reasonably reliable strategy had been to expect that deferred-month crude oil futures would outperform deferred-month heating oil futures from the beginning of the year through the summer. A contributing reason for this strategy's historical consistency is as follows.

At the beginning of the year, there had been a historical tendency for airlines or their intermediaries to buy heating oil futures as a proxy hedge for their future jet fuel needs. There would also be no natural commercial sellers of heating oil in the deferred (six to nine months out) sector of the futures curve in similar magnitude to the purchases by the airlines. This then caused deferred heating oil prices to be bid up relative to other petroleum complex products. Specifically, the deferred heating oil crack spread (long heating oil/short crude oil) would be bid to a level that was higher than what it would likely converge to six to nine months forward, given refinery economics. With the crack spread sufficiently wide, marginal providers of liquidity would enter the market, selling deferred heating oil and buying crude oil against this sale. By holding this spread at levels beyond what one would expect the spread to converge to, spread traders had historically earned a liquidity premium.

Exhibit 3 shows the historical results of entering into a spread position of selling deferred-delivery heating oil versus buying deferred-delivery crude oil. Exhibit 4 shows the worst within-period loss that a commodity futures investor would have sustained historically. The largest loss over the period had been -$1,385 per spread.

Exhibit 5 shows how this spread fared during 2005. Given the unprecedented demand for heating oil, the crude-oil-versus-heating oil spread performed very poorly, ultimately losing -$7,549 per spread.

The conclusion from this discussion is that a commodity program will not experience the full brunt of a structural break if one exits a trading strategy after experiencing losses that are greater than have been the case in the past. In our example, once the spread had lost more than the previous worst-case loss of -$1,385, one had an indication that there may

have been structural changes in heating oil demand, which would have led to an early exit from this strategy, thus substantially reducing the ultimate losses experienced with this strategy.

Inadequate Historical Data

The summer of 2005 provides another good example of the need to monitor worst-case scenarios. Some commodity futures contracts do not have long-term historical data in which to evaluate the range of possible outcomes of a trading strategy. For example, the natural gas futures contract only started trading in 1990. This becomes a problem when one needs very long-term data to understand the potential severity of hurricane risk. A news bulletin of the time stated that as of September 2005, "[Hurricane] Rita is the 17th named storm of the Atlantic hurricane season. That makes this season already the fourth busiest since record-keeping began in 1851," according to Sullivan and Piotrowski (2005).

Fusaro (2005) discusses some of the investment consequences of incompletely understanding hurricane risk: "The new energy hedge fund phenomenon has also been slammed recently as several very big funds lost $100 to $150 million apiece on natural gas prices. They thought natural gas would … [decline] in the … fall [contract months] when gas usage [typically] drops. They were … wrong due to the 'event risk' of Hurricane Katrina."

Exhibit 6 shows the unprecedented rise in natural gas prices, as of September 2005.

This example again shows the need to monitor the worst-case historical loss. Once this loss is exceeded, this could indicate that one's historical data does not incorporate the full range of possible negative outcomes. In that case, it is advisable to either exit or scale down the sizing of the losing strategy.

RISK MEASUREMENT AT THE PORTFOLIO LEVEL

The previous section had focused on risk measurement at the strategy level. We had advocated that the investor use two metrics: Value at Risk and Worst-Mark Evaluation. We had discussed the Worst Mark recommendation in depth because this recommendation may seem unusual to investors whose previous experience had only been in the financial markets.

Risk measurement at the portfolio level is fundamentally different than risk measurement at the strategy level. At the portfolio level, an investor is concerned with how dynamic correlations among strategies may affect portfolio-level risk. An investor is further concerned with how one's commodity portfolio may perform during financial shocks since commodity products are frequently marketed as being uncorrelated to the dominant financial asset classes. This section will describe appropriate portfolio-level metrics that address these concerns.

Diversified Portfolio Goal

As discussed by Erb and Harvey (2005), "To a large degree, commodity futures are uncorrelated with another." Using data from December 1982 to May 2004, the authors study the interrelationships of the following commodity futures contracts: heating oil, live cattle, lean hogs, wheat, corn, soybeans, sugar, coffee, cotton, gold, silver, and copper. Erb and Harvey write that:

"The average correlation of individual commodities with one another is only 0.09 [with the average absolute correlation being 0.11]. For instance, heating oil's average correlation with the other eleven commodities is 0.03, its highest correlation of 0.15 is with gold and its lowest correlation of -0.07 is with coffee."

A commodity portfolio manager will use this property of commodity futures contracts to attempt to create a portfolio of diversified commodity strategies with dampened risk. Commodity hedge fund manager Paul Touradji affirms this view: "One of the best things about being a commodity manager is the natural internal diversification." "While even unrelated equities have a beta to the overall market, many commodities, such as sugar and aluminum, traditionally have no correlation at all," according to Teague (2004) in his interview with the hedge fund manager.

Exhibit 7 illustrates a commodity futures portfolio from June 2000, which combined seven unrelated commodity trades. The exhibit demonstrates the effect of incrementally adding unrelated trades on portfolio volatility.

One difficulty with using historical correlations to evaluate portfolio risk is that correlations amongst commodities vary both seasonally and during eventful periods. There are times when a common factor can impact seemingly unrelated positions, causing a seemingly diversified portfolio to have inadvertent concentration risk to the common factor. Therefore, a commodity investor needs to include scenario analyses, which show a portfolio's sensitivity to meaningful events, in his or her risk-measurement toolkit. Example scenario analyses are provided below.

Extreme Weather Events

Normally, natural gas and corn prices are unrelated. But during the summer, they can be highly correlated. During a three-week period in July 1999, for example, natural gas and corn prices were +85% correlated. Both corn and natural gas trades are heavily dependent on the outcome of weather in the U.S. Midwest. And in July, 1999, the Midwest had blistering temperatures (which even led to some power outages.) During that time, both corn and natural gas futures prices responded in nearly identical fashions to weather forecasts and realizations, as seen in Exhibit 8.

More recently, Exhibit 9 shows how corn and natural gas prices waxed and waned in concert during the summer of 2005 due to their common reactions to the possibility of extreme Midwest heat.

What this means for commodity managers is that they should measure how much sensitivity their portfolio has to extreme summer weather in the Midwest. The manager would want to ensure that in the event of a heat-wave in the U.S. Midwest that his or her portfolio would not perform exceptionally poorly.

Other potentially extreme weather shocks to include in ongoing scenario analyses include the chance of an end-of-February cold shock on energy positions as well as the possibility of a damaging hurricane season, as discussed earlier.

Sharp Shocks to Business Confidence

Futures products are typically marketed as equity investment diversifiers. Therefore, one job of risk management is to attempt to ensure that a futures investment will not be too correlated to the equity market during periods of dramatic equity losses.

Although a commodity futures portfolio may contain no financial futures contracts, the portfolio can still have systematic risk to the stock market. For example, Bessembinder (1992) found that live cattle, soybeans, silver and platinum futures contracts had statistically significant betas to the U.S. stock market using data from January 1967 to December 1989. (The data for platinum started in January 1968.) More recently, Erb and Harvey (2005) state that "the non-energy sector has a statistically significant, but small equity risk premia beta" using data from December 1982 to May 2004.

Exhibits 10 and 11, for example, illustrate how live cattle futures positions performed poorly along with the stock market during the October 1987 stock market crash *and* during the aftermath of the September 11th, 2001 terrorist attacks.

Given the potential of a commodity portfolio to perform poorly during financial shocks, a manager should therefore examine what the portfolio's performance would have been during the October 1987 stock market crash, the 1990 Gulf War, the Fall 1998 bond debacle, and during the immediate aftermath of September 11, 2001. If the commodity portfolio would have done poorly during these events, then the manager may consider either deleveraging his or her portfolio or buying option protection against one of the damaging scenarios.

Rajagopal (2004) notes that a commodity-index investment provides "tail protection for fixed income." In other words, during those quarters where bonds had negative performance, commodities cumulatively performed well over the period, 1992 to 2004. For a portfolio that has a long commodity bias, one can also state the converse: long fixed-income positions can potentially provide event-risk protection for a commodity portfolio. This is illustrated in Exhibit 12, which is discussed in the next section on summary risk metrics.

Summary Risk Metrics

Exhibit 12 provides an example risk report, which shows the Value-at-Risk and Worst-Case scenarios at both the strategy and portfolio level. The events used in Exhibit 12's risk report are defined above in the Sharp Shocks to Business Confidence section of this article. Note that a deferred long position in Eurodollar (short-term U.S. interest-rate) futures contracts reduces the commodity portfolio's risk to extreme financial events.

On a per-strategy basis, it is useful to examine each strategy's:

- Value-at-Risk based on recent volatilities and correlations;
- Worst-case loss during normal times;
- Worst-case loss during well-defined eventful periods;
- Incremental contribution to Portfolio Value-at-Risk; and
- Incremental contribution to Worst-Case Portfolio Event Risk.

The latter two measures give an indication if the strategy is a risk reducer or risk enhancer.

On a portfolio-wide basis, it is useful to examine the portfolio's:

- Value-at-Risk based on recent volatilities and correlations;
- Worst-case loss during normal times; and
- Worst-case loss during well-defined eventful periods.

Each measure should be compared to some limit, which has been determined based on the risk tolerance of one's investors. If the product should not perform too poorly during financial shocks, then the worst-case loss during well-defined eventful periods should be constrained to a relatively small number. If that worst-case loss exceeds the limit, then one can devise macro portfolio hedges accordingly.

Now obviously the danger with these recommended approaches is that one is relying on historical data for guidance since completely unprecedented events do happen, as discussed previously. That is why we recommend exiting any futures trades in which the losses exceed those known in history since one is then in uncharted territory.

Exhibit 12 displays the recommended risk measures for an example portfolio. Note again the properties of the Eurodollar (short-term interest rate) futures. The interest-rate position is a portfolio event-risk reducer, as discussed previously, but it also adds to the volatility of the portfolio under normal conditions.

Therefore, an incremental-contribution-to-risk measure based solely on recent volatilities and correlations does not give complete enough information about whether a trade is a risk reducer or risk enhancer.

Final Caveat on Dynamic Correlations: The Relationship Between Commodities and Interest Rates

Correlations During the Aftermath of the 9/11/01 Attacks

A number of commodity futures strategies have a long commodity bias since they rely on taking on inventory risk that commercial participants wish to lay off. One consequence is that these strategies are at risk to sharp shocks to business confidence. And during sharp shocks to business confidence as occurred in the aftermath of September 11th 2001, not only did the stock market perform quite poorly, but economically sensitive commodities also performed poorly.

The Greenspan Federal Reserve Board has responded to financial shocks by cutting interest rates, which has resulted in the stock market stabilizing. As long as this type of policy continues, one way to hedge a portfolio that has exposure to shocks to business confidence or shocks to the availability of credit is to include a fixed income hedge. The hedge could take the form of either a Eurodollar futures contract overlay or purchases of out-of-the-money fixed-income calls. The post-9/11/01 experience validated that a long fixed-income position was an effective hedge for a portfolio that is primarily long economically sensitive commodities.

Exhibit 13 reviews the performance of gasoline futures contracts and short-term interest rate contracts in the aftermath of the 9/11/01 attacks. While gasoline prices plummeted due to the expectation of an economic slowdown, short-term interest rate contracts rallied as the Federal Reserve Board (Fed) cut interest rates to calm the financial markets.

Correlations During the Aftermath of Hurricane Katrina

One caveat to this lesson is that the relationship between commodities and interest rates varies according to the type of meaningful event. For example, during the aftermath of Hurricane Katrina in late August through the middle of September, 2005, gasoline and short-term interest rates reacted similarly to the prospect of scarce gasoline supplies, as shown in Exhibit 14. During the initial explosive rise in gasoline prices, due to the shut-down of crucial Gulf Coast refineries, interest-rate-market participants concluded that the Fed would pause in its interest-rate tightening cycle, which then caused deferred month interest-rate contracts to rally.

According to a Dow Jones Newswire report (2005) of the time, "[Hurricane] Katrina shut in nearly all of oil and gas production in the Gulf of Mexico … The large scale supply disruption and fear of an economic shock triggered a massive government response. The outages prompted the Bush administration to release Strategic Petroleum Reserve oil, waive air-pollution rules on fuels, and ease restrictions on use of foreign-flagged vessels to carry fuel in U.S. waters." Further, "Members of the Organization of Economic Cooperation and Development agreed … to [release] 2 million barrels a day of crude oil and petroleum products from their strategic stocks for 30 days."

This unprecedented government response caused gasoline prices to decline from their post-Katrina peak, and with that response, fears of an economic slump diminished, which in turn caused deferred interest-rate contracts to also decline, as the market resumed pricing in the expectation that the Fed would continue tightening interest rates.

In the scenario just described, changes in daily gasoline prices and short-term interest rates became +75% correlated during the aftermath of Hurricane Katrina. This is in sharp contrast to the negative relationship between changes in gasoline prices and short-term interest rates that occurred in the aftermath of Twin Tower attacks.

In the aftermath of Hurricane Katrina, long positions in interest rates did not serve as an event hedge for long positions in gasoline; instead these two positions became the same trade, both on the upside and the downside.

The lesson from this section is that risk measurement at the portfolio level is a constant and dynamic process.

FINAL NOTE

According to an equity hedge fund manager who specializes in options trading, "There is a lumpiness to returns with volatility trading. You take the returns when they are there, and the rest is risk management," wrote Gallo (2005) in his interview with the manager.

A commodity futures investor, who relies on the stability of historical relationships, could say much the same thing. There are pockets of predictability within the commodity futures markets that managers can potentially take advantage of in disciplined futures trading strategies. As a matter of fact, Till and Eagleeye (2005a) summarize the academic and practitioner literature, which provides evidence of numerous empirical regularities in these markets.

That said, fundamental structural changes occur constantly in the commodity markets. Therefore, the measurement and management of risk are absolutely crucial to the ongoing viability of an active commodity futures program.

ACKNOWLEDGEMENTS

The author would like to note that the ideas in this chapter were jointly developed with Joseph Eagleeye, co-founder of Premia Capital Management, LLC. As such, we had previously discussed some of this chapter's concepts in Till and Eagleeye (2004) and in Till and Eagleeye (2005a) as well as in Till (2002).

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REFERENCES

Akey, Rian, 2005, "Commodities: A Case for Active Management," *Journal of Alternative Investments*, forthcoming Fall.

Bessembinder, Hendrik, 1992, "Systematic Risk, Hedging Pressure, and Risk Premiums in Futures Markets," *The Review of Financial Studies,"* pp. 637-667, April.

Deaton, Angus, and Guy Laroque, 1992, "On the Behavior of Commodity Prices," *Review of Economic Studies*, pp. 1-23, January.

Dow Jones Newswire, 2005, "Nymex Crude Tumbles as Output Recovers," September 6.

Erb, Claude and Campbell Harvey, 2005, "The Tactical and Strategic Value of Commodity Futures," Trust Company of the West and Duke University working paper, August 24.

Everett, Bevan, 2005, "FCStone Grain Recap," p. 1, March 18.

Farivar, Masood, 2005, "Diesel Prices Take on Life of Their Own as Demand Surges," Dow Jones Newswires, May 20.

Fusaro, Peter, 2005, "Energy: An Immature Financial Market," *Energy Hedge*, p. 1, October 1.

Gallo, Pete, 2005, "Volatility Players Aim to Escape the Doldrums," *Absolute Return Magazine*, p. 37, July.

Rajagopal, Mohan, 2004, "Examining the Financial Benefits of Commodities and Practical Issues of Implementation," Deutsche Bank, Marcus Evans Conference on Investing in Commodities, London, November 8.

Rodger, Angus, 2005, "Goldman Sachs Confident on Index Returns Despite Contango," *Oil Daily*, p. 5, 26 September.

Stein, Gabriel, 2005, "World Oil Demand Revised Down Again," *Lombard Street Research's World Service Daily Note*, September 9.

Sullivan, John and Matt Piotrowski, "New Storm Threatens US Gulf, Drives Crude Oil Up $4," *Oil Daily*, p. 3, September 20.

Teague, Solomon, 2004, "The Commodities 'Gladiator'," *Risk Magazine*, p. 88, June.

Till, Hilary, 2000, "Passive Strategies in the Commodity Futures Markets," *Derivatives Quarterly*, pp. 49-54, Fall.

Till, Hilary, 2002, "Risk Management Lessons in Leveraged Commodity Futures Trading," *Commodities Now*, pp. 84-87, September.

Till, Hilary and Joseph Eagleeye, 2004, "How to Design a Commodity Futures Trading Program," in G. Gregoriou, V. Karavas, F-S Lhabitant, and F. Rouah, (eds), *Commodity Trading Advisors: Risk, Performance Analysis, and Selection* (Hoboken, NJ: Wiley Finance), pp. 277-293.

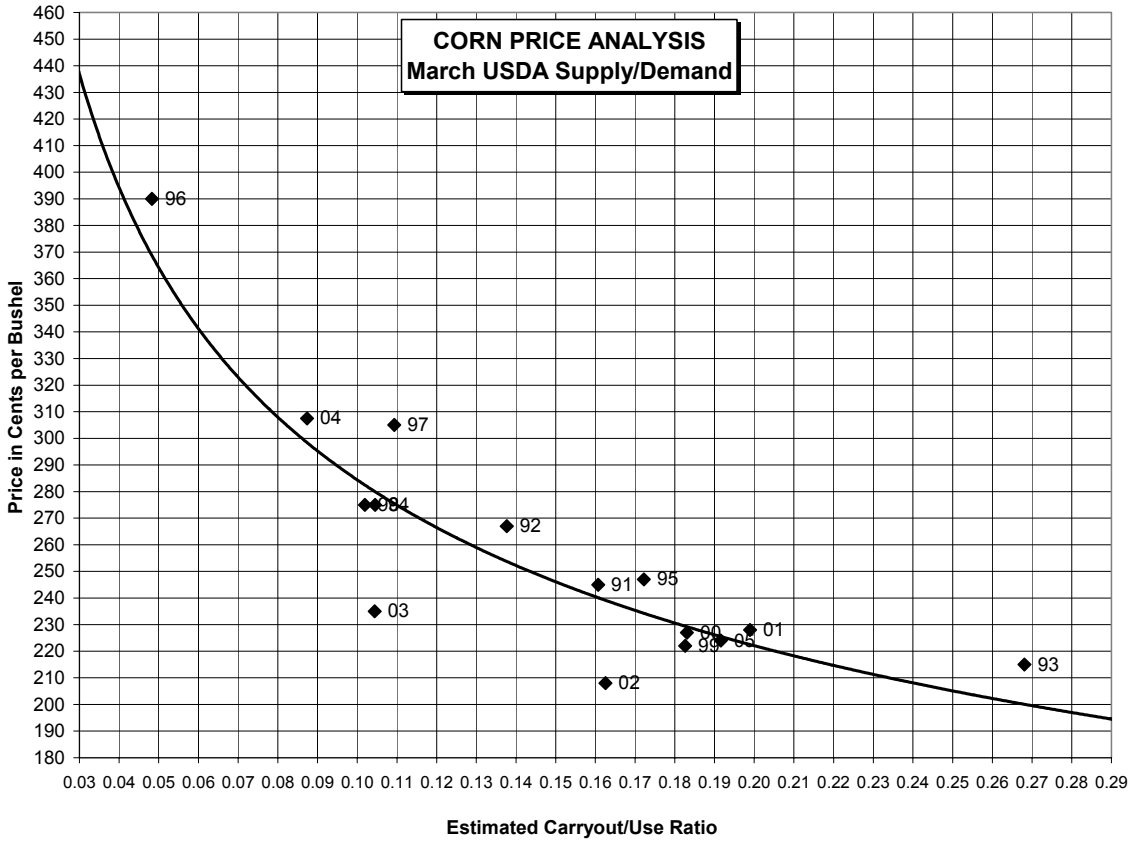
Till, Hilary and Joseph Eagleeye, 2005, "Commodities – Active Strategies for Enhanced Return," in R. Greer, (ed), *The Handbook of Inflation Hedging Investments,* (New York: forthcoming McGraw Hill book), and in *Journal of Wealth Management*, pp. 42-61, Fall.

Till, Hilary and Joseph Eagleeye, 2005, "Challenges in Commodities Risk Management," *Commodities Now,* forthcoming September.

EXHIBITS

Exhibit 1

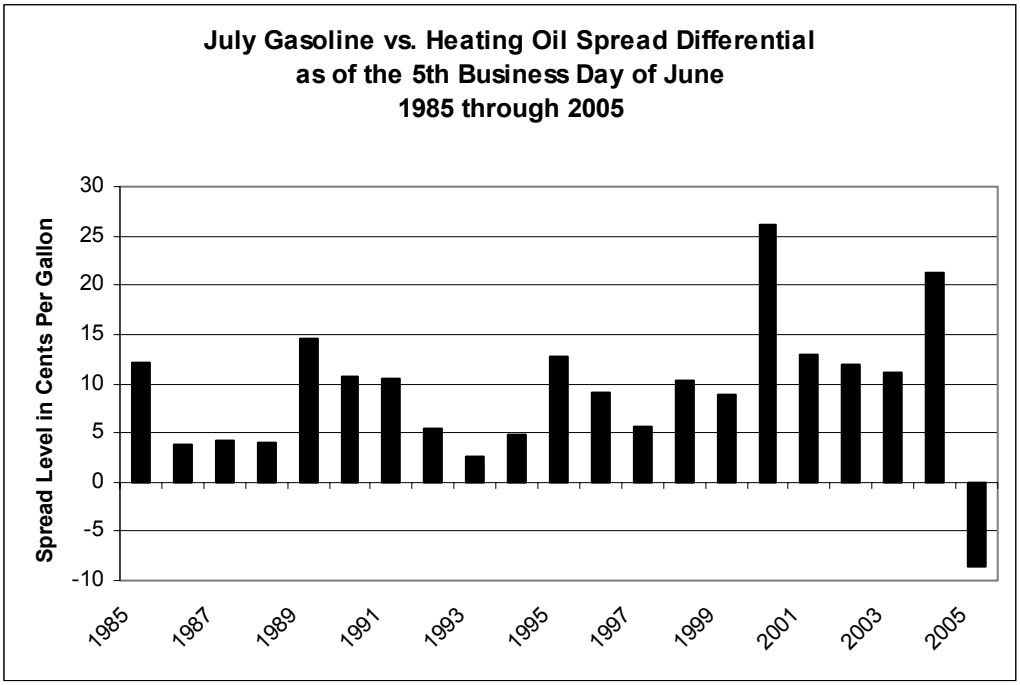
Corn Price Versus Inventories Normalized for Demand



Source: Everett (2005).

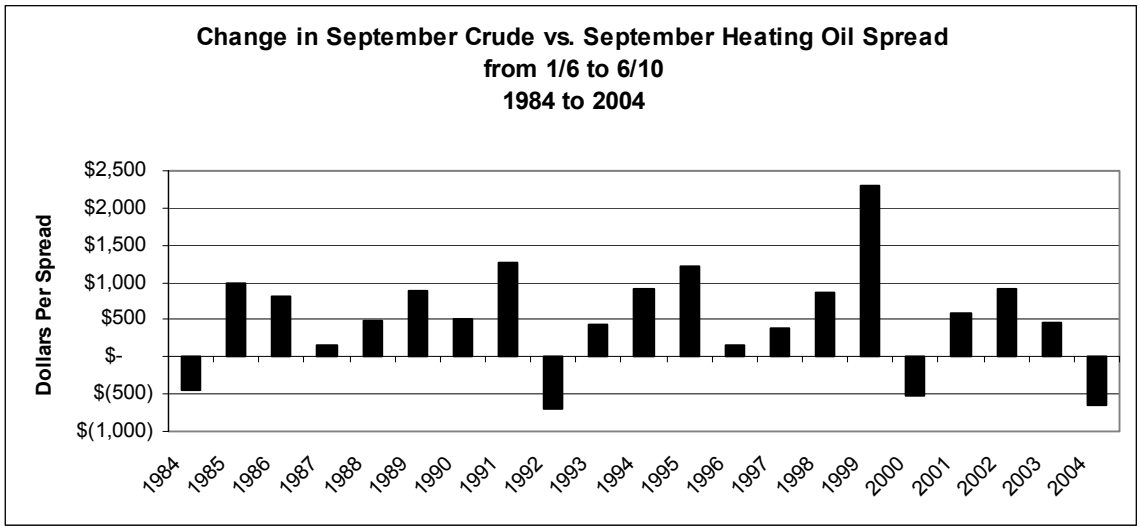
Exhibit 2

Gasoline versus Heating Oil Spread Level



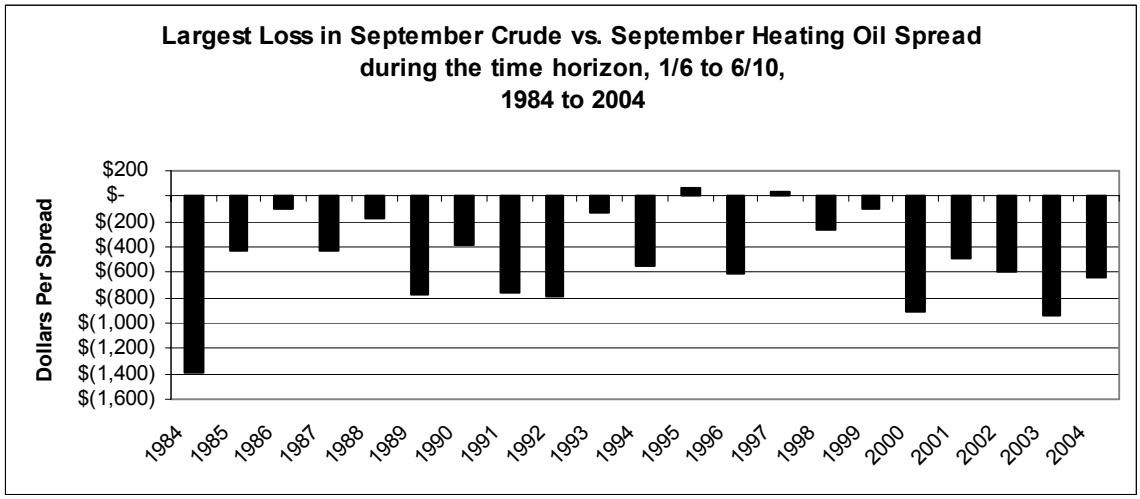
Source: Premia Capital Management, LLC.

Exhibit 3



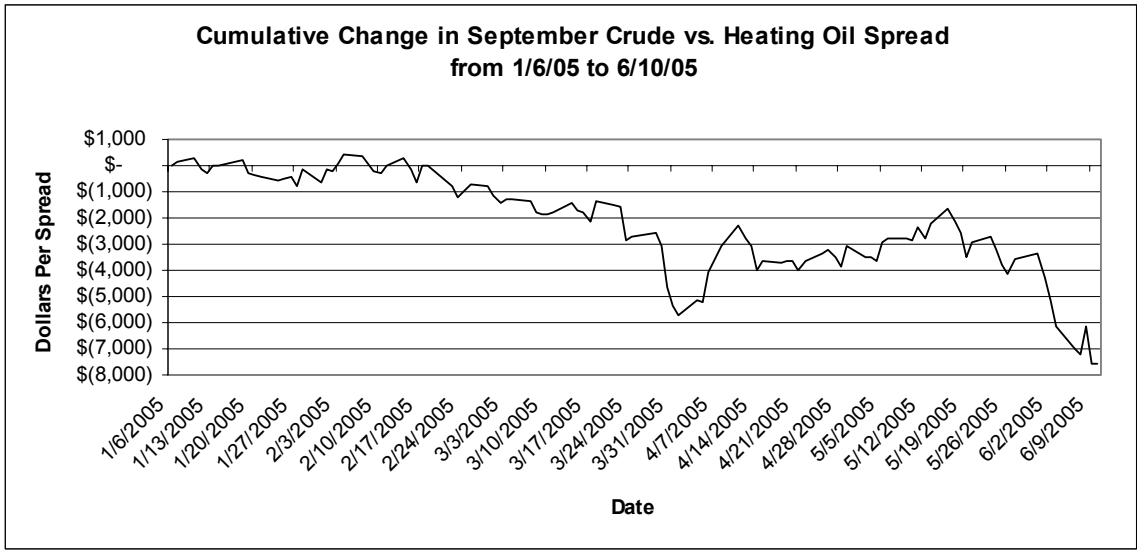
Source: Premia Capital Management, LLC.

Exhibit 4



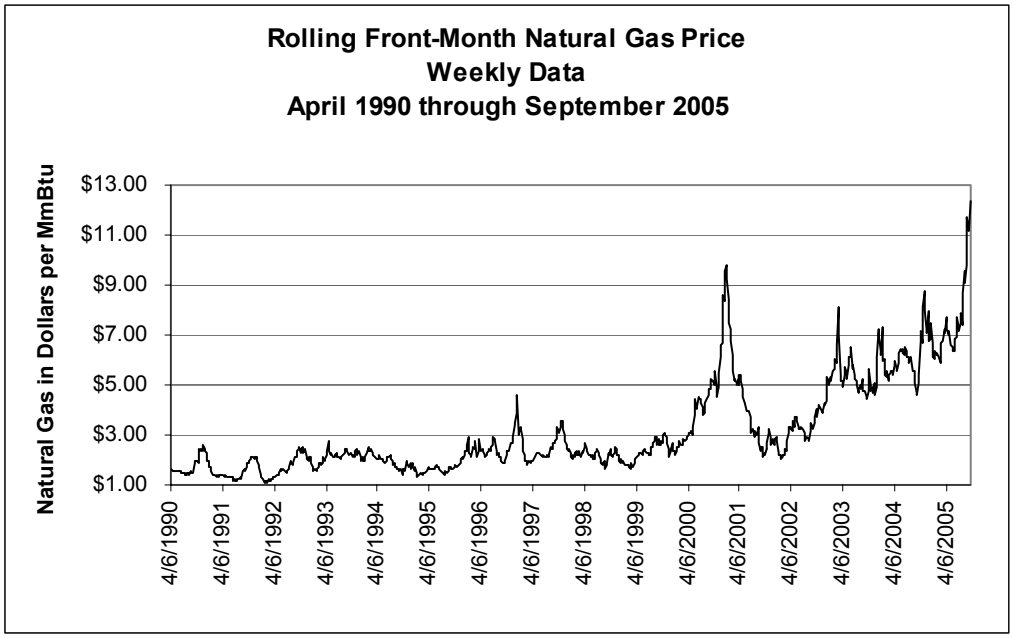
Source: Premia Capital Management, LLC.

Exhibit 5



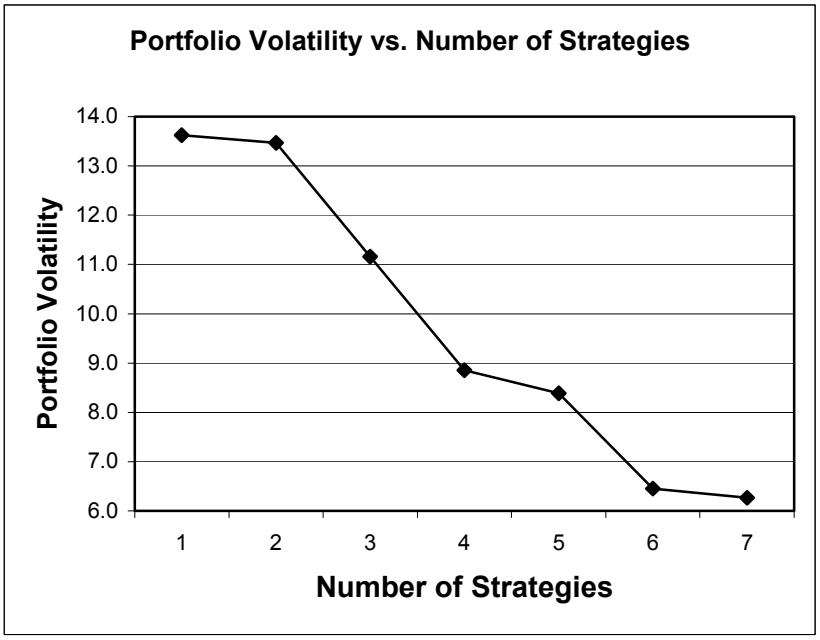
Source: Premia Capital Management, LLC.

Exhibit 6



Data Source: The Bloomberg.

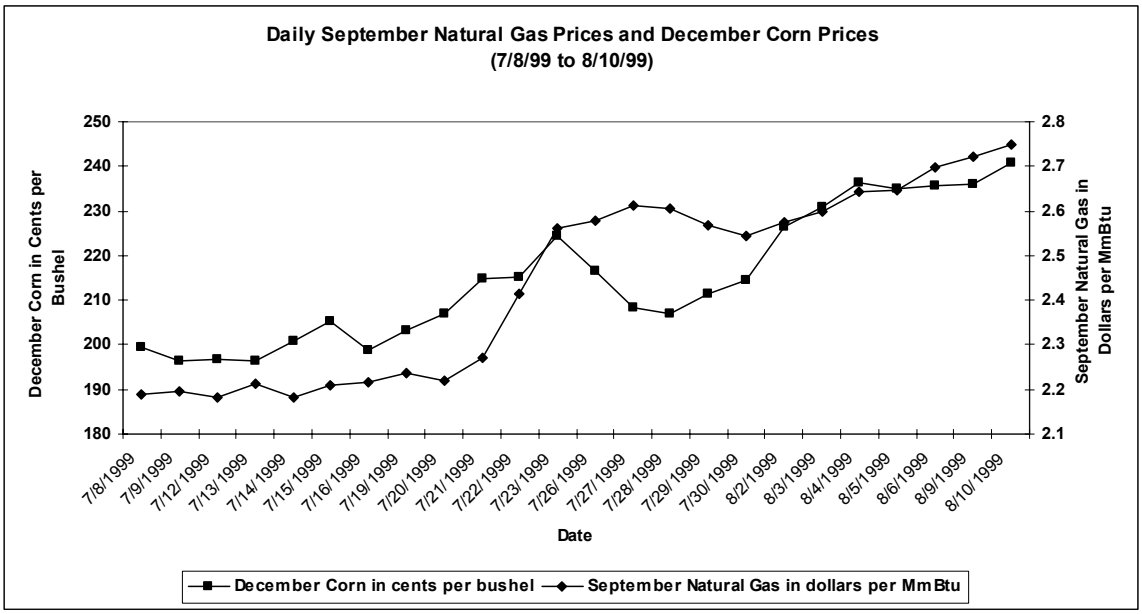
Exhibit 7



Based on three months of recent price data as of June, 2000, these strategies have correlations amongst each other of between –20% and +20%. This graph shows annualized portfolio volatility versus number of commodity strategies during June 2000.

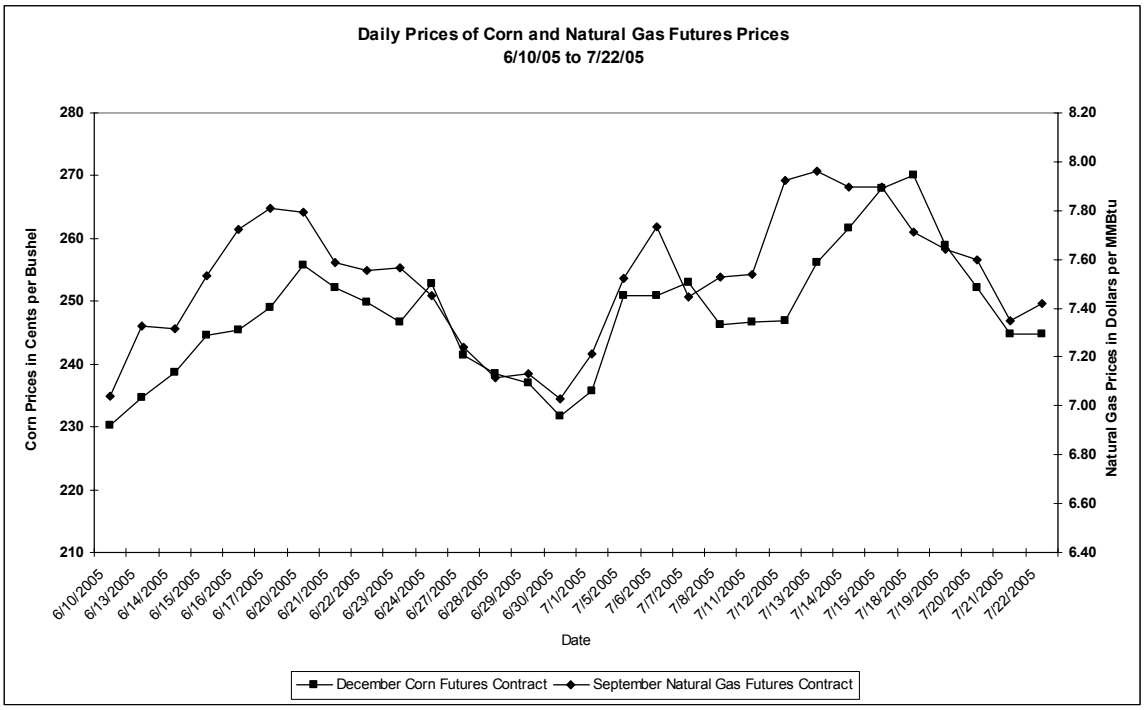
Source: Till (2000), Exhibit 5.

Exhibit 8



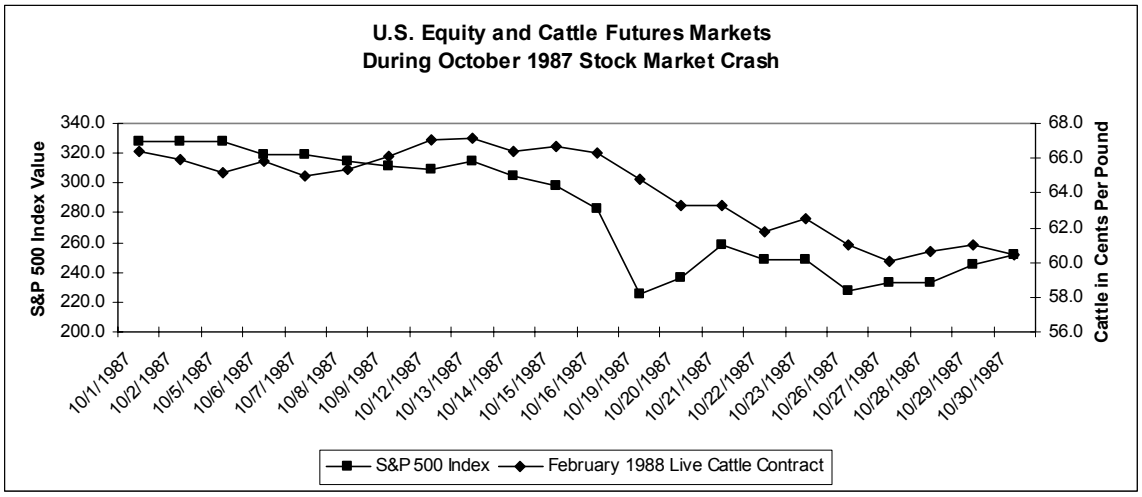
Source: Premia Capital Management, LLC.

Exhibit 9



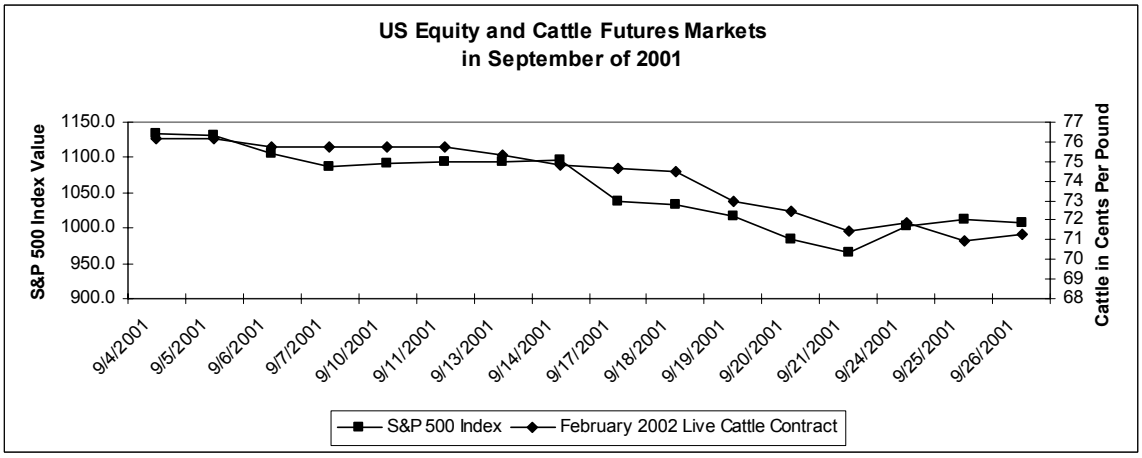
Source: Till and Eagleeye (2005b), Figure 5.

Exhibit 10



Source: Premia Capital Management, LLC.

Exhibit 11



Source: Premia Capital Management, LLC.

Exhibit 12

Strategy- and Portfolio-Level Risk Analysis

8/11/2004

	Strategy	Value-At-Risk	Worst-Case Loss During Normal Times	Worst-Case Loss During Eventful Period
1	Gasoline Front-to-Back Spread	2.59%	-5.59%	-4.31%
2	Deferred Outright Gasoline	3.81%	-2.50%	-2.76%
3	Deferred Outright Natural Gas	0.67%	-0.15%	-0.29%
4	Deferred Eurodollar Futures	2.42%	-5.92%	-0.96%
5	Hog Spread	3.87%	-2.66%	-3.23%
6	Deferred Gasoline Spread	1.60%	-0.29%	-0.53%
7	Cattle Spread	1.62%	-0.50%	-1.34%
	Portfolio	**9.24%**	**-8.89%**	**-2.27%**

	Strategy	Incremental Contribution to Portfolio Value-at-Risk*	Incremental Contribution to Worst-Case Portfolio Event Risk*
1	**Gasoline Front-to-Back Spread**	**1.62%**	**0.64%**
2	**Deferred Outright Gasoline**	**2.93%**	**-0.72%**
3	Deferred Outright Natural Gas	0.52%	0.16%
4	**Deferred Eurodollar Futures**	**0.77%**	**-2.86%**
5	Hog Spread	1.18%	-0.29%
6	Deferred Gasoline Spread	1.33%	0.29%
7	Cattle Spread	0.25%	-0.32%

* A positive contribution means that the strategy adds to risk while a negative contribution means the strategy reduces risk.

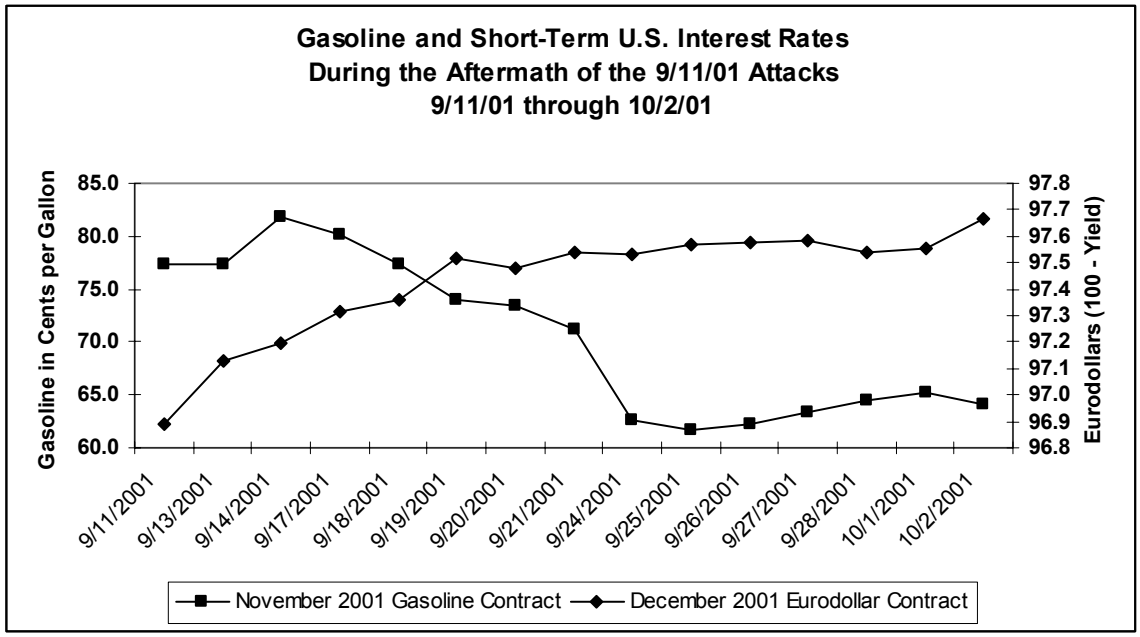
Notes

While under "normal" times, the gasoline spread position is less risky than the outright, during particular "eventful" times the spread adds to risk while the outright reduces risk.

While under "normal" times, the Eurodollar futures position adds to risk, during particular "eventful" times this interest-rate position reduces risk.

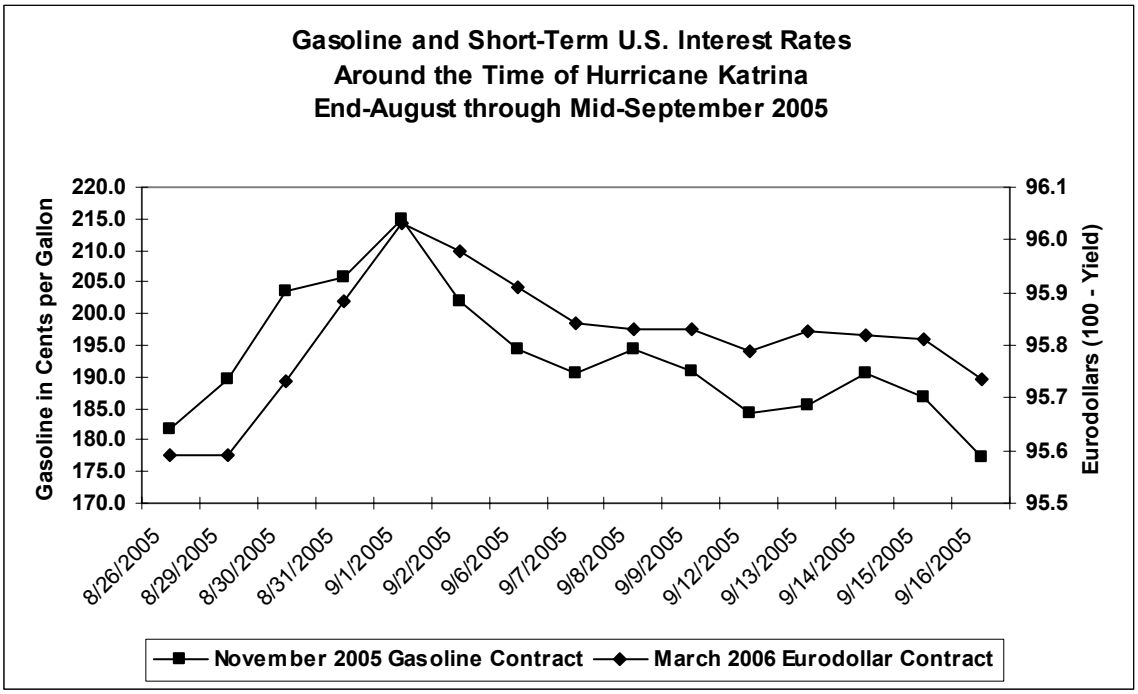
Source: Till and Eagleeye (2005a), Exhibit 18.

Exhibit 13



Source: Premia Capital Management, LLC.

Exhibit 14



Source: Premia Capital Management, LLC.

BIOGRAPHY

HILARY TILL is the co-founder of Premia Capital Management, LLC (http://www.premiacap.com). Chicago-based Premia Capital specializes in detecting pockets of predictability in derivatives markets using statistical techniques. The firm's main focus is on the natural resources futures markets.

In addition, Ms. Till is an Advisory Board member of the Tellus Natural Resources Fund, a fund of hedge funds.

Before co-founding Premia Capital, Ms. Till was Chief of Derivatives Strategies at Boston-based Putnam Investments. Her group was responsible for the management of all derivatives investments in domestic and international fixed income, tax-exempt fixed income, foreign exchange, and global asset allocation. In 1997 for example, the total notional value of derivatives structured and executed by her group amounted to $93.2 billion.

Prior to Putnam Investments, Ms. Till was a quantitative analyst at Harvard Management Company (HMC) in Boston. HMC is the investment management company for Harvard University's endowment.

She has B.A. in Statistics with General Honors from the University of Chicago and a M.Sc. in Statistics from the London School of Economics (LSE.) She studied at LSE under a private fellowship administered by the Fulbright Commission.

Ms. Till's articles on commodities, risk management, and hedge funds have been published in the *Journal of Alternative Investments, AIMA (Alternative Investment Management Association) Journal, Derivatives Quarterly, Quantitative Finance, Risk Magazine*, *Journal of Wealth Management,* and the *Singapore Economic Review*.

She has also contributed chapters to the following edited books: *The New Generation of Risk Management in Hedge Funds and Private Equity Investments* (co-author, Euromoney, 2003), *Intelligent Hedge Fund Investing* (Risk Books, 2004), *Commodity Trading Advisors: Risk, Performance Analysis, and Selection* (co-author, Wiley, 2004), *Core-Satellite Portfolio Management* (McGraw Hill, 2005), *Hedge Funds: Insights into Performance Measurement, Risk Analysis, and Portfolio Allocation* (co-author, Wiley, 2005), *The Handbook of Inflation Hedging Investments* (co-author, forthcoming McGraw Hill, 2005), and *Hedge Fund Investment Management* (co-author, forthcoming Elsevier, 2005).