# The Market Tension Index

How many of us have, in the course of a particularly disagreeable trading day, punched up every piece of information on the news screen to pinpoint the source of our torment, then picked up the phone to our favorite broker and demanded, “Why’s the market going up?”  We often hear some variation on “More buyers than sellers!” in response.  Yet we sense this to be manifestly untrue, for we know the real answer is that the buyers are more eager, or anxious,  than the sellers.

Since neither understanding nor solace have any noticeable effect upon our equity, is there any way to quantify the measure of anxiety in the market so that some useful trading decisions can be made beforehand?  A real-time method for determining relative anxiety is offered below.

First, a postulate is offered:  markets trade in three dimensions that can be derived from their own price data. Each of these three measures can be centered around a “zero point” that is necessary for the proper construction of an index.

- **Volatility**, or the measure of uncertainty in the market;
- **Intermonth spread**, or the measure of price expectation over and above normal carrying costs; and
- **Trend**, or the measure of continuity of a price path over time.

These three measures are not completely unrelated, as shown below.  Central to the determination of both the trend and volatility measures used is an Adaptive Moving Average (AMA) that simultaneously minimizes 1) the differences between itself and the underlying price, and 2) the sum of its own price changes. The speed of the AMA is bounded by four days at its fastest (for consolidating markets) and twenty-nine days at its slowest (for trending markets).  This speed, referred to as N below, is the number of days that minimizes the function

$$\frac{1}{N}\sum_{i\ \ 1}^{N}\frac{N}{Vol^{2}}\cdot\left|(P-\ \ MA\right|*\left|\Delta MA\right|$$

The zero point for volatility occurs when implied volatility, as calculated from actual option prices, coincides with theoretical volatility, as calculated from any one of a number of historical measures. As the perceived risk of a market and the demand for price protection increase, implied volatility can outstrip the theoretical underlying volatility, and vice-versa.  We will use a high/low/close volatility, which incorporates both intraday price range and interday price change, as determined in the following two-step approach:

1. $\mathbf{V' = max(.5 * log(High/Low)^{2} - .39 * log(Close/Close_{t-1})^{2} , .000001)}$ ,

2. $\mathbf{Vol = \sum [V' * 260 / N]^{1/2}}$ ,

The zero point for the intermonth spread occurs when the market is in full carry:

$\mathbf{Month_{2} = Month_{1} * (1+r)^{t}}$  **+  Physical Storage Costs**,  where $(1+r)^{t}$ represents the financial costs of carry.

A market in deeper contango has a negative ‘convenience yield,’ as measured by the implied financial return for holding inventories available for immediate processing.  A market in backwardation has a positive convenience yield, which implies that the convenience of holding prompt inventories exceeds the physical and storage costs of those inventories. Convenience yields can be calculated by

$$\mathbf{[(Spread - Carry)/Price_{Month\ 1}]^{(360/Days)}},$$

which is simply the annualization of the difference between the actual intermonth spread and the intermonth spread at full carry as a percentage of the spot month price.

The zero point for trend occurs when the price equals its AMA. Since price and the AMA often cross, this trend measure is often referred to as an oscillator, and is defined as

$$\frac{\text{Price} - \text{AMA}}{\left(\frac{\text{Vol}}{\text{Price}}\right)},$$

This oscillator will tend to move away from balance more quickly in trending, low-volatility markets.

As buying or selling pressure builds in a market, balance can get disrupted in all three trading dimensions. For example, a market in a sharp downtrend will certainly have a negative trend, probably will have a negative convenience yield, and generally will have expanded implied volatility.

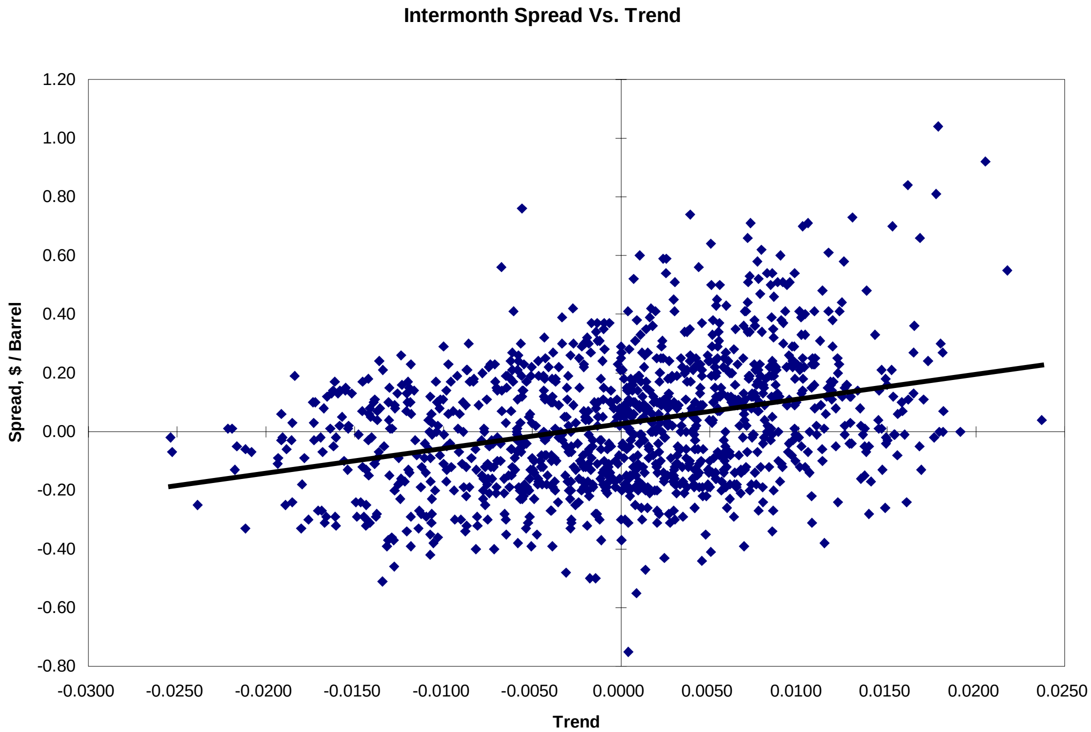
**A Case Study: NYMEX Crude Oil**

The widely fluctuating volatility and intermonth spreads of the crude oil market make it an excellent laboratory for demonstrating the construction of the Market Tension Index (MTI). The data used will be restricted to those available after the Persian Gulf War, not because the index behaves differently, but because the index's scale during the War is orders of magnitude greater than both before and after the War, and thus distorts graphical depiction.

First, we should familiarize ourselves with the data and convince ourselves that the three dimensions of trading are sufficiently unrelated to one another that we are not being redundant in our analysis. The graph "Intermonth Spread Vs. Trend" may come as a surprise to traders (NYMEX locals in particular) who persist in viewing spreads as a proxy for market direction. The statistical relationship is

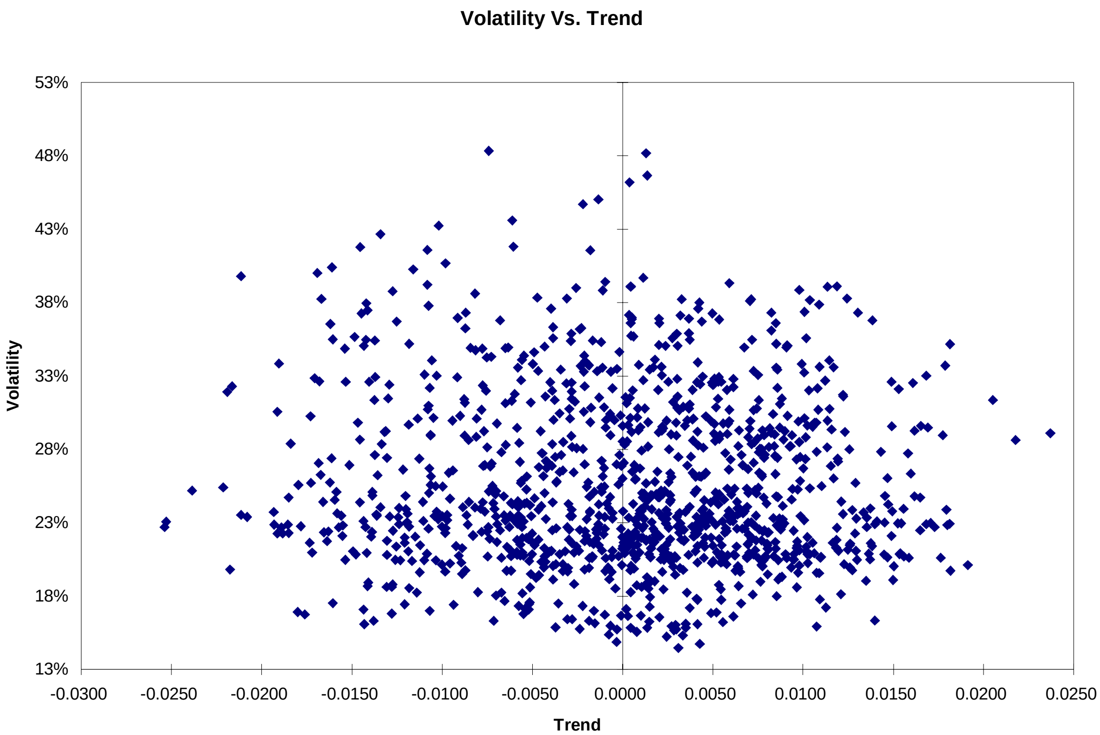
$$\begin{aligned}\textbf{Intermonth Spread} = \ & \mathbf{.15} \ + \ \mathbf{9.8 * Trend}, \ R^2 = \mathbf{.036}, \\ & \mathbf{(1.22)} \quad \mathbf{(.011)}\end{aligned}$$

which means that price movement can account for a mere 3.6% of the change in intermonth spread values.




The relationship between implied volatility and trend is even weaker; trend is statistically insignificant in explaining volatility:

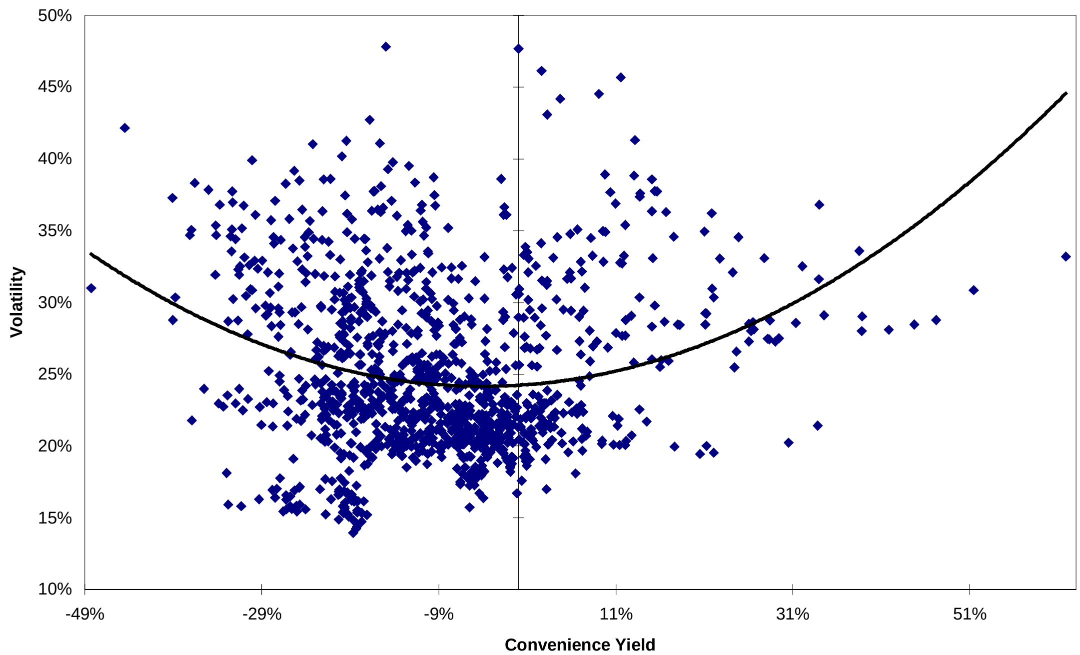
**Volatility = .30 - .14 * Trend , $R^2$ = .000067**
**(.43) (.004)**




The relationship between implied volatility and convenience yield is slightly more definite and, as can be expected, is quadratic in nature; we should expect volatility to rise more rapidly in both strong backwardation and strong contango.

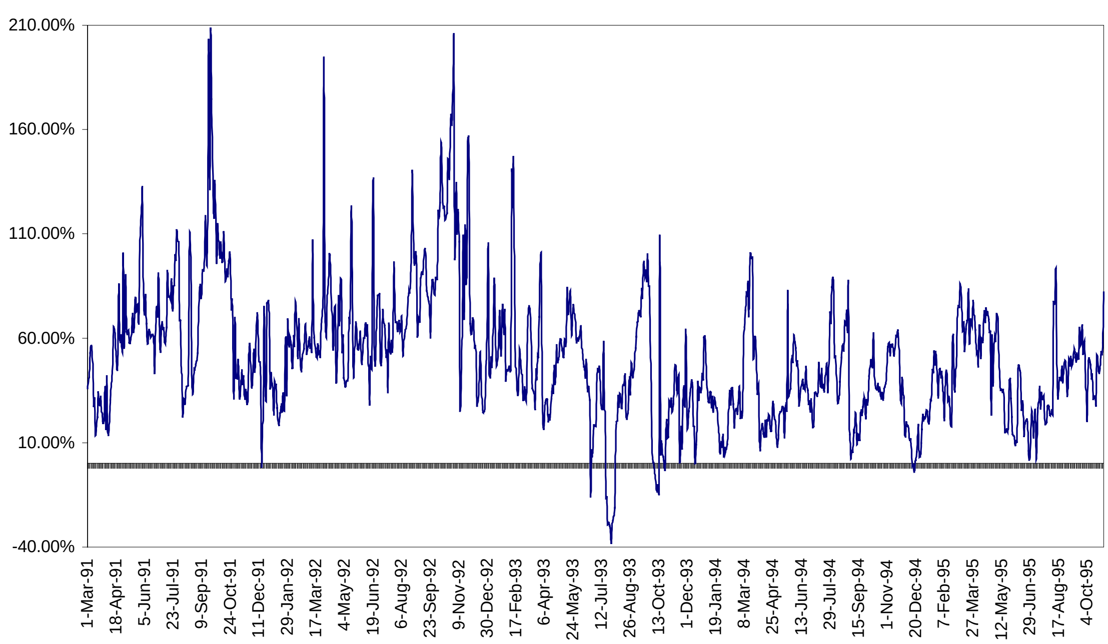
$$\textbf{Volatility} = .31 + \underset{(.018)}{.27} * \text{ConvYld} + \underset{(.026)}{.17} * \text{ConvYld}^2,\ R^2 = .219$$

**Implied Volatility Vs. Convenience Yield**



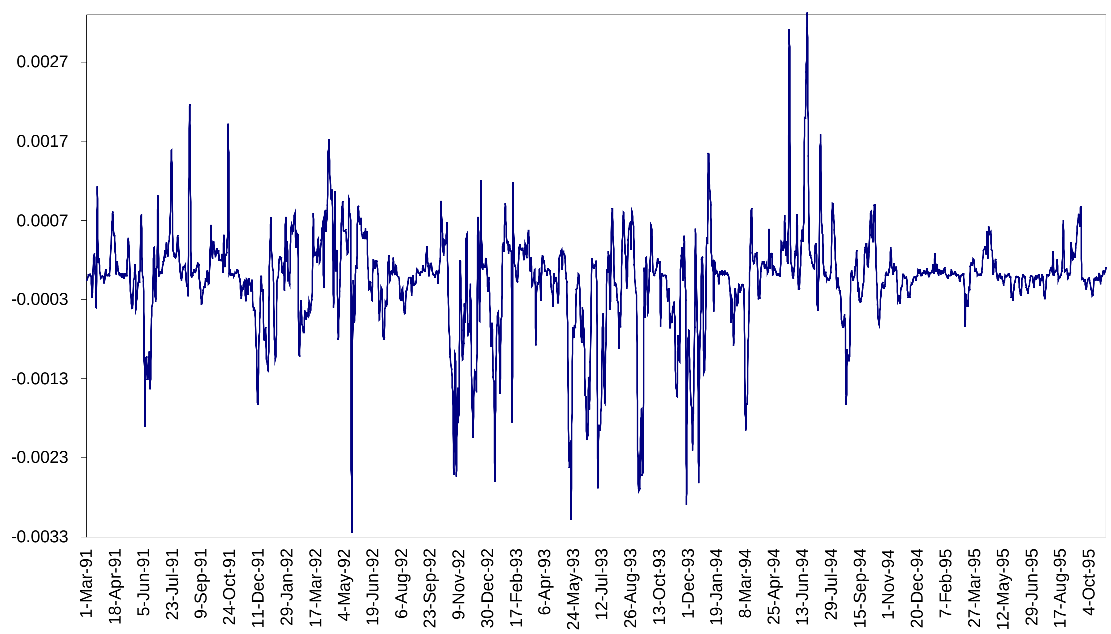

The relationship between implied volatility and high/low/close volatility demonstrates how implied volatility usually is higher. Given the high cost of being wrong in the options market, it is not surprising that option writers succeed in demanding a premium.

**Premium of Implied Volatility To High/Low/Close Volatility**



We can, using a generally multiplicative approach, combine the three components, the implied/theoretical volatility ratio, the convenience yield, and the trend oscillator into the unified MTI, shown below:

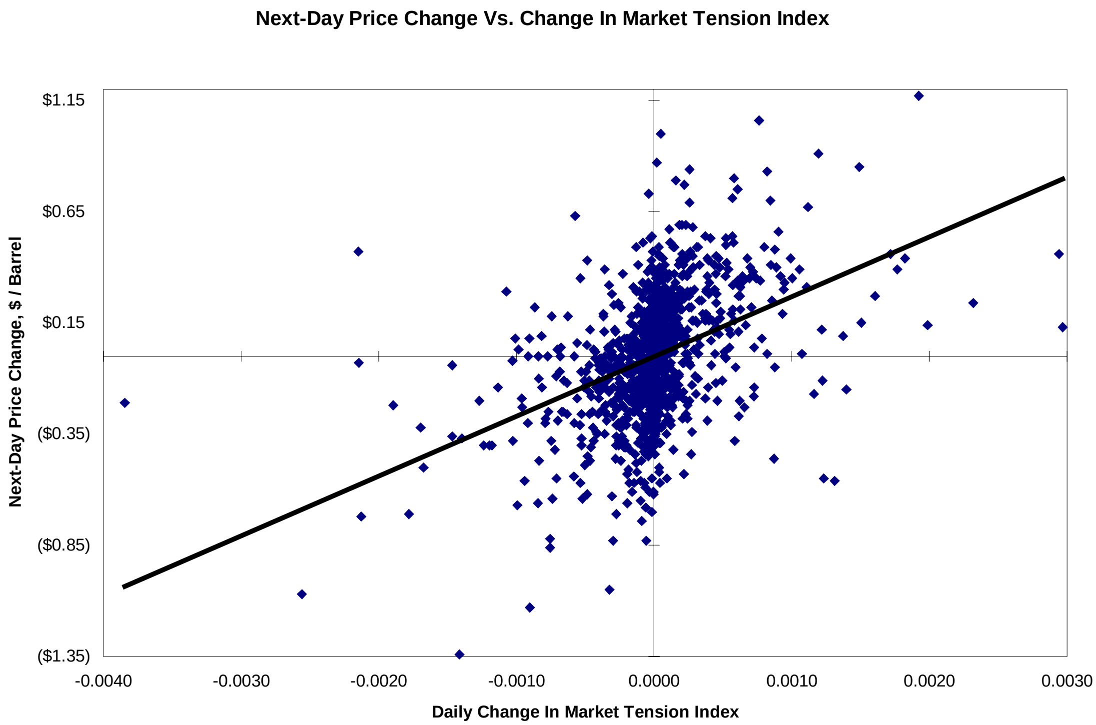
**Crude Oil Market Tension Index**




The pattern of the MTI mirrors price movement of crude oil during this period, with many pronounced downward spikes during the last half of 1993's price collapse, pronounced upward spikes during the first half of 1994's recovery, and very small movements during the 1995 trading range.

More importantly for our purposes, however, is the ability of the MTI to act as a predictor of next-day price change. The graph below depicts the strong predictive relationship of the change in the MTI upon next-day price change. Adding the absolute level of the MTI into the equation yields the following statistical relationship:

$$\Delta \text{Price} = \underset{(34.17)}{240.4} * \Delta \text{MTI} + \underset{(12.88)}{19.03} * \text{MTI}, \quad r^2 = .176.$$




## Conclusion

The ability of the MTI to predict price change is unsurprising given its composition. For years, technicians of various stripes in both commodities and equities markets have tried to measure the flow of money into a market. Price/volume/open interest indicators have long been used despite the facts that open interest is not available until the next day, is highly influenced by proximity to expirations, and can be distorted by arbitrage between cash markets, futures, and options. The MTI is both immune to these distortions and is highly sensitive, on a real-time basis, to the slightest changes in market sentiment.