Long-Short Strategies involving Oil Futures and Shares of Firms that depend on Oil

Finance 925 – Practicum in Analytical Finance

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Executive Summary

Expected cash flows and hence asset valuations for both general stock market and oil industry stocks are impacted by oil prices. In this paper we analyze the predictive ability of the broad stock market (S&P 500 index) and oil industry stocks found in the American Exchange Oil Index (XOI), on future oil prices reflected by the West Texas Intermediate (WTI) crude spot and futures prices. We use statistical tools to analyze the dynamics of the variables as they relate one month in the future. The results of our statistical model suggest that there may be information embedded in the S&P and the XOI that is not yet reflected in the future prices of WTI crude oil.

The most common approach of extrapolating information about future oil prices is to analyze the oil futures market. However, our research and other recent studies indicate that equity markets may also be useful in predicting future oil prices. For instance, Pollet (2003) concluded that the Norwegian stock market and US oil index along with oil futures data can be important predictors of the next month oil price change. Our approach was to concentrate exclusively on information from the US stock market as the inputs for our statistical model. The two indexes we utilized have inverse relationships to the price of oil. The S&P typically realizes negative returns when oil prices increase while XOI equities typically generate positive returns when oil prices rise. By using both indexes in the regression we hope to eliminate systematic risk from the oil companies included in the XOI and focus only upon fluctuations driven by oil prices. We feel this could make a more precise estimate about future oil prices.

To summarize, the four variables utilized in our analysis are:

- American Exchange Oil Index (XOI) prices for a proxy of oil companies
- S&P 500 index (S&P) prices for a proxy of the overall market

- Western Texas Intermediate (WTI) for a proxy of spot oil prices
- WTI oil futures to be utilized as our trading vehicle.

We utilized monthly prices for S&P, XOI, and WTI from January 1986 through May 2004. It is important to note that this period of time has a good representation of different economic conditions including the stock market crash of 1987, the early 1990's war in Iraq with its high oil prices and following recession, the economic boom of the late 1990s and the subsequent early 2000's bear market and recession.

Regressions were run in an attempt to predict the WTI spot returns for the next month as well as two-months ahead utilizing the actual returns from the XOI and the S&P 500 for the last month. It is important to note that the expected return on the WTI spot rate provides useful trading information because WTI spot oil prices are 99% correlated with WTI one-month futures prices. Our study predicted 204 or 192 oil price changes (depending on the regression period used) utilizing 12 and 24 month rolling regression methodologies for the nearly 20 year period examined. The regression equations and associated trading strategies are as follows:

1. ***Directional Strategy Regression:***

$$Ln\ (F_{t,\ t+2} / F_{t+1,\ t+2}) = \alpha + \beta_{S\&P}\{Ln\ (S\&P_t / S\&P_{t-1})\} + \beta_{XOI}\{Ln\ (XOI_t / XOI_{t-1})\} + \varepsilon$$

$$R_{2M\ Future,\ t+1} = \alpha + \beta_{S\&P}\{R_{S\&P,\ t}\} + \beta_{XOI}\{R_{XOI,\ t}\} + \varepsilon$$

- If the regression predicts a positive expected change in the 2-month future price of oil over the next month, a long position should be taken in 2-month futures for one month.
- If the regression predicts a negative expected change in the 2-month future price of oil over the next month, a short position should be taken in 2-month futures for one month.

2. ***Semi-Directional and Long-Short Strategy Regression:***

$$Ln\ (WTI_{t+2} / WTI_{t+1}) = \alpha + \beta_{S\&P}\{Ln\ (S\&P_t / S\&P_{t-1})\} + \beta_{XOI}\{Ln\ (XOI_t / XOI_{t-1})\} + \varepsilon$$

$$R_{Oil\ Spot,\ t+2} = \alpha + \beta_{S\&P}\{R_{S\&P,\ t}) + \beta_{XOI}\{R_{XOI,\ t}\} + \varepsilon$$

- If the regression predicts a higher expected change in the spot price of oil one month ahead in time than the current oil futures curve is pricing (2-months future / 1-month future ratio) a long position should be taken in 2-month futures for one month.
- If the regression predicts a lower expected change in the spot price of oil one month ahead in time than the current oil futures curve is pricing (2-months future / 1-month future ratio) a short position should be taken in 2-month futures for one month.

3. Long-Short Trading Strategy:

- If the regression predicts a higher expected change in the spot price of oil one month ahead in time than the current oil futures curve is pricing (2-months future / 1-month future ratio) a long position should be taken in 2-month futures and a short position should be taken in the 1-month future, in both cases for one month.
- If the regression predicts a lower expected change in the spot price of oil one month ahead in time than the current oil futures curve is pricing (2-months future / 1-month future ratio) a short position should be taken in 2-month futures and a long position should be taken in the 1-month future, in both cases for one month.

We analyzed the performance of these strategies over the 18 year horizon described above. Our study generated positive results suggesting that returns on oil futures and spot prices can be reasonably estimated by analyzing the returns of oil dependent equities after adjusting for systematic risk. The presence of abnormally high returns described in (further described in section 5) serves as evidence that the information received from the stock market may not be completely priced into the oil futures market.

1 Introduction

There is much speculation that returns in certain industries or commodity markets may predict future excess returns in the overall stock market, Hong, Torous, Valkanov (2002). Their team concludes that oil is one of certain commodity markets that may play a role in predicting overall equity market returns. Opposing viewpoints exist regarding the predictive ability oil price changes have on anticipating future excess market returns. For instance, Pollet (2003) and Chen, Roll and Ross (1986) agree and disagree, respectively, about the ability of oil returns to forecast equity market returns. Our analysis takes the inverse approach of these research projects and attempts to determine if equity market returns can predict future oil returns.

We feel it is important to focus upon oil spot and futures prices versus consumer oil prices. Consumer oil prices are subject to governmental control contributing to the fact that they are not entirely correlated to the spot price of oil, which we feel is the true free-market price. In the research projects cited above Pollet utilized oil futures returns while Chen, Roll and Ross utilized fluctuations in consumer oil prices to predict future overall market returns. This may partially explain the disparity in their findings.

Our predictive model starts with the generally accepted notion that current month's market returns are typically negatively correlated with next month's spot oil returns. We take this trend further and incorporate the positively correlated returns of oil companies. By combining oil equities with the overall market we attempt to eliminate the systematic market risk embedded in oil equities and focus only upon fluctuations driven by oil prices. The net coefficient could potentially provide insight into information contained in oil equities that has not yet been incorporated into the price of oil futures.

It is equally important to understand how the commodities markets operate to determine if a tradable arbitrage opportunity exists. We have investigated various aspects of the New York Mercantile Exchange (NYMEX) to determine what degree of returns must be generated to exceed trading costs. Consideration must be given to minimum contract sizes, margin requirements, and trading timeframes. If the excess returns predicted by our model are statistically significant and exceed the costs of trading on an exchange similar to the NYMEX there is potential that our model may provide a profitable opportunity for a properly funded entity.

The rest of this paper is structured in the following manner. Section 2 provides a general overview of the oil futures market. Section 3 describes the empirical methodology including our assumptions and variables. Section 4 discusses the results of our regression analysis. Section 5 presents a simple trading strategy based upon our results. Finally, Section 6 presents our conclusion regarding the ability of oil equities combined with the overall market to predict returns in the oil futures market.

2 Oil Futures Market Overview

According to the NYMEX website, crude oil is the world's most actively traded commodity and is typically traded in the US on the NYMEX and in the UK on the International Petroleum Exchange (IPE). US spot oil prices are referred to as WTI Cushing (WTI) in reference to West Texas Intermediate oil delivered to Cushing, Oklahoma. UK spot oil prices are referred to as North Sea Brent (Brent) in reference to North Sea oil delivered to Sullom Voe in the Shetland Islands. Nearly all oil sold outside the US is priced using the UK spot oil price of Brent crude as a benchmark. WTI oil is primarily produced near US shores while Brent oil is generated from the North Sea. On the NYMEX, WTI futures trade under the ticker CL and Brent futures trade under the ticker SC. WTI was selected instead of Brent as the primary dependent variable and trading vehicle for this project for reasons described in section 3.2.

WTI oil futures are the most heavily traded and liquid oil futures in the world. The WTI futures contracts trade in units of 1,000 barrels and the delivery point is Cushing, Oklahoma, which is the origin of a major US oil pipeline. See Appendix A for contract specifics. The contract provides for delivery of several grades of domestic and internationally traded foreign crudes, and serves the diverse needs of the oil consuming market. The varying grades of crude oil are priced according to a benchmark versus the WTI spot rate (i.e. 95% of WTI price). Light, sweet crudes similar to WTI are preferred by refiners because of their low sulfur content and relatively high yields of high-value products such as gasoline, diesel fuel, heating oil, and jet fuel. Risk management and trading opportunities are offered through options on WTI futures contracts; calendar spread options; crack spread options on the pricing differential of heating oil futures, crude oil futures, gasoline futures, crude oil futures and average price options.

The *e-miNY* crude oil futures contract, designed for investment portfolios, is the equivalent of 500 barrels of crude, 50% of the size of a standard futures contract. The contract is available for trading on the Chicago Mercantile Exchange (CME) GLOBEX electronic trading platform and clears through the New York Mercantile Exchange clearinghouse.

The Brent futures contract is based on a light, sweet North Sea crude oil that also serves as a benchmark grade and widely trades as a differential to the NYMEX Division's bellwether light, sweet crude oil futures contract. Most of the crude oil is refined in Northwest Europe, but significant volumes move to the U.S. Gulf and East Coasts. Complementing the Brent crude oil futures contract are options contracts, calendar spread options contracts, and an options contracts on the Brent/West Texas Intermediate crude oil spread. Several other oil derivatives are exchange traded such as:

- A financially settled futures contract for Dubai crude oil
- A futures contract on the differential between the light, sweet crude oil futures contract and Canadian Bow River crude at Hardisty, Alberta
- A futures contract on the differentials of the light, sweet crude oil futures contract and four domestic grades of crude oil: Light Louisiana Sweet, West Texas Intermediate-Midland, West Texas Sour, and Mars Blend.

3 Empirical Methodology

3.1 Theoretical Assumptions

The theoretical claim that expected future cash flows determine stock prices should lead to the conclusion that the expected price of important inputs needs to be monitored by investors and reflected in the valuation of stocks. The future price of oil is an important variable for many firms' expected future cash flows. The broad stock market is sensitive to the future prices of oil and should accommodate these in its valuation of firms. The companies within the oil industry are sensitive to future oil prices which make a significant impact on their profits. Hence, it is reasonable to expect that these future prices should be reflected in their valuation as well.

Because future prices of oil change the current valuation of stocks, it should be possible to extract this information and compare it with the actual oil prices. We tested these assumptions by analyzing historical data described in section 4.0. From the historical analysis we felt it may be possible to predict the two-month oil spot and futures price changes based upon the prior month S&P and XOI returns.

3.2 Data: Oil Futures and Spot Rates selected for Analysis

Our project focused on US WTI oil prices instead of Brent oil prices because they are the most heavily traded and liquid oil futures in the world and the Brent market was exposed to documented price squeeze arbitrage during the periods of our analysis.

Price squeezes occur when a trader buys all available cargoes for a particular month hoping to take advantage of sellers with commitments to deliver oil who will pay a premium price when

they can't find a cargo. A successful squeeze increases the price of the one-month future relative to the spot, when the two are typically 99% correlated. Research showed that on 23 occasions from 1989 to 2002 the price of Brent one-month futures rose more than one dollar against the price of the Brent spot. Two weeks later, 82% of the time the price of the one-month future had fallen back by nearly 50 cents a barrel. With cargoes of 500,000 barrels this translates into substantial price swings in only a matter of days (Fielden, 2003).

This arbitrage resulted in fundamental changes to the definition of Brent in 2002. Prior to July 2002, Brent oil referred to oil produced from the North Sea comprising of approximately 25 cargoes per month, or 12.5 million barrels. Subsequent to July 2002, Brent oil was expanded to include oil produced in Forties (Norwegian Sea) and Oseberg (UK North Sea). This change expanded monthly Brent cargoes to approximately 100 to prevent the likelihood of future price squeezes.

The potential volatility in Brent one-month futures versus spot during the 1990's could adversely affect the results of this analysis because our regression model utilizes the predicted percent change in spot prices to determine whether to go long or short two-month futures contracts. The larger cargo volumes of WTI and the fact that in the 1990's one-month futures were 99.9% correlated to the spot price provided sufficient justification to only utilize WTI futures and spot rates for our analysis.

3.3 Data: Oil Equities Selected for Analysis

The equity indexes selected for our regression analysis were the S&P 500 and the American Exchange Oil Index (XOI). The reasons we chose these indexes were the broad exposure to the market the S&P 500 provided and the specific oil industry exposure (and consequently oil

specific exposure) and long historic data the XOI presented. Although a number of oil indexes could have been used, including the CBOE Oil Index (OIX), Morgan Stanley's Oil Services Index (MGO) and the Philadelphia Stock Exchange Oil Services Index (OSX), the short historic data these indexes have compared to XOI's 20 years of existence did not allow us to perform an analysis that could have included all the significant equities and oil market corrections that have occurred in the years covering our study.

- ***Standard & Poor 500 (S&P 500)***: The S&P 500 is widely regarded as the best single gauge of the overall U.S. equities market. This index includes a representative sample of 500 leading companies in leading industries of the U.S. economy. Although the S&P 500 focuses on the large-cap segment of the market, covering over 80% of U.S. equity market capitalization, it is also an ideal proxy for the total market.
- ***American Exchange Oil Index (XOI)***: The American Exchange Oil Index is a price-weighted index of the leading companies involved in the exploration, production, and development of petroleum. The index was established in August 27, 1984 and has become a well known index for those interested in exposure to the oil industry. As of 05/21/04 the XOI was composed of:

Company Name	Symbol	% Weighting
Total 'b' ADS	TOT	12.88%
Chevrontexaco Corp	CVX	12.75%
Conocophillips	COP	10.03%
Amerada Hess	AHC	9.93%
Sunoco Inc	SUN	8.33%
BP p.l.c. ADS	BP	7.33%
Kerr-Mcgee	KMG	6.96%
Royal Dutch Petrol ADR	RD	6.88%
Occidental Petroleum	OXY	6.37%
Exxon Mobil	XOM	6.06%
Unocal Corp	UCL	4.99%
Marathon Oil	MRO	4.62%
Repsol Ypf S.A. ADS	REP	2.87%

4 Regression Analysis Results

An Ordinary Least Squares (OLS) regression was utilized to perform our analysis of the 3 trading strategies previously described. We used two types of rolling regressions. We first utilized a 12 month rolling regression in order to have a model that adjusts rapidly to current economic conditions in the oil market while still utilizing historical data as a guide. We also included a 24 month rolling regression to analyze the fit of using a longer regression that adjusts slower. In the process of determining our model we also considered simply having one regression that added a data point each month for the most current returns. We concluded that this would not accurately reflect current economic conditions because as time goes by, one month would not impact the regression model due to its immaterial impact on the large number of previous monthly results. Consequently the two types of regressions used (adjusting also for length 12-24 months) are as follows:

$$\textbf{\textit{Directional}}: R_{2M\ Future,\ t+1} = \alpha + \beta_{S\&P}\{R_{S\&P,\ t}\} + \beta_{XOI}\{R_{XOI,\ t}\} + \varepsilon$$

and

$$\textbf{\textit{Semi-Directional or Long-Short:}}\ R_{Oil\ Spot,\ t+2} = \alpha + \beta_{S\&P}\{R_{S\&P,\ t}) + \beta_{XOI}\{R_{XOI,\ t}\} + \varepsilon$$

We utilized monthly prices for S&P, XOI, and WTI from January 1986 through May 2004. It is important to note that this period of time has a good representation of different economic conditions including the stock market crash of 1987, the early 1990's war in Iraq with its high oil prices and following recession, the economic boom of the late 1990s and the subsequent early 2000's bear market and recession. Our study predicted 204 or 192 oil price changes (depending on the regression period used) utilizing 12 and 24 month rolling regression methodologies for the entire period of time that we have examined.

Our model generated promising results when predicting the direction of next month's 2 month future oil price change. However, the magnitude of that change is not as accurate as the direction. The sign of the return is usually right, but the absolute value varies significantly from the actual one. Additionally, our second model has shown even better results than the directional one. In this case, our model has generated positive returns 76% of the times for the 12 month rolling regression and 74% of the times for the 24 month rolling regression. It has not only yielded more than the S&P but has achieved it with a much lower distribution of returns. In that sense, our research indicates that the information reflected in the stock market about the expected changes in the oil prices is a better predictor of the actual changes for the coming month than the information embedded in the futures oil curve. As it can be seen in the summary table below, the Long-short strategy is the one that provides more bank for the buck given its best risk-reward profile.

Exhibit 1: Summary of Risk-Return profiles for various strategies

		Strategy Return					***S&P Return***				
Strategy	***Regression***	***Total***	***Annual***	***Stdev***	***Min***	***Max***	***Total***	***Annual***	***Stdev***	***Min***	***Max***
2M Future 1m Lag Directional	1Y	359%	**20.8%**	9.0%	-21.2%	29.4%	140%	**8.1%**	4.5%	-21.2%	29.4%
	2Y	199%	**12.2%**	9.3%	-29.4%	27.6%	148%	**9.1%**	4.1%	-29.4%	27.6%
WTI 2m Lag Semi-Directional	1Y	174%	**10.1%**	9.2%	-29.4%	26.6%	137%	**8.0%**	4.5%	-20.2%	12.0%
	2Y	50%	**3.1%**	9.3%	-29.4%	19.4%	143%	**8.8%**	4.1%	-11.2%	12.0%
WTI 2m Lag Long-Short	1Y	229%	**13.3%**	1.8%	-4.2%	7.7%	137%	**8.0%**	4.5%	-20.2%	12.0%
	2Y	217%	**13.4%**	1.9%	-4.2%	7.7%	143%	**8.8%**	4.1%	-11.2%	12.0%

5 Trading Strategy

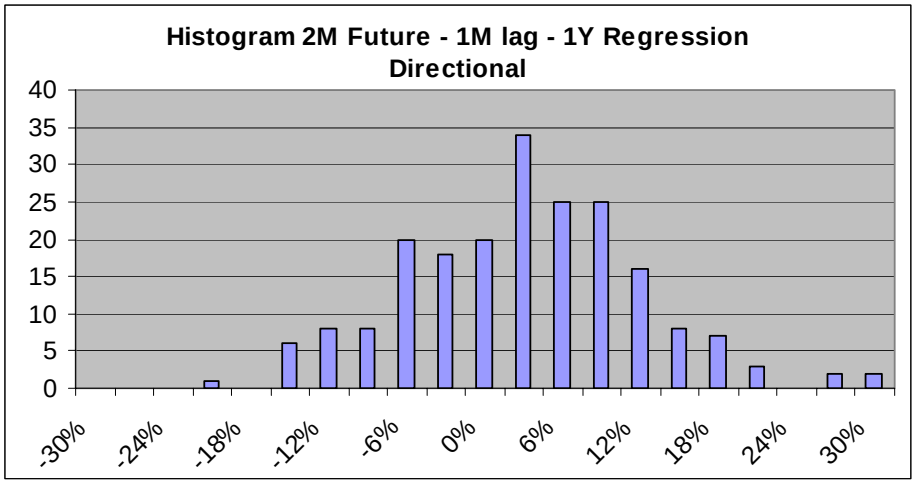
5.1 Directional Strategy

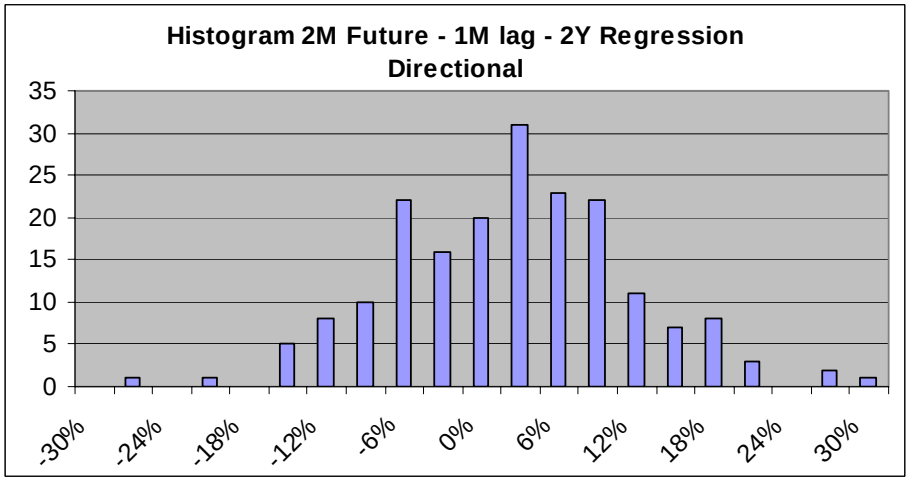
As our model appears to enable us to predict the change in next month's 2-month oil future price of oil, we find it prudent to review a simple trading strategy. Our strategy is a directional strategy attempting to capitalize on the volatility of oil prices and can be summarized as follows:

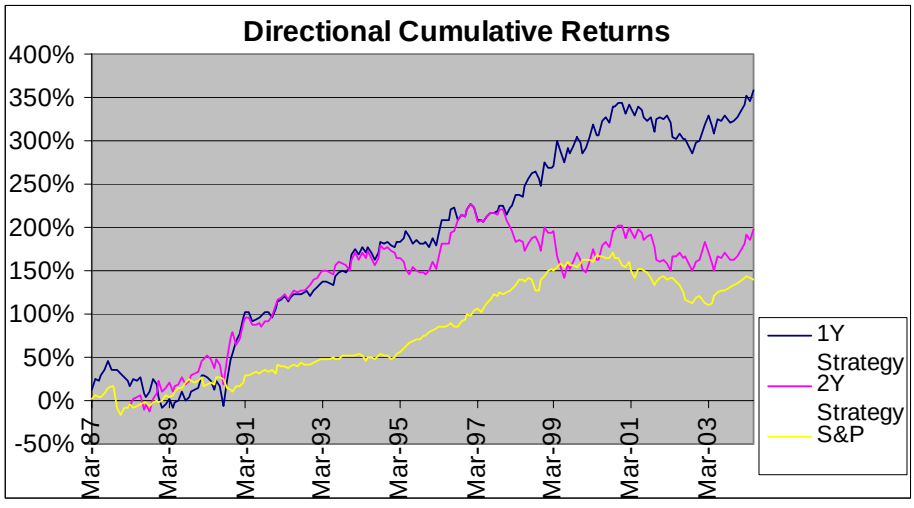
- If the regression predicts a positive expected change in the 2-month future price of oil over the next month, a long position should be taken in 2-month futures for one month.
- If the regression predicts a negative expected change in the 2-month future price of oil over the next month, a short position should be taken in 2-month futures for one month.

To illustrate our trading strategy in a real-life scenario, consider the following depiction. Assume today is January 1st 20XX and the spot price of oil is $40 per barrel and the 2-month future is $41 per barrel. Utilizing the regression model described in Section 4 we predict that on February 1st 20XX, what would now be the 1-month future price is expected to increase 2% to $41.82 per barrel. Given this prediction, we would go long the 2-month future and close the trade in one month. This strategy is basically a directional one and as it can be seen below it has yielded very high returns not without assuming a high volatility of returns.

Exhibit 2: Results of the Directional Strategy



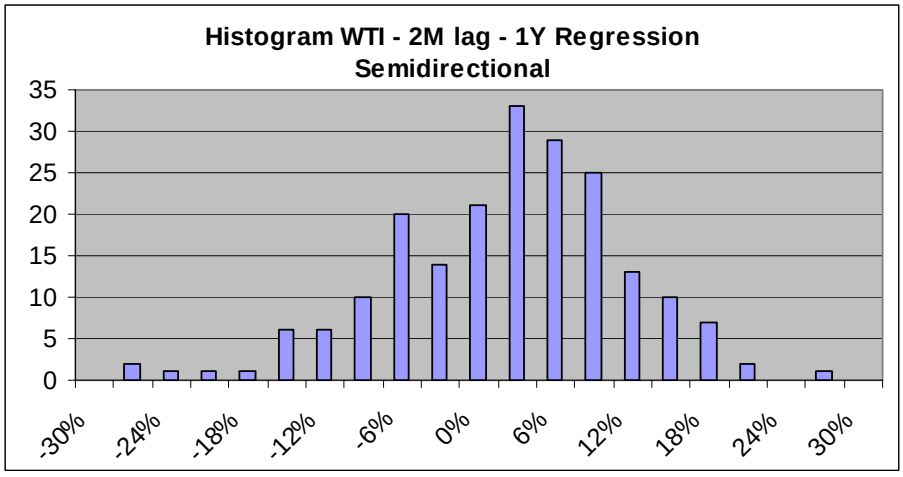


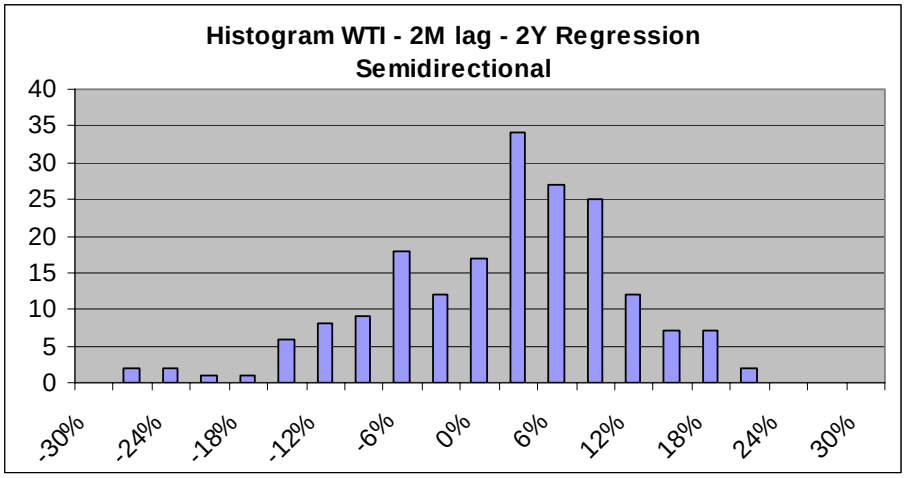


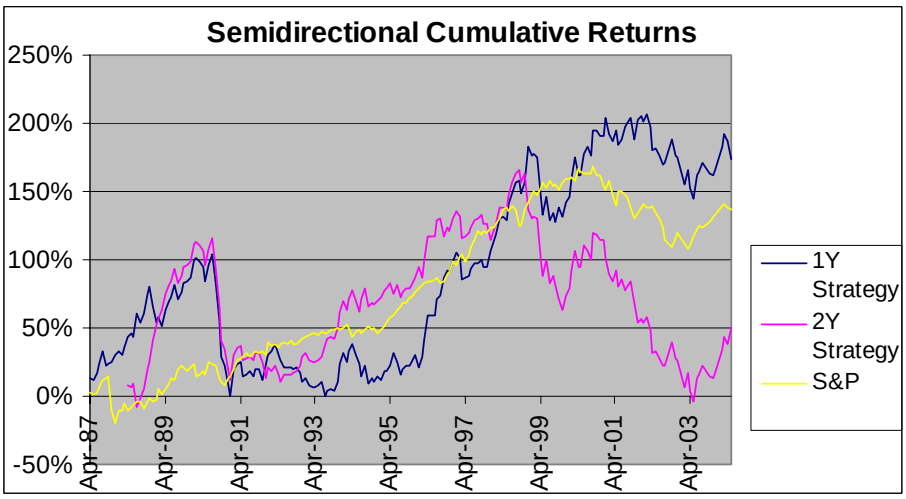
5.2 Semi-Directional Strategy

In this strategy we try to verify if even assuming directional risk (and thus not isolating the spread) we can still earn positive returns by comparing the information embedded in the stock market to that in the future oil curve. In this case the analysis is the following. Assume today is January 1st 20XX and the spot price of oil is $40 per barrel and both the 1-month and 2-month oil future prices are $41 and 42 per barrel. Utilizing the regression model described in Section 4 we predict that on March 1st 20XX the 1-month oil spot return will be 4% while the oil future curve is flat thus predicting no change at all. In this case, given that we believe the future markets are underestimating the future spot oil increase we would go long the 2-month future for only 1 month. Thus, given that we are basing our decision on a comparison we do not isolate the spread (by going short the 1-month future) and thus end up assuming directional risk. Despite assuming this unnecessary risk, this strategy still yields a positive return although is not as reliable as the previous one.

Exhibit 3: Results of the Semi-Directional Strategy





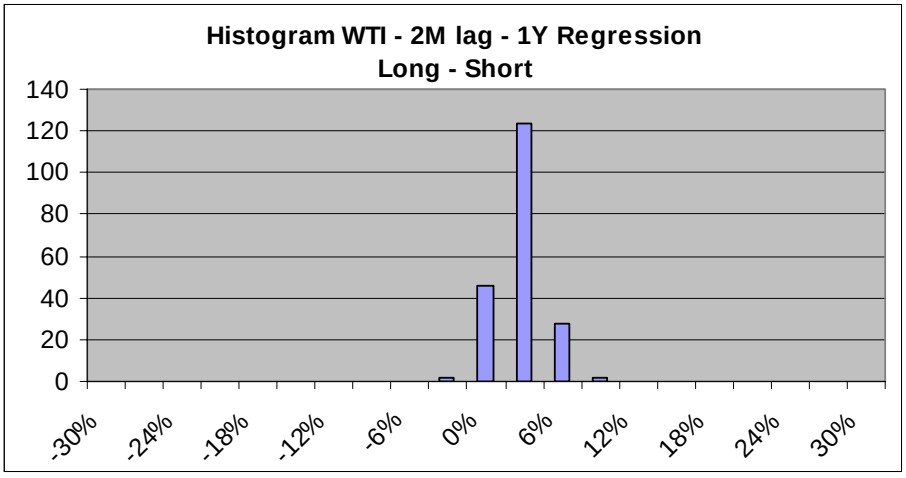


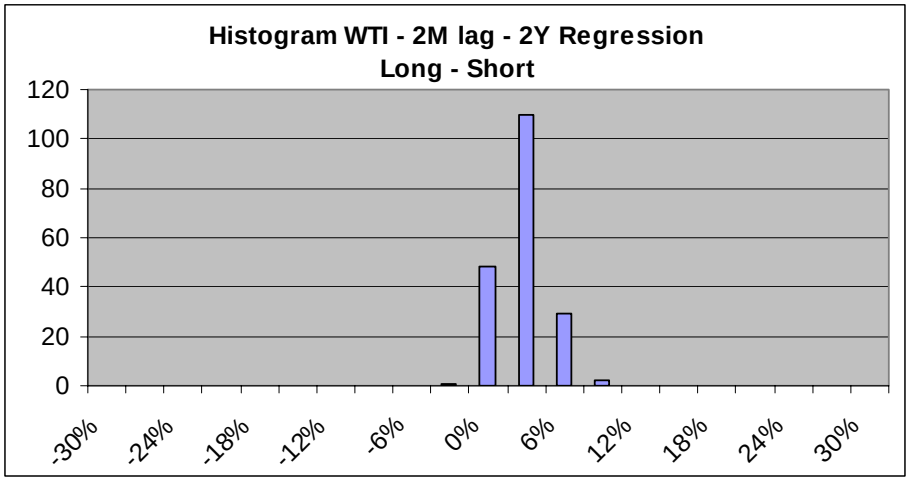
5.3 Long-Short Strategy

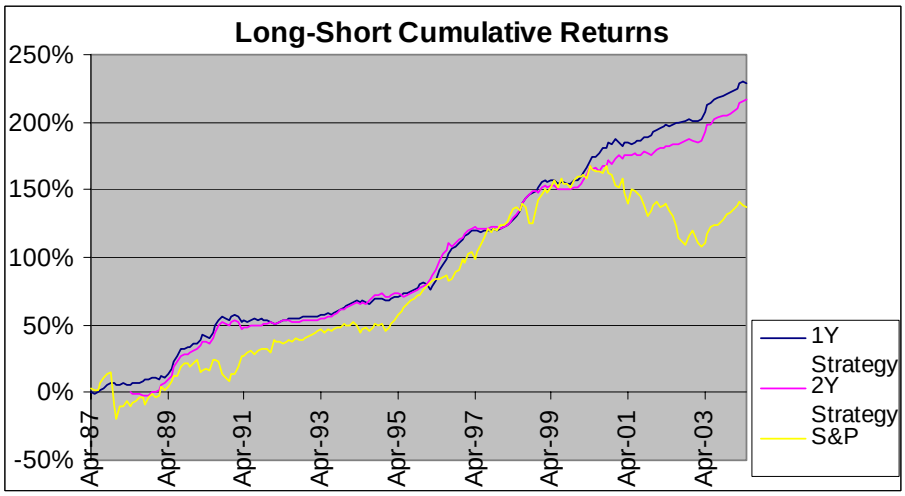
Finally is what we believe the most robust model of the three. This model as well as the previous one compares the information embedded in the stock markets to that in the oil future curve but unlike the previous one isolates the predicted spread by taking an opposite trade in the one month future. Let's look at an example. Assume today is January 1st 20XX and the spot price of oil is $40 per barrel and both the 1 month and 2 month oil future prices are $41 and 42 per barrel. Utilizing the regression model described in Section 4 we predict that on March 1st 20XX the 1 month oil spot return will be 4% while the oil future curve predicts a 6% increase in the oil spot

price two months ahead. In this case, given that we believe the future markets are overestimating the future spot oil increase we would go short the 2 month future and go long as well the 1 month future, in both cases for only 1 month. Basically, what this model is saying is that the spread between the 1 and 2 month future should be smaller and thus take this trade. In this case, we do not take any directional risk given that any increase in oil should affect both positions. Though this might seem like a very simple trade the results are more than promising. As it can be seen below, the distribution of returns is very narrow (not much risk in this strategy) while the returns show a positive skew. This positive skew generated a higher return than the S&P over the period analyzed with much less volatility.

Exhibit 4: Results of the Long-Short Strategy







5.4 Risk adjusted returns using Fama/French benchmark factors

As a final examination, we run a series of regressions to normalize each strategy. We run the regressions on the Fama/French benchmark factors (R_m – the excess return on the market, SMB – Small Minus Big is the average return on three small portfolios minus the average return on three big portfolios, HML – High Minus Low is the average return on two value portfolios minus the average return on two growth portfolios). For each strategy we separate out the excess returns from the Long position and the Short position. Finally, we verify if it is possible to obtain positive alphas. Exhibit 5 shows the results of risk adjusted returns from our trading strategies.

Exhibit 5: Summary of risk adjusted returns

Strategy	Regression	Type	Coefficients and t-stats α	β_{Mkt-RF}	β_{SMB}	β_{HML}	R^2	Adjusted R^2
2m Future 1m Lag (Directional)	1Y	LONG	**1.7%**	-0.215	-0.349	0.004	0.046	0.021
			2.025	-1.043	-1.400	0.014		
		SHORT	**0.0%**	0.489	0.075	0.505	0.047	0.010
			0.001	1.865	0.222	1.215		
	2Y	LONG	**1.5%**	-0.702	-0.429	-0.292	0.098	0.074
			1.786	-2.893	-1.761	-0.921		
		SHORT	**-0.5%**	0.025	0.313	0.068	0.011	-0.034
			-0.432	0.085	0.807	0.154		
WTI 2m Lag (Semi-Directional)	1Y	LONG	**1.4%**	-0.037	-0.553	-0.381	0.055	0.025
			1.646	-0.185	-2.353	-1.209		
		SHORT	**-0.8%**	0.649	0.048	-0.111	0.100	0.072
			-0.744	2.518	0.145	-0.314		
	2Y	LONG	**1.0%**	-0.323	-0.409	-0.256	0.035	0.005
			1.043	-1.213	-1.487	-0.687		
		SHORT	**-1.4%**	0.522	0.187	0.015	0.071	0.036
			-1.290	1.855	0.531	0.041		
WTI 2m Lag (Long-Short Strategy)	1Y	LONG	**1.2%**	0.069	0.054	0.176	0.077	0.049
			7.370	1.700	1.122	2.740		
		SHORT	**0.2%**	-0.085	-0.152	-0.126	0.120	0.092
			1.318	-1.928	-2.680	-2.086		
	2Y	LONG	**1.1%**	0.043	0.047	0.135	0.033	0.003
			5.501	0.786	0.839	1.770		
		SHORT	**0.3%**	-0.103	-0.085	-0.178	0.114	0.081
			1.628	-2.037	-1.341	-2.729		

6 Conclusion

Public information about future changes in the price of oil has a significant impact on numerous markets. Historically, common practice has been to look at the oil futures market for information about the expected changes in the price of oil. However, we feel stocks of publicly traded companies also react to the expected changes in oil prices and they appear to provide information regarding future oil prices that is not reflected in current futures prices. Using statistical analysis, it appears possible to extract this information and compare it with the information reflected in the futures markets.

As we illustrated in this paper, there is information about future oil price changes embedded in the current valuation of the stock market that the futures market does not appear to capture. We feel our model can reasonably extract this information to provide valuable information when trading oil futures. The reliability of our predictive model is dependent on the market information because we must accurately predict the direction of either the 2 month oil future prices or the 1-2 month oil future spread for an investor to make profitable trades. Through the successful results observed by our trading strategy we have shown that much of this information was not reflected in futures prices, however it was extracted by our model. It is an important insight and can be used by practitioners to improve their assessment of the short-term forecast of oil spot prices. The additional information regarding oil that our model extracts from the equity markets that is not reflected in the futures market adds to the precision of the oil price forecasts made by our model.

Appendix A: Light, Sweet Crude Oil Futures Contract

Specifications

Trading Unit
1,000 U.S. barrels (42,000 gallons).

Price Quotation
U.S. dollars and cents per barrel.

Trading Hours (All times are New York time)
Open outcry trading is conducted from 10:00 AM until 2:30 PM.

After-hours futures trading is conducted via the NYMEX ACCESS® internet-based trading platform beginning at 3:15 PM on Mondays through Thursdays and concluding at 9:30 AM the following day. On Sundays, the session begins at 7:00 PM.

Trading Months
Thirty (30) consecutive months plus long-dated futures initially listed 36, 48, 60, 72, and 84 months prior to delivery.

Additionally, trading can be executed at an average differential to the previous day's settlement prices for periods of two to 30 consecutive months in a single transaction. These calendar strips are executed during open outcry trading hours.

Minimum Price Fluctuation
$0.01 (1¢) per barrel ($10.00 per contract).

Maximum Daily Price Fluctuation
$10.00 per barrel ($10,000 per contract) for all months. If any contract is traded, bid, or offered at the limit for five minutes, trading is halted for five minutes. When trading resumes, the limit is expanded by $10.00 per barrel in either direction. If another halt were triggered, the market would continue to be expanded by $10.00 per barrel in either direction after each successive five-minute trading halt. There will be no maximum price fluctuation limits during any one trading session.

Last Trading Day
Trading terminates at the close of business on the third business day prior to the 25th calendar day of the month preceding the delivery month. If the 25th calendar day of the month is a non-business day, trading shall cease on the third business day prior to the business day preceding the 25th calendar day.

Settlement Type
Physical.

Delivery
F.O.B. seller's facility, Cushing, Oklahoma, at any pipeline or storage facility with pipeline access to TEPPCO, Cushing storage, or Equilon Pipeline Co., by in-tank transfer, in-line transfer, book-out, or inter-facility transfer (pumpover).

Delivery Period
All deliveries are ratable over the course of the month and must be initiated on or after the first calendar day and completed by the last calendar day of the delivery month.

Alternate Delivery Procedure (ADP)
An alternate delivery procedure is available to buyers and sellers who have been matched by the Exchange subsequent to the termination of trading in the spot month contract. If buyer and seller agree to consummate delivery under terms different from those prescribed in the contract specifications, they may proceed on that basis after submitting a notice of their intention to the Exchange.

Exchange of Futures for Physicals (EFP)
The commercial buyer or seller may exchange a futures position for a physical position of equal quantity by submitting a notice to the Exchange. EFPs may be used to either initiate or liquidate a futures position.

Deliverable Grades
Specific domestic crudes with 0.42% sulfur by weight or less, not less than 37° API gravity nor more than 42° API gravity. The following domestic crude streams are deliverable: West Texas Intermediate, Low Sweet Mix, New Mexican Sweet, North Texas Sweet, Oklahoma Sweet, South Texas Sweet.

Specific foreign crudes of not less than 34° API nor more than 42° API. The following foreign streams are deliverable: U.K. Brent and Forties, and Norwegian Oseberg Blend, for which the seller shall receive a 55¢-per-barrel discount below the final settlement price; Nigerian Bonny Light and Colombian Cusiana are delivered at 15¢ premiums; and Nigerian Qua Iboe is delivered at a 5¢ premium.

Inspection
Inspection shall be conducted in accordance with pipeline practices. A buyer or seller may appoint an inspector to inspect the quality of oil delivered. However, the buyer or seller who requests the inspection will bear its costs and will notify the other party of the transaction that the inspection will occur.

Position Accountability Levels and Limits
Any one month/all months: 20,000 net futures, but not to exceed 1,000 in the last three days of trading in the spot month.

Margin Requirements
Margins are required for open futures positions.

Trading Symbol
CL

Margins

Non-Member Customer Initial	Member Customer Initial	Clearing Member and Customer Maintenance
$3,375	**$2,750**	**$2,500**

Non-Member Customer Initial	Member Customer Initial	Clearing Member and Customer Maintenance					Assessments Spot Month
		Group 1	Group 2	Group 3	Group 4	Group 5	
135%	**110%**	$400*	$250*	$150*	$100*	N/A	**$3,000†**

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