The impact of news sentiment on energy futures returns

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Abstract

We investigate how energy futures markets respond to positive and negative sentiment in news, as measured by the Thomson Reuters News Sentiment Engine. We address this by performing an event study for daily oil futures prices of various maturities and the daily aggregated news sentiment. We define positive or negative news events as those days where the aggregated sentiment occupied the extreme 10% quantiles of the daily news sentiment distribution and relate these events to abnormal futures returns.

We find that, for all maturities, positive resp. negative news events follow long periods of higher resp. lower than normal returns, suggesting that news are correlated with price momentum. Furthermore, after the news event occurs, returns continue increasing in the 20 days after a positive news event. This is especially pronounced for more distant maturities, whose returns increase by 3% on average. After a negative news event, returns fall on average by 3% for nearby maturities and stay flat for more distant maturities. These effects are both statistically and economically significant. These findings suggest that the degree of backwardation in the forward curve is reduced after both positive and after negative news events. On the contrary, the contango state seems to deepen after a significant news event, whether it was a positive or a negative one. We also show a great asymmetry in the market’s behavior: although positive and negative events are both 10% of days, the negative events are accompanied by much greater losses than the gains surrounding positive events.
1. Introduction

Traditionally, the analysis of security returns has concentrated on responses to quantitative or hard measures such as corporate and economic statistics or, at most, a few ingeniously selected variables intended to proxy for some qualitative characteristic. Over the past decade, the IT revolution has provided us with a wealth of digitized text containing qualitative information and the processing power to apply algorithms that seek to quantify soft aspects of this text, such as relevance, sentiment and novelty. Recently, Thomson Reuters has introduced its News Analytics Engine, which is based on powerful linguistic analysis techniques. Computer analysis of thousands of news articles determines whether the news is positive, negative or neutral, and whether an article is relevant to a specific company, index or a commodity.

In the past few years, even before the emergence of computer-aided news analysis such as Thomson Reuters NewsScope, several articles appeared that have analyzed the effects of volume and “tone” of news on equities – specifically stock index and individual stock returns, volumes and volatilities and company earnings. The forerunners of such research are two articles by Tetlock (2007, 2008). The 2007 article studies the relationship between daily DJIA returns and sentiment (measured by Harvard IV-4 Psychosocial Dictionary (HPSD)) in the Wall Street Journal. The main findings of this article is that low sentiment predicts low returns followed by a rebound, low returns predict low sentiment and high absolute sentiment predicts high trading volume. This is inconsistent with the theory that news provides information about fundamental asset values. Tetlock et al (2008) use event studies to investigate the relationship between a sentiment index based on the HPSD and stock returns and earnings of specific S&P500 companies. In contrast to Tetlock (2007), this article finds that sentiment forecasts fundamentals (firm earnings) over as much as 18 months while stock returns underreact very slightly and briefly (only 1 day) to sentiment information.

Broadly, the existing research in this area finds that sentiment can help predict stock returns and fundamentals such as earnings. In the case of forecasting the returns of stock indices, there is indication that news is largely noise: it drives down returns for a few days, but prices subsequently rebound to fundamentals.

Research into the effects of sentiment on the returns of other assets such as commodities, however, is virtually nonexistent. So in this paper, we provide the first attempt at analyzing the relationship between news sentiment and energy, specifically crude oil futures.

There are several challenges when dealing with commodities. First of all, in contrast to equities, for which there is a single price that is the focus of attention, commodities trade in the form of futures contracts with monthly maturities that stretch several years into the future. So the object of interest is not just one price (a scalar) but an entire forward curve, which is a multi-dimensional object. News sentiment may affect the returns of different maturities differently. Furthermore, it is not immediately clear whether sentiment measures will work as well for commodities as they do for equities, as commodity prices are driven by supply and demand rather than by present value of future cash flows. So while one would presume that just about any article with lots of positive words and a reference to Apple would correlate with upward pressure in its stock price, it is not clear whether an article with lots of positive words and a
reference to crude oil would correlate with upward or downward pressure on the oil price. If the headline is “Stability in Middle East and growth in rig counts leads to boom in crude supply”, we would expect the price to go down, whereas the sentence “Boom in China and growth in the US makes oil soar” might lead us to expect prices to go up, while both articles may be classified as “positive”. Thus, for sentiment measures to work effectively for commodities, they have to differentiate between sentiment with relation to factors that cause, or correlate with, supply and demand.

In this article, we provide the first study of the effect of news sentiment on energy futures returns. We employ event studies to relate the daily aggregated news sentiment to crude oil futures returns for different maturities and investigate how the impact of news sentiment on futures prices vary with time to maturity of the contract.

We consider the Reuters newswire articles that are tagged as referring to a given energy commodity (crude oil) from 2003 to 2008. For each of these articles, Thomson Reuters provides a measure of sentiment, determined by a proprietary machine-reading algorithm: the Reuters NewsScope Sentiment Engine. We aggregate and normalize these sentiment marks to form a daily index of sentiment, and establish that particularly high or low levels of sentiment constitute an event. We then analyze cumulative returns of commodity futures of various maturities in the days surrounding these events.

We find that, for all maturities, positive respectively negative news events follow long periods of higher respectively lower returns, suggesting that news are correlated with price momentum. Abnormally high or lower returns precede positive or negative news sentiments by as much as 80 to 100 days, but after approximately 15-20 days we observe a return to fundamentals. After a positive news event occurs, returns continue increasing for 20 days. This is especially pronounced for more distant maturities, whose returns increase by 3% on average. After a negative news event, returns fall on average by 3% for nearby maturities and stay flat for more distant maturities. These effects are both statistically and economically significant. These findings suggest that the degree of backwardation in the forward curve is reduced after both positive and after negative news events. On the contrary, the contango state seems to deepen after a significant news event, whether it was a positive or a negative one. However, positive events seem to cause this effect by raising more distant future prices, while negative events cause nearby prices to fall relatively more.

We observe a great asymmetry between market’s behavior around positive and negative news events: although positive and negative events are both 10% of days, the negative events are accompanied by much greater losses as compared to neutral events than the gains of positive events as compared to neutral days. We also shows that abnormally low or high returns precede negative or positive events by as much as 80 to 100 trading days (again, indicating the news’ correlation to the price momentum), but after the event we observe a return to fundamentals.

The analysis here is focused on crude oil and is primarily concerned with daily aggregated news sentiment and its effect on daily settlement prices. Our current and future research extends this to other energy commodities as well as metals and agriculturals, and will consider also news and prices at higher frequencies such as hourly or even tick by tick.
2. Data

Thomson Reuters NewsScope Sentiment Engine (RNSE) historical data for commodities provides us with 3.9 million articles from the start of 2003 to the end of 2008, time-flagged to the millisecond. For each article we have measures of positive, neutral and negative sentiment, intended to be interpreted as probabilities that the article conveys a positive, neutral or negative outlook on that commodity price. There are additional variables such as relevance, which indicates to what degree that article is thought to be relevant to the commodity in question, and linked counts, which are the IDs of other articles that are thought to be related. In contrast to the news data on equities, where there is a large spread of the relevance measure, for commodities most mentioned articles are considered 100% relevant. So in the first instance we choose to ignore the relevance measure as well as linked counts and concentrate on the sentiment measure.

We aggregate the article sentiment measures into a daily index, in order to relate it to the daily settlement futures prices and returns. We use NYMEX WTI futures, as these are the most liquid oil futures contracts in the world. We focus here on the daily data because the behavior of returns over longer periods such as a trading day is arguably more economically relevant than that over milliseconds, which is largely due to the market microstructure and not fundamentals such as supply and demand. Moreover, studying the raw news dataset, we found that the sentiment measure is quite noisy: similar articles can be classified very differently. So, hopefully, aggregating over a day should reduce this noise. Finally, working on a longer time scale reduces complications caused by market microstructure, such as the bid-ask bounce and asynchronous trading.

We form the daily index bearing in mind the closing time of InterContinental Exchange (ICE) in London and New York Mercantile Exchange (NYMEX) in New York (19:30 GMT or 14:30 EST, which is the same time, given the 5 hour time zone difference). We adjust the timestamps in such a way that each news item is stamped with the date indicating that it was available to traders before the market settlement on that day. The daily aggregated news sentiments are formed by adding up each of the three sentiment scores for all articles on each day and then dividing by the total number of articles. In this way, the daily sentiment scores also add up to one. Then we subtract the negative score from the positive one, in order to have a single net positiveness score. Tables 2 and 3 display summary statistics for the obtained daily scores.
There is some kurtosis and skewness in all the sentiment scores (Table 4). We also observed that
the number of articles has negative correlation with the negative sentiment score and positive
correlation with neutral sentiment score.

The number of articles varies widely within a week. Very few articles are published on
weekends, as compared to weekdays, as we can see below: the average weekday has 200 to 300
articles about crude oil, while Saturdays only have around 60, and Sundays only around 30.
The number of articles grows from Sunday to Tuesday, peaks on Wednesday and falls each day
until Sunday again. This is not surprising: the most important weekly statistics such as API crude
oil inventories and DoE Weekly Petroleum Status Report are published at 10:30 am EST on
Wednesdays.
3. Methods and results

We employ event studies as outlined in Kinlay (1997) and used in Tetlock et al (2008). We define a day in which net sentiment is in the top 10% of the sample as a positive news event, a day in which it is in the bottom 10% as a negative news event and the middle 80% as a neutral news event. For example, let March 17, 2003 be the event day (positive or negative). We select the specific maturity (e.g., 2nd nearby, i.e., two months to maturity) and the event window - how many trading days before and after the event we consider (e.g., 20 trading days). For each event day, we select the specific contract that has the selected maturity. For instance, on March 17, 2003, the 2nd nearby contract is May 2003.

We analyze the returns of this specific contract during the event window. In our example, as there are approximately 20 trading days in a month, we consider the price of the May 2003 contract from roughly February 17, 2003 to April 17, 2003. Note that, although the May contract is the 2nd nearby in March, it is the 3rd nearby in February and the 1st nearby in April. In fact, if the event window is longer, by the end of the window the contract would no longer be trading. So in the event study we are considering returns that are actually feasible – we can buy the May contract in February and sell it in March. The alternative would be to consider, at each date in the event window, the contract of the fixed time to maturity, whichever specific contract that might be. This would give us an understanding of how the shape of the forward curve changes as a response to sentiment, but it would not show us feasible returns. However, we will perform such an event study in the follow-up paper.

We calculate the daily returns during the event window for the selected contracts, and then average the returns over the observed events for each day. For crude oil, we have 150 positive, 150 negative and 1205 neutral sentiment events. The 95% confidence intervals for the returns in the event window (represented in all the plots as dashed lines) are obtained by the bootstrap simulation.

<table>
<thead>
<tr>
<th>Number of Articles</th>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Mean</td>
<td>32</td>
<td>211</td>
<td>263</td>
<td>308</td>
<td>279</td>
<td>237</td>
<td>64</td>
</tr>
<tr>
<td>Max</td>
<td>355</td>
<td>466</td>
<td>690</td>
<td>624</td>
<td>677</td>
<td>551</td>
<td>334</td>
</tr>
<tr>
<td>Variance</td>
<td>1.258</td>
<td>4.391</td>
<td>6.277</td>
<td>5.815</td>
<td>5.790</td>
<td>5.022</td>
<td>1.346</td>
</tr>
<tr>
<td>Skewness</td>
<td>4.41</td>
<td>-0.26</td>
<td>-0.24</td>
<td>-0.60</td>
<td>-0.05</td>
<td>-0.14</td>
<td>3.04</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>30.40</td>
<td>4.87</td>
<td>7.34</td>
<td>5.75</td>
<td>6.64</td>
<td>5.31</td>
<td>18.70</td>
</tr>
</tbody>
</table>

Table 4
Descriptive statistics for conditional on weekday – news tagged “Crude Oil”
First, we consider 20-day windows before and after the events (so the total length of the window is 40 trading days). Figure 1 shows the average returns on 12-months ahead WTI futures during the event window. The top graph (blue lines) shows the average returns for a positive event, the middle graph (black lines) – for a neutral event and the bottom graph (red lines) – for a negative event. We see that, in the 20 days leading to a positive event, the overall average return on 12-month ahead crude oil futures is 6%, of which 2% are in the 2-3 days immediately prior to the event. In contrast, the overall average return is -8% leading up to a negative event, again with about -2% in the 2-3 days immediately prior to the event. Figure 2 shows the results for the futures with the time to maturity of 2 months. The picture is similar, but even more pronounced, especially in case of a negative event. The returns are even lower preceding a negative event (-11%) and fall another 2% after the event.

Thus, either the news are providing stale information which has already been incorporated into prices, or the news sentiment is correlated with the price momentum: articles about previous returns are likely rated as positive if past returns were good and negative if past returns were bad – if this is the case, returns will cause sentiment. It is likely that the emerging picture is the result of both stale information and correlation of news sentiment with the price momentum.

If there is no dramatic news (neutral event), returns are 2% per month, this is in line with the theory that, by buying commodity futures, you are essentially selling insurance (the return on the contract is your premium) to the commodity producer against a drop in price. For an insurance salesman, no news is good news. Equivalently, one can think of this in terms of normal backwardation: if the normal situation is for the price of the future to increase as it approaches maturity, that is what we expect to happen if there is no dramatic news.

Note that, in the 15 days after a positive event, cumulative returns rise further 2-3%, then flatten out. It is unclear whether that is significantly more than the 2% returns observed in the absence of dramatic news. In contrast, cumulative returns stay flat, or even drop slightly, after a negative event.
Figure 1

Event Study: Crude Oil Futures - 12 mo. ahead

Cumulative returns vs. Trading days from event
Looking at a more distant 2-year maturity in Figure 3, we see that returns fall only 6% preceding a negative event, and the post-event fall in returns is also smaller than in the 2- and 12-month cases. In contrast, cumulative returns climb an extra 3% after a positive event – more than for shorter maturities.

Thus, if positive sentiment causes the price of distant futures to rise more than that of nearby futures, positive events should reduce the degree of backwardation or deepen the contango, depending on the market state. Similarly, if negative sentiment causes nearby prices to fall by more than distant prices, the degree of backwardation is also reduced and contango is deepened. However, positive events seem to do so by raising more distant future prices, while negative events cause nearby prices to fall relatively more. Surprisingly, the shape of the forward curve reacts to the extreme news events in a similar way, regardless whether the news was positive or negative.

To confirm this conclusion, we will extract the fundamental factors driving the forward curve evolution such as the level, slope and the convenience yield, as described in the forward curve model by Borovkova and Geman (2008). Then we will apply the event study, such as the one outlined here, to these fundamental factors (the factor explaining the forward curve’s slope is of a particular interest here) and report the results shortly. Moreover, we will separate the backwardation and contango market states and analyze them separately.
Finally, we look at a longer event window. The results for the window length of +/- 100 trading days are shown in Figure 4. It shows that abnormally low and high returns precede negative or positive events by as much as 80 to 100 trading days, but the cumulative returns stay flat for as much as 50 trading days after a negative event. Cumulative returns continue increasing at a rate higher than that of the neutral days only for a very short period after a positive event: 15 to 20 days. After that, cumulative returns grow at a slightly lower rate than for neutral events, which indicates a return to fundamentals.

In all of the above graphs, the most distinctive feature is the asymmetry: although positive and negative events are both 10% of days, the negative events are accompanied by much greater losses as compared to neutral events than the gains surrounding positive events as compared to neutral days. So it seems that, overall, the oil futures market gives greater credence to negative news: positive news being seen to include self-serving statements for market participants.
References


