Christal Lint
Director and Associate General Counsel
Legal Department

March 28, 2011

VIA E-MAIL

David Stawick
Secretary
Commodity Futures Trading Commission
Three Lafayette Center
1155 21st Street NW
Washington, DC 20581

Re: Position Limits for Derivatives (RIN 3038–AD15 and 3038 AD16) (Federal Register Vol. 76, No.17, Page 4752)

Dear Mr. David Stawick:

In addition to our comment letter dated March 28, 2011, we are submitting copies of studies and reports to be included in the Commission's official record on this important matter.

Sincerely,
/s/ Christal Lint

Enclosure

20 South Wacker Drive, Chicago, Illinois 60606 T 312 930 4527 F 312 930 3323 christal.lint@cmegroup.com cmegroup.com

Is Speculation Destabilizing?

Celso Brunetti

Bahattin Büyükşahin*

Abstract:

The possibility that speculative trading destabilizes or creates a volatile market is frequently debated. To test the hypothesis that speculative trading is destabilizing we employ a unique dataset from the U.S. Commodity Futures Trading Commission (CFTC) on individual positions of speculators. While others have used a more aggregated version of our data, here we test, for the first known time, whether speculators cause, in a forecasting sense, price movements and volatility in futures markets and, therefore, destabilize markets. Our findings provide evidence that speculative trading in futures markets is not destabilizing. In particular, speculative trading activity reduces volatility levels.

Key Words: Speculation, hedge fund, swap dealer, realized volatility, price, Granger-causality

JEL Codes: C3, G1

April 22, 2009

Draft: Please do not cite or quote without permission from the authors.

* **Büyükşahin**: Economist, Commodity Futures Trading Commission (CFTC), 1155 21st Street NW, Washington, DC 20485. Tel: (202) 418-5123 Email: bbuyuksahin@cftc.gov. **Brunetti**: Economist (IPA), CFTC and Assistant Professor of Finance, Carey Business School at John Hopkins University, 10 N. Charles St., Baltimore, MD, 21201, Tel: (202) 418-5253. Email: celsob@jhu.edu. We would like to thank Michael Haigh, Jeffrey Harris, Jim Moser, Frank Diebold, Jim Overdahl, David Reiffen, Frank Schorfheide for useful discussions and comments. We also thank Kirsten Soneson for excellent research assistance. The views expressed on this paper are those of the authors and do not, in any way, reflect the views or opinions of the Commodity Futures Trading Commission, its Commissioners or its staff. Errors or omissions are the authors' responsibility.

"[…] there is no question that speculators […] have pushed prices beyond the supply-demand fundamentals and into an era of speculative bubble in oil markets […] hedge funds are exploiting recently deregulated energy trading markets to manipulate energy prices."

Tyson Slocum, Director, Public Citizen's Energy Program,

Capital Hill Hearing Testimony, July 11, 2008

"[…] swap dealers […] convinced institutional investors that commodity futures were an asset class that would deliver 'equity like returns' […] the result has been a titanic wave of speculative money that has flowed into the commodities futures markets and driven up prices dramatically."

Adam K. White, Director, Research White Knight Research & Trading

Capital Hill Hearing Testimony, July 10, 2008

1. Introduction

The role of speculators, in particular hedge funds, in futures markets has been the source of considerable interest as well as controversy, in recent years. The traditional speculative stabilizing theory of Friedman (1953), that profitable speculation must involve buying when the price is low and selling when the price is high, has come under strong criticism. The critique originates from the observation that trading behavior of hedge funds and other large speculators can increase the fragility of financial markets leading to a potential destabilization of the broader market system. Two of the most important functions of futures markets are the transfer of risk and price discovery. In a well functioning futures market, hedgers, who are trying to reduce their exposure to price risk, will trade with someone who is willing to accept the risk by taking opposing positions. By taking the opposing positions, these traders facilitate the needs of hedgers to mitigate their price risk, while also adding to overall trading volume, which contributes to the formation of liquid and well-functioning markets. One important development in futures markets in recent years is the increased participation of speculators. In addition to traditional speculators such as hedge funds, other financial institutions, such as commodity swap dealers, have entered commodity futures markets. These institutions view commodities as a distinct *asset class* and allocate a portion of the portfolios they manage into futures contracts tied to commodity indices. The increased participation of traditional speculators as well as other financial institutions in futures markets[1] has led to claims that the trading activities of these speculators destabilize markets. Despite these accusations, there has been surprisingly limited

[1] Buyuksahin *et al*. (2009) show that the amount of money invested globally in commodity indices has been steadily growing and that the percentage participation of hedge funds and swap dealers in futures and options on futures has also been growing.

research on how speculative trading activity may impact prices and volatility. On the one hand this is particularly remarkable given the fact that this class of trader is controversial; on the other hand a lack of data stands in the way of a formal study of speculative trading in markets.

The available evidence on the effects of speculation activity is mixed. Speculators, and hedge funds in particular, have been examined in several financial distresses, including the 1992 European Exchange Rate Mechanism (ERM) crisis, and the 1994 Mexican peso crisis (Fung and Hsieh, 2000[2]); the 1997 Asian financial crisis (Brown, Goetzman and Park, 2000); and perhaps most famously the financial bailout of Long Term Capital Management (Edwards, 1999). In some episodes, hedge funds were deemed to have significant exposures and more than likely exerted market impact, whereas in other episodes they were unlikely to have contributed to destabilization. Brunnermeier and Nagel (2004) in their study of hedge funds and the technology bubble concluded that those funds did not exert a correcting force on stock prices during the bubble and hence question the efficient markets notion that rational speculators stabilize prices.

The limited nature of the previous literature on the market impact of speculators can be attributed to the difficulty of obtaining data on their trading activities. We do not face this problem. In fact, in this paper we employ the Commodity Futures Trading Commission (CFTC) Large Trader Reporting System that allows us to identify positions of each trader category in each futures contract for every contract maturity on each day. We use unique, highly disaggregated, precisely defined, position-level data in five different futures markets collected by the US CFTC. These markets are crude oil and natural gas in energy futures markets, corn in agricultural futures markets, and three-month Eurodollars and mini-Dow in financial futures markets. Choosing commodities and other financial derivatives from different sectors allows us to analyze the role of speculators in a variety of markets. The choice of these markets is uniquely made. Crude oil, natural gas and corn have experienced an amazing increase in price followed by a sudden reduction. We investigate whether these price movements are caused by speculation activity.

The three-month Eurodollar contract is the most heavily traded futures contract in the United States. This market is experiencing high volatility due to the current sub-prime crisis. Here we would like to investigate what is the role of speculative activity in the highly volatile interest rate market. Finally, the mini-Dow is chosen to represent the market-wide

[2] Fung and Hsieh (2000) analyze the impact of hedge funds in several events including the 1994 Mexican crisis.

overall stock market index. We are, therefore, covering a broad spectrum of assets traded in organized exchanges.

The data period considered in the paper runs from January 2005 until March 2009. We select this time period because it covers two important episodes: 1. the rise and the subsequent decline in commodity price (especially, energy markets); and 2. the sub-prime crisis. Our analysis, therefore, provides insights on the role exerted by speculation activity during these important events.

Contrary to common claims, we find that speculative activity does not affect prices. In addition, we find that speculation activity actually reduces volatility. Specifically, we analyze, in a simple multivariate framework, Granger-causality between the daily rate of returns of the above mentioned futures contracts and the daily positions of the five most important categories of market participants in these markets. With the exception of the stock market (mini-Dow), the results unambiguously show that hedge fund activity does not Granger-cause returns. In particular, hedge fund activity does not Granger-cause any other variable in the system but it is Granger-caused by the other variables in the system. Our results suggest that, by taking the reverse positions of other market participants, hedge funds provide liquidity to the market.

Furthermore, to assess the impact of speculative activity on risk, we construct *realized volatility* measures from high frequency data, and run Granger-causality tests between volatility and positions of the five most important trader categories in the crude oil, natural gas, corn, Eurodollar and mini-Dow futures contracts. We find evidence that swap dealer and hedge fund activities Granger-cause volatility. We, therefore, analyze impulse response functions and find that swap dealer and hedge fund activity reduces volatility. This result is of particular importance. Lower levels of volatility imply a reduction in the overall risk of the markets analyzed. Trading activities of swap dealers, in commodity markets, and hedge funds, in all five markets considered in our study, stabilize prices and, therefore, help these markets to perform their risk transfer function.

Our paper contributes to a reach literature. Empirically, the relationship between trader positions and price movement in futures markets has been studied using a highly aggregated public report produced by the CFTC called Commitments of Traders (COT). Brorsen and Irwin (1987) find no significant relation between price volatility and hedge fund positions in COT data, and Brown et al (2000) find no link between fund positions and falling currency values around the 1997 Asian financial crisis. Irwin and Yoshimaru (1999) also fail to find a link between funds positions and prices. Although these findings are suggestive, researchers generally acknowledge that CFTC COT data is highly aggregated; therefore results from these studies should be interpreted with caution. Recent research using disaggregated data from the CFTC Large Trading Reporting System provides further evidence on the relationship between trader positions and price movements. Irwin and Holt (2004) use CFTC data on large hedge funds and commodity trading advisors for the six-month period from April 1994 to October 1994, for 13 different futures markets. They find a small but positive relationship between trading volume and volatility. Yet, their study suffers from the aggregation problem since they used total hedge fund position as a proxy for nearby position. Haigh, Hranaiova and Overdahl (2007) also adopted CFTC data to analyze the relationship between positions of different trader categories and price movements. Using daily data from August 2003 to August 2004 for crude oil and natural gas futures markets, they find that hedge funds enhance the price discovery function of futures markets.[3] They use directed graph analysis and focus only on the return process while we consider both returns and volatility and adopt a different methodology. We also employ a richer data set in terms of both markets analyzed and time period covered.

Our results are also linked to a vast theoretical literature that starts with Friedman (1953). This theory predicts that profitable speculation has a stabilizing effect, since speculators buy when the price is low, therefore, increasing depressed prices, and sell when the price is high, therefore, decreasing inflated prices. According to Friedman's theory, speculation activity smoothes the price process. Our results confirm this view. Moreover, we find evidence that hedge funds take the opposite positions with respect to other market participants, therefore providing liquidity to the market. This is in line with Keynes' (1923) view that speculators fill hedgers' demand-supply imbalances and provide liquidity to the market. Our results are also linked to the work of Hirshleifer (1989, 1990). In a general equilibrium framework, he shows that speculation lowers hedge premia. We do not measure hedge premia directly. However, we find that speculation activity reduces volatility levels and lower volatility levels reduce the cost of hedging.

The remainder of the paper proceeds as follows. In section 2 we describe our data. In section 3 we analyze contemporaneous correlation between return, volatility, and the five most important categories of market participants in the crude oil, natural gas, corn, three-month Eurodollars and mini-Dow futures markets. In section 4 we analyze Granger-causality tests between trader positions and rate of return as well as positions and volatility. We conclude in section 5.

---

[3] Boyd, Buyuksahin, Haigh and Harris (2009) employ the same data set to analyze the existence of herding among hedge funds. They find that the degree of herding in futures markets is similar to equity markets and that the moderate level of herding in futures markets serves to stabilize prices.

2. Data

We select futures contracts that represent a broad spectrum of assets traded in futures markets: energy (crude oil and natural gas), agriculture (corn), interest rates (Eurodollar) and stocks (mini-Dow).

We analyze a considerable amount of data covering the period of January 3, 2005 (August 1, 2006 for corn)[4] through March 19, 2009. During this time period, the role of speculators has been heavily criticized. This is particularly true for energy and agricultural markets. In fact, at the beginning of our sample, the futures price of crude oil is just over $42, then reaches the staggering price of $146 in July 2008 and goes back to $42 at the end of our sample (see Figure 1, row 1). Natural gas also experiences great price variability, during our sample. Prices move up from $6 to $15 at the end of 2005, and then return back to $6 in 2006, moved up again to $13 in 2008 and settle below $4 in March 2009 (see Figure 1, row 2). The corn market also experienced a sharp increase in price (from $5 to $16) followed by a sharp decline, during our sample. Many have attributed these price movements to speculative activity.[5]

For each market analyzed, we use three different data sets: 1) daily futures rate of returns; 2) high frequency transaction data which we employ for computing realized volatility measures; and 3) data on daily net futures positions of the most important categories of market participants in each market.

We use futures market data for several reasons. First, futures prices are readily available on a tick-by-tick basis. Second, the contracts we analyze are very actively traded, and transactions costs are lower in futures markets. Third, the CFTC collects data on the market participants' positions for futures and options but not for the cash market. Fourth, numerous studies find that futures markets tend to lead cash markets in terms of price discovery.[6] This last point is very important as we focus on the impact of speculation activity on prices and volatility.

For each market we concentrate on the nearby contract (closest to delivery). Before maturity (the expiration date), market participants roll over their positions from the nearby contract (March 2005, say) to the next-to-nearby contract (June 2005). This behavior generates some type of seasonality in the data. To mitigate these problems, the roll-over strategy adopted in this paper is to switch to the new contract when the open interest of the nearby contract (March 2005) is lower than the open interest of the next-to-nearby contract

---

[4] High frequency data for corn are not available before August 2006.

[5] Indeed, in the natural gas market over the sample period analyzed, a hedge fund (Amaranth) has been formally charged with market manipulation.

[6] See Hausbrouk (2003).

(June 2005).[7] Futures contracts rarely involve physical delivery. In fact, they are closed before maturity. The roll-over strategy employed in this paper may also solve the delivery distortion problems caused by the need of market participants to close their positions before the nearby contract expires.

In what follows we describe the data in some detail.

2.1 Futures Market Return Data

Table 1 provides an overview of the five selected contracts. Crude oil and natural gas are listed on the New York Mercantile Exchange (NYMEX). Crude oil is the world's most actively traded commodity and the light sweet crude oil traded on NYMEX is the most liquid futures contract on a physical commodity. Natural gas accounts for almost a quarter of U.S. energy consumption, and the natural gas futures contract traded on NYMEX is widely used as a national and international benchmark price. Energy futures contracts are traded on both an electronic platform and an open auction. Daily settlement prices refer to the prevailing price at 2:30 pm EST, when the open auction closes.[8] Futures contracts on corn are traded on the Chicago Board of Trade (CBOT). Corn is becoming increasingly important for the production of bio-fuel (ethanol). Trading on both the open outcry and electronic platform starts at 10:30am and ends at 2:15pm EST (there is also an additional electronic trading session from 7:00pm to 7:00am EST). We compute daily returns using settlement prices which are set by the exchange at the close of the trading day (2:15pm EST). The Eurodollar futures contract is listed on the Chicago Mercantile Exchange (CME) and is the most widely traded interest rate futures product in the US. Eurodollar deposits[9] play a major role in the international capital market, and are considered the benchmark interest rate for corporate funding. The market is open from 8:20am to 3:00pm EST for floor trading, while the electronic trading on Globex occurs between 6:00pm (the previous day) and 5:00pm EST. The settlement price is derived from trades and quotes occurring between 2:59pm and 3:00pm EST on Globex. The last market considered is the mini-Dow futures, which is traded on CBOT. Mini-Dow futures provide a way to efficiently gain exposure to the Dow Jones 30 index, using a small-sized electronic contract (each point is worth $5). The contract trades only electronically on Globex from 6:00pm (the previous day) until 4:15pm EST (there is also an additional session from 4:30pm to 5:30pm EST).

Daily returns are constructed as $r_t = p(t) - p(t-1)$, where $p(t)$ is the natural logarithm of the settlement price in day *t*. When we switch contract from the nearby

[7] See Gao and Wang (1999).
[8] We only consider days when the market is open for at least five (three for corn) trading hours.
[9] Eurodollars are defined as U.S. dollars deposited in commercial banks outside of the U.S.

position to the next-to-nearby position, $p(t)$ and $p(t-1)$ refer to the next-to-nearby contract. Table 2, column one, reports summary statistics for the return processes. Daily returns on crude oil have a negative mean (-11.6% annually) and high standard deviation. The unconditional distribution is non-Gaussian with negative skew and kurtosis in excess of three. The negative first-order autocorrelation indicates mean reversion. Natural gas exhibits a significant negative average daily return (-47% annually) and a very large standard deviation (the largest of the five markets). The unconditional distribution of the daily rate of returns on natural gas is non-Gaussian. Corn displays the highest average daily rate of return over the sample (6.3% annually). The standard deviation dominates the mean and the unconditional distribution is close to a Gaussian. Not surprisingly, the Eurodollar interest rate has a very low standard deviation and daily average close to zero. The Eurodollar returns also exhibit significant first order autocorrelation and excess kurtosis. Returns on the mini-Dow have negative daily average (11% annually), negative skew and excess kurtosis. The standard deviation of futures returns on the mini-Dow is higher than that of the Eurodollar but lower than that of energy products and corn, confirming that, over our sample, commodity markets experience large price variations. The negative return for the mini-Dow is mainly due to the sub-prime srisis and the recession that followed soon after the crisis.

2.2 High Frequency Transaction Data

To construct realized volatility measures, we obtained transaction data from the Commodity Futures Trading Commission. At the end of each trading day, the CFTC receives data on all transactions that occurred in futures and options directly from the exchanges.

For crude oil and natural gas we consider transactions in both the electronic platform and the traditional pit. Energy markets started to trade electronically on September 5th 2006. After that day, most of the transactions take place in the electronic platform. However, there is still a 30 percent of volume traded on the pit. We, therefore, constructed realized volatility measures considering all transactions that took place between 9:00 am and 2:30pm EST (see Table 1).

In the corn market we only utilize electronic transactions that took place between 10:30am and 2:15pm EST. In fact, in this market the majority of transactions occur on the electronic platform. Pit trading is sometimes infrequent and pit transaction data are somehow problematic. Electronic trading on corn starts on August 1st 2006, this is when our sample starts.

For the Eurodollar market we construct realized volatility measures considering both electronic and pit transactions that took place between 8:20am and 3:00pm EST. The mini-Dow is only traded electronically, and we consider transactions that took place between 9:30am and 4:00pm EST, when traded volume is the highest and when the market for the underline stocks is most actively trading.

We are dealing with very liquid markets. Crude oil and mini-Dow, for example, have several days where the number of transactions is over 150,000 (see last row of Table 1). The median intertrade duration for all the markets analyzed, is zero seconds.[10]

The use of high frequency data for constructing realized volatility measures could be problematic given the bias produced by market microstructure noise. Several solutions have been proposed to overcome this problem. In this paper we follow three approaches. Barndorf-Nielsen *et al.* (2008) propose a kernel estimator where the bias correction is achieved by taking into account the autocorrelation structure of high frequency data. The second approach we follow is that of Andersen *et al.* (2001) where the bias correction is achieved by sampling at relatively lower frequencies. The last approach we implement is developed by Zhang *et al.* (2005) and is referred to in the literature as *two scales realized volatility*. The results of our analysis are qualitatively the same regardless of the realized volatility estimator adopted. To conserve space, we only report results for the two scales realized volatility estimator.[11] Here we describe this estimator in some detail and to do so we need to introduce some notation.

Let $\{p(\tau)\}_{\tau \in t}$ be the natural logarithm of the price process over the time interval t, and let $[a,b] \subset t$ be a compact interval which is partitioned in m subintervals. In our setup the interval $[a,b]$ is a trading day. For a given m, the ith intraday subinterval is given by $[\tau_{i-1,}^m, \tau_i^m]$, where $a = \tau_0^m < \tau_1^m < \ldots \tau_m^m = b$, and the length of each intraday interval is given by $\Delta_i^m = \tau_i^m - \tau_{i-1}^m$. The intraday returns are defined as

$$r_i^m = p\left(\tau_i^m\right) - p\left(\tau_{i-1}^m\right)$$

where $i = 1,2,\ldots,m.$ Realized volatility in day t is the sum of squared intraday returns sampled at frequency m

$$RV_t^m = \sum_{i=1}^{m} \left(r_i^m\right)^2 \qquad (1)$$

The two scales realized volatility estimator is quite simple. Starting from the first observation, set m=300 transactions, say, and compute RV using equation (1). Then, starting from the second observation re-compute RV using equation (1) (m is unchanged).

[10] Our high frequency data contain information up to the second, but actual transactions are recorded in hundredths of a second (centiseconds) or thousands of a second (milliseconds).
[11] Results for the other realize volatility estimators are available from the authors.

In this way, even if m is set to a given sampling frequency, we still make use of all available observations (transactions). We then average the estimators obtained on the subintervals. Sampling at a relatively lower frequency (say, 5-minute, in calendar time, or every 300 transactions in transaction time) dramatically reduces the effect of market microstructure noise. This benefit is now retained, while the variation of the estimates will be lessened by the averaging. When applying equation (1) to all observations (i.e. sampling at the highest possible frequency, $m=1$), we obtain a consistent estimate of the variance of the market microstructure noise. The last step in the two scales realized volatility estimator is to correct for the bias of the noise, by subtracting from the average estimator the noise variance

$$RV_t^{TSRV} = \frac{1}{k}\sum_{j=1}^{k} RV_{t,j}^{m} - \gamma RV_t^{all} \tag{2}$$

where k denotes the number of subintervals of size m and, therefore, the number of realized volatilities computed using equation (1) and setting m to a lower frequency; γ is a ratio between m and the total number of observations in $[a,b]$; and RV^{all} refers to the realized volatility measure in (1) computed using all available data in the interval $[a,b]$. Intraday returns can be constructed using different sampling schemes. In our framework, $\tau_{i,m}$ denotes the time of a transaction. We, therefore, compute the two scales realized volatility measure in transaction time (for example, sampling every 300 transactions). In order to implement equation (2), we need to choose m, the sampling frequency. *Volatility signature plots*[12] provide valuable information about the bias in RV measures in (1) and about optimally choosing m in order to correct that bias. For each asset, we construct volatility signature plots for each month in our sample and then select m.[13]

Figure 1 depicts prices and two scales realized volatility measures for the five assets analyzed in the paper. Crude oil, interest rates (Eurodollar) and the stock market (mini-Dow) exhibit high volatility in the last part of our sample, after the sub-prime crisis hits the economy. We may conjecture that these markets are strongly linked to the overall *status* of the economy. The uncertainty about the sub-prime crisis and the recession is clearly evident in the volatility of these assets. Natural gas and corn also exhibit higher volatility towards the end of our sample, but these volatility levels are comparable to those computed in the first part of our sample.

Table 2, column 2, provides descriptive statistics for RV. Energy and corn markets show both a very high average volatility and a high variation in volatility levels. This is not

[12] Volatility signature plots show average daily realized volatility measures, computed using equation (1), against sampling frequencies m - see Andersen, Bollerslev, Diebold and Labys (2000).
[13] Details on this procedure can be obtained from the authors.

surprising, given that we are indeed covering the period where commodity markets experience dramatic price increases. The lowest volatility is in the Eurodollar market followed. All realized volatility measures are stationary and highly persistent.

2.3 Market Participants' Positions

The CFTC monitors U.S. futures and options on futures markets through its market surveillance program, and since the 1920s, the CFTC (and its predecessors) has been utilizing the central tool of market surveillance known as the Large Trader Reporting System (LTRS). Following the Commodity Exchange Act (CEA), the CFTC collects and stores data from daily reports on market data and position information from the Futures Commission Merchants (FCM's), foreign brokers, exchanges, clearing members, and also traders. These reports show the positions of traders that hold contracts above specific levels set by the CFTC. These large trader reporting levels include crude oil, 350 contracts; natural gas, 200 contracts; corn, 250 contracts; Eurodollar, 3,000 contracts; and mini-Dow, 1,000 contracts. The total amount of all trader positions reported to the CFTC represents approximately 70 – 90 percent of total open interest in any market, while the remainder are traders who generally trade a small number of contracts, known as Non-Reportable Positions (NRP).[14]

When a trader is identified to the CFTC, the trader is classified either as a *commercial* or *non-commercial*. A trader's reported futures position is determined to be commercial if the trader uses futures contracts for the purposes of hedging as defined by CFTC regulations. The non commercial category includes participants who are not involved in the underlying cash business – otherwise known as speculators and include hedge funds, floor brokers/traders and so forth (see Exhibit 1 in the appendix).[15]

The Commitment of Traders Report (COT), which utilizes data from the LTRS, provides a summary of highly aggregated traders' position (commercial, noncommercial and NRP) as of the close of business on Tuesday for each market in which at least 20 traders hold positions. Information released to the public in the form of the COT is highly aggregated, but the disaggregated LTRS enables the CFTC surveillance team to monitor

[14] Occasionally, the CFTC will raise or lower the reporting levels in specific markets with the objective of striking a balance between maximizing effective surveillance and minimizing the reporting burden on the futures industry.

[15] Specifically, a reportable trader gets classified as commercial by filing a statement with the CFTC (using the CFTC Form 40) that he is commercially "…engaged in business activities hedged by the use of the futures and option markets." However, to ensure that the traders are classified consistently and with utmost accuracy, CFTC market surveillance staff in the regional offices checks the forms and re-classifies the trader by collecting further information about the trader's involvement in the markets.

individual participants and/or a specific group of market participants. It is these detailed groupings within the commercial and non-commercial categories that we analyze in this study. Active groupings of participants vary across contract markets but an exhaustive list of participants can be found in Exhibit 1 in the appendix.

Two categories of market participants deserve further discussion: commodity swap dealers and hedge funds. We start with the latter.

There is no consensus on the exact definition of a hedge fund in futures markets and the CEA, the statute governing futures trading, does not define hedge funds.[16] Accordingly, there is not a requirement that hedge funds be categorized in the LTRS. Despite this, many hedge fund complexes are registered as Commodity Pool Operators (CPOs),[17] Commodity Trading Advisors (CTAs)[18] and/or Associated Persons (APs),[19] who may control customer accounts. In addition to these three categories of traders, market surveillance staff at the CFTC identifies other participants who are not registered in any of these three categories but are known to be managing money (MM). These four categories combined are defined as being the hedge fund category (see bottom of Exhibit 1 in the appendix). We actually check the names of the funds in these four categories with those listed in press reports as hedge funds, and we find that many of the large CPOs, CTAs, APs and MMs are generally considered to be hedge funds and hedge fund operators. As such, and to conform with the academic literature and common financial parlance, we refer to these four categories collectively as hedge funds in our study.

In commodity markets, commercial commodity swap/derivatives dealers (henceforth, swap dealers), play an important, albeit controversial, role. This category of market participants uses derivative markets for two main reasons: i) to manage their price

---

[16] However, the SEC notes that a hedge fund is an 'entity that holds a pool of securities and perhaps other assets, whose interests are not sold in a registered public offering and which is not registered as an investment company under the Investment Company Act" (p.3. SEC, 2003).

[17] "Commodity Pool Operator (CPO): A person engaged in a business similar to an investment trust or a syndicate and who solicits or accepts funds, securities, or property for the purpose of trading commodity futures contracts or commodity options. The commodity pool operator either itself makes trading decisions on behalf of the pool or engages a commodity trading advisor to do so."
Source: Glossary of the CFTC (http://www.cftc.gov/educationcenter/glossary/index.htm).

[18] "Commodity Trading Advisor (CTA): A person who, for pay, regularly engages in the business of advising others as to the value of commodity futures or options or the advisability of trading in commodity futures or options, or issues analyses or reports concerning commodity futures or options."
Source: Glossary of the CFTC (http://www.cftc.gov/educationcenter/glossary/index.htm).

[19] "Associated Person (AP): An individual who solicits or accepts (other than in a clerical capacity) orders, discretionary accounts, or participation in a commodity pool, or supervises any individual so engaged, on behalf of a futures commission merchant, an introducing broker, a commodity trading advisor, a commodity pool operator, or an agricultural trade option merchant."
Source: Glossary of the CFTC (http://www.cftc.gov/educationcenter/glossary/index.htm).

exposure originating from their over-the-counter (OTC) business; and ii) to manage their transactions with commodity index funds. These funds are often employed by pension funds and other large institutions that seek diversification by investing in commodities. For this reason commodity index funds hold significant long-only positions, especially in near-term futures contracts. The controversy regarding swap dealers owes to the fact that they are classified as commercial traders (i.e. hedgers) - indeed these market participants are hedging their price exposure - but they are often trading to fulfill the needs of commodity index funds that are entering commodity markets to have an exposure in these markets. Over our sample, commodity index funds have experienced a significant growth.[20]

For each market, we consider four types of traders' information: i) number of contracts held in long positions by a specific trader category (futures long); ii) number of contracts held in short positions by a specific trader category (futures short); iii) the difference between futures long and futures short positions (net futures positions); and iv) net total positions which accounts for both the net futures positions and the net (delta adjusted) option positions of each trader. To conserve space we report only results for the net futures positions. However, results for futures short, futures long and net total positions[21] are qualitatively similar to those obtained with the net futures positions.

For each market we concentrate on the five largest categories of market participants. Hedge funds (HF) and floor brokers/traders (FBT) are common to the five markets analyzed. According to the CFTC definition, these two categories of market participants are non-commercial – i.e. speculators. In the crude oil, natural gas and corn markets, we analyze dealers/merchants (AD) – which include wholesalers, exporters/importers, shippers, etc.; swap dealers (AS) – see discussion above; and manufacturers[22] (AM) – which includes fabricators, refiners, etc.; and producers (AP)[23]. For the Eurodollar market, in addition to hedge funds and floor brokers/traders, we study the positions of commercial arbitrageurs or broker/dealers (FA), non-U.S. commercial banks (FB) and U.S. commercial banks (FC).[24] It is not surprising that domestic and foreign banks are very active in this market. Finally, the hedger categories for the mini-Dow are arbitrageurs or broker/dealers (FA), financial institutions other than those already classified (FO), and hedge funds (FH) – hedge funds that are shown to be hedging.

[20] By June 2008, the notional value of commodity index investments tied to U.S. futures exchanges exceeded 160 billion dollars (CFTC, 2008).
[21] These results are available from the authors.
[22] For crude oil and corn.
[23] For natural gas.
[24] For a definition of broker, dealer, floor trader and floor broker, we refer the interested reader to the glossary of the CFTC, which can be found on line at http://www.cftc.gov/educationcenter/glossary/index.htm.

Table 1 shows descriptive statistics for the level and first difference of the net futures positions of each category of market participants organized by market. Dealers and merchants (AD) are net short over our sample, while swap dealers are net long. This is to be expected given that commodity index funds hold long positions. Hedge funds are net long in crude oil, corn, Eurodollar and mini-Dow, but net short in natural gas. Positions in levels are stationary for all markets but the Eurodollar. This market, in fact, is experiencing a reduction in volume and open interest since the inception of the sub-prime crisis. Interestingly, hedge fund positions in the Eurodollar market are stationary, indicating that these market participants are not fleeing the market. Positions in levels exhibit strong autocorrelation. Positions in levels measure the stock hold by each market participants in each market and are, therefore, a measure of stock. To measure trading activity (flow) we compute change in positions. Swap dealers exhibit negative mean and median indicating an overall reduction in their positions. This is also true for hedge funds. Swap dealers (AS) and hedge funds (HF) exhibit high standard deviation in change in positions - .i.e. they are changing their positions often and by large amounts.

Table 3 shows the participation rate of each trader category in each market as percentage of the total open interest. While in Table 2 we analyze net futures positions of market traders, in Table 3 we concentrate on the long and the short components of trader positions. Dealers and merchants (AD) are mainly short. This is in line with the needs of these market participants to hedge their positions in the underlying commodity. Swap dealers hold 40 percent of the long positions in all commodities analyzed. Interestingly, hedge funds hold large positions in all five markets, and they are present on both sides of the market (long and short positions). The last column of Table 3 shows the percentage (mean, maximum and minimum) of total open interest held by the five categories of market traders over our sample. Even if we only consider five categories of traders in each market, we cover most of the total open interest traded on these markets.

We proceed with the correlation analysis.

3. Unconditional Contemporaneous Correlation

Our preliminary analysis of the relationship between returns, volatility, and trader positions begins by computing correlation coefficients. Table 4 reports, for each market, correlation coefficients between returns, realized volatilities, and the positions of the five categories of traders analyzed. The top number refers to the positions in levels, while the bottom number refers to the change in positions. Positions for dealers/merchants (AD) are negatively correlated with rate of returns and positively linked to volatility of natural gas and corn but negatively linked to volatility of crude oil. There is no evidence of a contemporaneous link between swap dealer positions, either in levels or first difference, and rate of returns. Swap dealer activity seems to move in the opposite direction of volatility in the corn and the natural gas markets but is positively link to volatility levels in the crude oil market. Hedge funds have a positive correlation with returns. This implies that hedge fund positions move in the same direction as the market. It is also interesting to note that hedge fund activity is negatively linked to volatility. An increase in hedge fund activity is associated with lower volatility levels. Finally, swap dealer activity and hedge fund activity is negatively linked to other traders' positions. This may suggest that by taking the opposite position with respect to the other market traders, swap dealers and hedge funds may provide liquidity to the market. This is in line with the results of Haigh, Hranaiova and Overdahl (2005) who study the interaction between traders in the natural gas and crude oil futures markets. They find that hedge funds provide liquidity to hedgers. This is also in line with the theory of speculation as described in Keynes and Hicks, which postulates that speculator positions should offset any imbalance of hedger positions.

The simple correlation analysis provides three main results. First, swap dealer activity is not contemporaneously correlated with returns and is negatively linked to volatility. Second, hedge fund activity is positively correlated with returns but negatively correlated with volatility. Third, the correlation between hedge fund positions and positions of the other market traders is always negative. The same result also holds for swap dealers.

4. Granger-Causality Analysis

The concept of Granger-causality relates to predictions – x_t is Granger-causal for z_t if x_t contains useful information for predicting z_t. This definition of causality is practical but has limitations. In fact, the notion of causality is an old one and goes back to the ancient Greek philosophy - Aristotle distinguishes between cause and effect: a cause is an event that produces an effect. Unfortunately, Granger-causality does not allow us to distinguish between causes and effects. Nonetheless, Granger-causality is easy to compute and provides useful information as to whether a trader activity prompts, in a forecasting sense, price movements and/or *vice versa*.

We test for Granger causality in the context of Vector AutoRegression (VAR) models. Since the variables exhibit heteroskedasticity and serial correlation, we estimate VAR models using the Generalized Method of Moments (GMM) and Newey-West robust standard errors. We estimate four different sets of VARs. In the first we consider rate of returns and positions in levels; in the second we employ rate of returns and change in positions; in the third we utilize volatility and positions in levels; in the last we consider volatility and change in positions.[25] We only report results for the optimal lag-length.[26] However, we would like to emphasize that these results are very robust and hold regardless of the lag structure in the VAR.

4.1 Crude Oil

Table 5 provides the results (p-values) of Granger-non-causality tests. The last column and the last row of the Table are labeled "all". In the last column we test whether each variable is Granger-caused by all the other variables in the system - i.e. are returns (volatilities) Granger-caused by positions? The last row is, on the other hand, testing whether each variable is Granger-causing any other variable in the system. In other words, we are testing whether each variable is jointly Granger-causing the remaining variables in the system. Here we are particularly interested in testing whether swap dealer activity and hedge fund activity are Granger-causal for returns and volatility. The null hypothesis is that of Granger-non-causality - a p-value greater than 5 percent indicates failure to reject the null.

Panels A and B in Table 5 refer to Granger-causality tests between rates of returns and positions in levels, and in their first difference, respectively. We obtain some interesting results. Returns on the crude oil market are not Granger-caused by positions (the p-value is equal to 0.148 for levels and 0.199 for change in positions). On the other hand, returns Granger-cause positions (the p-value is 0.000). When jointly testing whether hedge funds Granger-cause returns or any other variable in the system, we fail to reject the null. In fact, hedge fund activity is the only variable which is not jointly Granger-causing any other variable in the system (the p-value 0.181 in panel A and 0.086 in panel B) at 5 percent significance level. This implies that hedge fund positions do not provide any useful information for predicting returns or positions of other traders. Moreover, hedge fund activity is Granger-caused by the system (the p-value is 0.000 for both levels and change in positions). If we pair this result with the negative correlation between hedge fund positions and positions of the other traders, it is reasonable to conjecture that by taking the opposite side in the market (negative correlation), hedge funds are providing liquidity to the market.

[25] We only report results for net futures positions. However, we perform the same analysis also for long futures positions, short futures positions and net total (future and options) positions.

[26] We select the optimal lag-length using a series of Wald tests (i.e. testing for the significance of the parameters of each lag). Given the problems of heteroskedasticity and serial correlation in our data, we could not rely on standard Akaike (AIC) and Schwartz information criteria (SIC). Wald tests do not pose any penalty to less parsimonious specifications, unlike AIC and SIC. Therefore, the optimal lag-length selected is always higher than that selected by AIC and SIC. However, the results do hold even when using AIC and SIC.

Our results for swap dealers indicate a feedback effect: swap dealer positions are Granger-caused by the other variables in the system and Granger-cause these variables.

The last two panels in Table 5 report Granger-causality tests for volatility and traders' positions (panel C refers to positions in levels while panel D refers to change in positions). A stylized empirical finding in the realized volatility literature is that logarithmic realized standard deviation is approximately Gaussian. Our realized volatility measures confirm this finding.[27] In fact, in modeling realized volatility measures in the context of VARs, it is customary to use logarithmic realized standard deviation – e.g. Andersen *et al*. (2006). In our analysis we use the three measures of realized volatility described in Section 2 and their logarithm realized standard deviations counterparts. To conserve space, we only report results for logarithmic two scales realized standard deviation in transaction time.[28]

Panels C and D show that positions, including those of swap dealers and hedge funds, Granger-cause volatility. There is also a feedback effect from volatility to traders' positions. Therefore, it seems that swap dealer and hedge fund trading, among others, are moving volatility levels in the crude oil market. To further investigate this issue we compute impulse responses. Pesaran and Shin (1998), proposed a technique, termed "generalized impulse responses", which is invariant to the ordering of the variable in the VAR and does not require shocks to be orthogonal. Assume that there is a one-standard deviation shock to the *k*-th variable; generalized impulse responses are then computed by applying a variable specific Cholesky factor which is derived by placing the *k*-th variable at the top of the Cholesky ordering. Figure 2, row 1, depicts generalized impulse responses of volatility to one standard deviation innovation in the level of traders' positions in the crude oil futures market, for the VAR with 5 lags.[29] We are particularly interested in the response of volatility to a standard deviation shock to commodity swap dealer activity and hedge fund activity. The second column in row 1 indicates that swap dealers have no impact on volatility. Interestingly, the fourth column in row 1 provides evidence of a short-lived and statistically significant reduction in volatility. In other words, a shock in hedge fund activity reduces volatility. It is also worth noting that positions of dealers and merchants (hedgers) have a positive impact on volatility levels (i.e. they increase volatility).

---

[27] Results not reported.

[28] Our results are robust to the different measures of realized volatility considered.

[29] This is the optimal lag-length. Generalize impulse responses for VARs with 4-1 lags are very similar to those reported in Figure 2. Response standard errors are computed with 1,000 Monte Carlo replications in EViews 6. On the horizontal axis is the number of days after the shock, in this instance 10 days.

We also compute impulse responses using the classic Cholesky decomposition which is very sensitive to the order of the variables in the VAR. To mitigate this problem we consider several orderings of the variables and always find results similar to those reported above.[30]

Figure 3 row 1 illustrates impulse responses of volatility to a standard deviation shock to change in positions. Swap dealer activity and hedge fund activity have a negative impact on volatility – i.e. the trading of these two market participants reduces volatility levels. There is also some evidence that dealers and merchants (commercial AD) swell volatility.[31]

4.2 Natural Gas

Table 6, panels A and B, report Granger-causality test results (p-values) for returns and positions in levels, as well as returns and change in positions, respectively. We find that rate of returns in the natural gas industry are not Granger-caused by positions, both in levels (p-value 0.486) and first difference (p-value 0.571), but positions are Granger-caused by rate of returns (p-value 0.001 for positions in levels and 0.000 for change in positions). Swap dealer positions are Granger-caused and Granger-cause the other positions in the system. There is also evidence that the system is Granger-causing hedge fund activity, but hedge fund activity is not Granger-causing the system. It seems that hedge funds are reacting to market conditions, and there is no indication that hedge fund activity is moving prices and/or positions of other traders. These results are qualitatively similar to those obtained in the crude oil market.

Panel C in Table 6 shows Granger-causality tests for volatility and positions in levels. Volatility is Granger-caused by traders' positions (p-value 0.016), including hedge funds. There is no evidence of a feed-back effect from volatility to trading activity (p-value 0.633). Figure 2, row 2, shows generalized impulse responses of volatility to a standard deviation shock in trader positions. Swap dealers and hedge funds have a short-lived negative impact on volatility, in the sense of a reduction of volatility levels (see second and fourth columns in Figure 2, row 2). On the other hand, it appears that dealers and merchants (AD) and producers (AP) increase volatility levels.

The last panel in Table 6 refers to Granger-causality tests for volatility and change in trader positions. The results suggest that volatility is marginally not Granger-caused by

[30] Impulse responses using the classic Cholesky decomposition are also calculated for all the other markets studied in this paper. Results from Cholesky decomposition are similar to generalized impulse responses; therefore we do not report them in this paper.

[31] For the change in positions we also compute impulse responses using Cholesky decompositions and several orderings of the variables. We always obtain qualitatively similar results.

trading activity (p-value 0.052) and does not Granger-cause trading activity (p-value 0.344). Similarly to what we find in the crude oil market, there is evidence that hedge fund trading is Granger-caused by the trading of the other market participants but is not causing, in a forecasting sense, any variable in the system. Figure 3, row 2, confirms our findings. In fact, hedge fund activity does not have any impact on volatility (fourth graph); swap dealers seem to slightly reduce volatility (second graph); while dealers and merchants seem to increase volatility levels.

4.3 Corn

Rate of returns on corn appear to not be affected by trader positions and by the change in trader positions. In fact, Table 7 shows that returns are not Granger-caused by the trading activity of the five largest categories of traders. Similar to the results for the energy market, hedge fund activity is Granger-caused by the system but does not Granger-cause the system. This is also true for swap dealer activity in panels B (change in positions).

There is evidence of a feed-back effect between volatility and trader positions. Hedge fund activity is non-causal for the system (p-values 0.070 and 0.148 in Table 7, panels C and D, respectively) but is caused by the other variables in the system. Similar results also hold for swap dealer positions in the last panel, where changes in positions are considered. Impulse responses in Figures 2 and 3, row 3, show that hedge fund activity and swap dealer activity do not have a significant effect on volatility.

4.4 Eurodollar

Since the inception of the so-called sub-prime crisis, interest rate markets experienced a decline in open interest. The Eurodollar futures market is no exception.[32] However, it still remains the most liquid futures market in the US in terms of traded volumes. For four of the trader types analyzed, net positions (futures or futures and futures equivalent options) are non-stationary (the ADF test fails to reject the null of stationarity). We, therefore, only analyze changes in positions. Table 8 reports Granger-causality tests for the Eurodollar market. In line with the previous results, rate of returns is not Granger-caused by positions (p-value 0.478). Interestingly, hedge fund activity is caused by the other variables in the system (p-value 0.001) but does not Granger-cause any variable in the system (p-value 0.411).

[32] During our sample, futures-only three-month Eurodollars open interest declined from a peak of 12 million contracts to 9 million contracts.

Similar to the results for crude oil and natural gas, it seems that volatility in the Eurodollar market is Granger-caused by trading activity (p-value 0.025). In particular, there is evidence that hedge fund activity is causal to volatility (p-value 0.007). To further investigate this issue, we compute generalized impulse responses. Figure 3, row 4, shows that four of the five trader categories (including hedge funds) have no effect on the Eurodollar volatility while commercial arbitrageurs and brokers/dealers (FA) seem to reduce risk in this market.

4.5 Mini-Dow

The last market we analyze is the mini-Dow. In this market we have two hedge fund categories: hedgers (commercial FH) and speculators (non-commercial HF). It is interesting, then, to compare how hedge funds behave when entering the market for different purposes.[33]

The results for this market are, in part, different from those obtained in the other markets analyzed. In fact, rates of return (see Table 9, panels A and B) are Granger-caused by trader positions. This is a feedback effect. Returns also cause, in a forecasting sense, positions. It also appears from panel B (change in positions) that speculative hedge fund activity is responsible for this causal effect. Positions of commercial hedge funds (hedgers) seem to affect rates of return when considering the levels of the positions (p-value 0.000); this is no longer the case when considering changes in positions (p-value 0.360). Since this is the first market analyzed where rates of return are Granger-caused by positions, we also investigate impulse responses. Figure 2, row 4 (positions in levels), and Figure 3, row 5 (change in positions), depict generalized impulse responses of mini-Dow returns to a shock in market positions. Speculative hedge fund activity has a positive impact on returns in the sense that it increases return levels. During the time period analyzed, the Dow index, first increases from a level of 10,750 to 14,200 in the second half of 2007 and then declines after the beginning of the sub-prime crisis and reaches 6,500 at the end of our sample. On average, the Dow experienced a negative return over our sample (11% on an annual basis). Trading activity of speculative hedge funds (HF) and commercial arbitrageurs and brokers and dealers (FA), contribute to reverse the negative trend. On the other hand, commercial financial institutions (FO) and floor brokers/traders (FBT) appear to contribute to the

[33] Among the five markets analyzed, commercial hedge funds hold significant positions only in the mini-Dow.

trend.[34] Interestingly, commercial hedge funds (FH) exhibit no significant impact on returns.

Now we turn our attention to the volatility of the mini-Dow. Table 9, panels C and D, show that volatility is Granger-caused by positions (including those of commercial and non-commercial hedge funds) but not *vice versa*. In line with the results for volatility dynamics described above, speculative hedge fund activity reduces volatility. It is interesting to contrast the graphs in the last two rows of Figures 2 and 3. Traders that increase rate of returns and reverse the trend (speculative hedge funds and arbitrageurs and brokers and dealers), decrease volatility; while traders that decreased returns (financial others), have a net positive effect on volatility. According to classical theory (Friedman, 1953) a speculator should buy when the price is falling and sell when the price is rising. This implies a trend reversal. Speculative hedge fund activity in this market does seem to reverse the trend. Moreover, speculation from hedge funds reduces the risk level in this market. We also notice a difference between the effects of trading activity of commercial hedge funds (hedgers) and non-commercial hedge funds (speculators). The latter category reverses the trend and reduces volatility levels while the former does not have any significant effect on returns and volatility.

4.6 Main Findings

Is speculation activity causing price movements in energy, agricultural, and financial markets?

The analysis of Granger-causality between returns and trader activities yields two main results. First, returns are not Granger-caused by positions. The only exception is the stock market where we find that speculative hedge fund activity has a positive impact on a bearish market. Therefore, the answer to the above question is negative for most markets analyzed and when we have evidence of a causal effect on returns, we find that speculation activity reverses the trend. Second, hedge fund activity is not Granger-causal for returns and/or positions of the other market traders, but it is Granger-caused by the other variables in the system. Once again, the stock market behaves differently. These results are particularly important for the issue we analyze in this paper. In fact, they suggest that speculation activity does not destabilize prices, even in markets and times when prices reach historical highs. Speculation activity, in general, and hedge fund activity, in particular, seems to be responsive to market conditions but is not moving the market, nor is it generating trading activity from other traders. We are aware that Granger-causality

[34] These results hold for the sub-periods January 2005 – August 2007, and September 2007 – March 2009.

tests have limitations. However, our results are very robust. Using different data filtrations (levels and first differences) and different VAR specifications, we always find that speculation activity does not move prices and, in the case of hedge funds, does not cause trading activity by other market participants. These findings are in line with previous literature. Irwin and Yoshimaru (1999), and Fung and Hsieh (2000), for example, find no evidence that hedge fund activity has an impact on market prices. The previous literature, however, analyzes highly aggregated data while we are able to precisely identify specific categories of traders. In this respect, our results are noteworthy.

Overall, the above results seem to provide support to the traditional Keynes-Hicks paradigm on the stabilizing role of speculation in financial markets.

Is speculation activity increasing risk? It is, in fact, possible that speculation activity may not have any impact on prices but it might have an impact on market volatility.

With the exception of the corn market, we find that trading activity Granger-causes volatility. In particular, there is evidence of causality from hedge fund activity to volatility. Further investigation, *via* generalized impulse responses, shows a statistically significant reduction in volatility. In other words, a shock in hedge fund activity reduces volatility. These results are very robust. In fact, we adopt three measures of realized variance and three measures of logarithmic realized standard deviation, and unambiguously find that if hedge fund activity is causal, in a Granger sense, for volatility, this causal relationship implies that hedge fund trading reduces volatility levels. Similar results also apply to commodity swap dealers in the crude oil and natural gas markets. Lower levels of volatility imply that markets are less risky. Less volatile markets are more attractive and perform their role of risk transfer. This implies a reduction in the hedge premia, as predicted by Hirshleifer (1989, 1990).

6. Conclusion

Is speculation activity destabilizing? Our analysis clearly shows that this is not the case. We employ a unique dataset that allows us to precisely identify positions of market participants in five futures markets. By adopting a very simple but well-established technique, Granger-causality, we investigate whether speculation activity is moving prices and increasing volatility. In general, we find that speculation activity is not causing any price movement, but it has some impact on risk: it reduces risk. We are not ruling out the possibility that a single trader (of any category of market participants) might implement trading strategies that move prices and increase volatility. However, as a whole, speculation does not seem to destabilize futures markets. The role of speculation activity in financial markets is very important because it allows hedgers to find counterparties to hedge their positions and, in general, it allows markets to perform their institutional role. Therefore, speculators, in general, and hedge funds, in particular, should not be seen as sinful agents. In fact, we find that speculative trading activity has beneficial effect on markets.

References

Andersen, T., Bollerslev, T., Diebold, F.X., and Ebens, H. (2001), "The Distribution of Realized Stock Return Volatility," *Journal of Financial Economics*, 61, 43-76.

Andersen, T., Bollerslev, T., Diebold, F.X. and Labys, P. (2000), "Great Realizations," *Risk*, 13, 105-108.

Andersen, T., Bollerslev, T., Diebold, F.X. and Labys, P. (2003), "Modeling and Forecasting Realized Volatility," *Econometrica*, 71, 529-626.

Bandi, F.M., and Russell, J.R. (2006), "Separating Microstructure Noise from Volatility," *Journal of Financial Economics*, 79, 655-692.

Barndorff-Nielsen, O. E., P. R. Hansen, A. Lunde, and N. Shephard (2008). "Designing Realised Kernels to Measure the ex-post Variation of Equity Prices in the Presence of Noise," *Econometrica*, forthcoming.

Bessembinder, H., and Seguin, P.J. (1993), "Price Volatility, Trading Volume, and Market Depth: Evidence from Futures Markets," *Journal of Financial and Quantitative Analysis*,. 28, 21-39.

Boyd, N., Buyuksahin, B., Haigh, M.S. and J. Harris (2009), "The Impact Herding in Futures Markets," CFTC Working Paper.

Brown, S.J., Goetzmann, W.N. and Park, J. (2000), "Hedge Funds and the Asian Currency Crisis of 1997," *Journal of Portfolio Management*, 26, 95-101.

Brunnermeier, M.K., and Nagel, S. (2004), "Hedge Funds and the Technology Bubble," *Journal of Finance*, 59, 2013-2040.

Buyuksahin, B., Haigh, M.S., Harris, J.H., Overdhal, J.A. and Robe, M.A. (2009), "Fundamentals, Trader Activity and Derivative Pricing," CFTC Working Paper.

Edwards, F.R. (1999), "Hedge Funds and the Collapse of Long Term Capital Management," *Journal of Economic Perspectives*, 13, 189-210.

Friedman, M. (1953), "The Case for Flexible Exchange Rates," in Essays in Positive Economics, University of Chicago Press, Chicago, 157-203.

Fung, W., and Hsieh, D.A. (2000) “Measuring the Market Impact of Hedge Funds,” *Journal of Empirical Finance*, 7, 1-36.

Gao, A.H., and Wang, G.H.K. (1999), “Modeling Nonlinear Dynamics of Daily Futures Price Changes,” *Journal of Futures Markets*, 19, 325-351.

Hansen, P.R., and Lunde, A. (2004), “Technical Appendix: An Unbiased Measure of Realized Variance,” Manuscript, Brown University and Aarhus University.

Hansen, P.R., and Lunde, A. (2006), “Realized Variance and Market Microstructure Noise,” *Journal of Business and Economics Statistics*, 24, 127-161.

Haigh, M.S., Hranaiova, J., and Overdahl, J.A. (2005), “Price Dynamics, Price Discovery and Large Futures Trader Interactions in the Energy Complex,” Mimeo.

Hirshleifer, D. (1989), “Determinants of Hedging and risk Premia in Commodity Futures Markets,” *Journal of Financial and Quantitative Analysis*, 24, 313-331.

Hirshleifer, D. (1990), “Hedging Pressure and Futures Price Movements in a General Equilibrium Model,” *Econometrica*, 58, 411-428.

Irwin, S.H., and Holt, B.R. (2004), “The Effect of Large Hedge Fund and CTA Trading on Futures Market Volatility,” in *Commodity Trading Advisors: Risk, Performance, Analysis and Selection*, Gregoriou, G.N., Karavas, V.N., L'Habitant, F-S. and Rouah, F. eds., John Wiley and Sons.

Irwin, S.H., and Yoshimaru, S. (1999), “Managed Futures, Positive Feedback Trading, and Futures Price Volatility,” *The Journal of Futures Markets*, 19, 759-776.

Keynes, J. M. 1923. Some Aspects of Commodity Markets. Manchester Guardian Commercial, Reconstruction Supplement, in Collected Writings 12.

Oomen, R.C.A. (2006), “Realized Variance and Market Microstructure Noise,” *Journal of Business and Economics Statistics*, 24, 208-218.

Pesaran, H.H., and Shin, Y. (1998), “Generalized Impulse Response Analysis in Linear Multivariate Models,” *Economics Letters*, 58, 17-29.

Weiner, R.J. (2002),”Sheep in Wolves Clothing? Speculators and Price Volatility in Petroleum Futures,” *Quarterly review of Economics and Finance*, 42, 391-400.

Zhang, L., Mykland, P.A., and Aït-Sahalia, Y. (2005), “A Tale of Two Time Scales: Determining Integrated Volatility with Noisy High Frequency Data,” *Journal of the American Statistical Association*, 100, 1394-1411.

Table 1
Contract Specifications

	Crude Oil (CL)	Natural Gas (NG)	Corn (C)	EuroDollars (ED)	Mini-Dow (YM)
Exchange	NYMEX	NYMEX	CBOT	CME	CBOT
Trading Unit	1000 US barrel	10000 mmBtu	5000 bushels	Eurodollar time deposit having a principal value of 1 million with a 3-month maturity	1 mini-sized Dow futures
Trading Hours (EST):					
Open Outcry:	9:00 am-2:30pm	9:00am-2:30pm	10:30am-2:15pm	8:20am-3pm	N/A
Electronic	6:00pm-5:15pm	6:00pm-5:15pm	7:00pm-7am and 10:30am-2:15pm	6:00pm-5:00pm	6:00pm-4:15pm, and 4:30pm-5:30pm
Trading months	Consecutive months in the current year and the next five years as well as June and December contracts are beyond sixth year	Consecutive months in the current year and the next twelve years	Dec, Mar, May, Jul and Sep	Mar, Jun, Sep, Dec, forty months in March quarterly cycle, and the four nearest serial contract months	Mar, Jun, Sep, Dec
Minimum Price Fluctuations	$).01 (1cent) per barrel ($10 per contract)	$0.01 (1cent) per mmBtu ($10 per contract)	1/4 cent/bushel ($12.50/contract)	$12.50 per contract ($6.25 for nearest expiring contract)	Minimum price increment is one index point (equal to $5 per contract).
Settlement Type	Physical	Physical	Physical	Cash	Cash
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.	Trading terminates three business days prior to the first calendar day of the delivery month.	The business day prior to the 15th calendar day of the contract month.	Futures trading shall terminate at 5:00a.m. (Chicago Time on the second London bank business day before the third Wednesday of the contract month.	Trading can occur up to 8:30 a.m. on the 3rd Friday of the contract month.
Daily average (max-min) number of contract traded	39,498 (182,330-837)	7,943 (61,860-302)	21,041* (96,391-942)	8,355 (33,641-725)	73,022* (321,700-1,110)

* Electronic trading only during times when open outcry is trading (9:30am – 4:00pm EST for mini-Dow).

Table 2
Descriptive Statistics

Panel A – Crude Oil (CL) – January 2005-March 2009 – 1047 obs.

	Returns	Volatility	AD	ΔAD	AS	ΔASP	AM	ΔAM	FBT	ΔFBT	HF	ΔHF
Mean	-0.0463	3.8032	-61509	-64.214	98528	-159.69	-24744	512.65	-7134.2	146.62	241.29	-1285.2
Median	0.0588	2.1706	-61580	306	94960	-492	-25603	272	-7185	18	1729	-1295
St.Dev.	2.5143	4.5557	25713	6782.5	34882	8207.6	12033	3161.8	8941.7	2228.9	27127	6644.2
Skew	-0.1671	2.7523	-0.4610	-0.2125	0.4544	0.0349	0.0441	0.5096	0.2030	0.3287	-0.1201	-0.9053
Kurt	6.4251	10.812	3.7731	5.0029	3.3507	3.8687	2.7207	4.8302	4.5732	4.9581	2.2813	9.9187
AC(1)	-0.0878	0.8653	0.9201	0.3441	0.9281	0.4697	0.9125	0.2846	0.8913	-0.0502	0.9346	0.0058
AC(20)	-0.0344	0.7717	0.3377	0.1519	0.1230	0.3021	0.5321	0.2352	0.1854	0.0898	0.5793	0.0874
ADF	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000	0.0000

Panel B – Natural Gas (NG) – January 2005-March 2009 – 1053 obs.

	Returns	Volatility	AD	ΔAD	AS	ΔAS	AP	ΔAP	FBT	ΔFBT	HF	ΔHF
Mean	-0.1882	5.2782	-8148.8	89.888	33214	-381.77	-1923.8	6.5489	-2373.2	64.730	-29401	-70.391
Median	-0.1569	3.9265	-6887	26	30503	-510	-1663	0.0000	-2318	39	-26874	-246
St.Dev.	3.0563	4.4653	7681.6	1429.4	20148	2867.1	2486.1	428.41	3937.6	1441.9	17628	3423.4
Skew	0.0966	1.9158	-0.2588	-0.0081	0.4349	-1.4249	-0.4238	1.3370	0.0564	0.0119	-0.4023	0.5964
Kurt	4.4262	8.3137	2.2316	5.2892	2.4758	7.6439	3.1552	17.7895	3.2987	8.5135	2.9345	6.3237
AC(1)	0.0243	0.3783	0.9498	0.2503	0.9602	0.5307	0.9312	0.2635	0.8767	-0.1286	0.9589	0.1562
AC(20)	0.0085	0.1789	0.2467	0.0009	-0.1129	-0.1683	0.2740	0.0077	0.0869	0.0308	0.1582	-0.0480
ADF	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0006	0.0000	0.0000	0.0000

Panel C – Corn (C) – August 2006-March 2009 – 646 obs.

	Returns	Volatility	AD	ΔAD	AS	ΔASP	AM	ΔAM	FBT	ΔFBT	HF	ΔHF
Mean	0.0251	3.1528	-191899	868.23	196425	-328.67	-6447.3	-116.57	-14321	-208.02	23135	-362.75
Median	0.0000	2.5354	-203709	830.50	205261	-620	-6107	-152.5	-12516	-151.5	25989	-423.32
St.Dev.	2.3031	2.3062	67578	6668.9	71087	7937.1	8007.7	1400	22989	4191.12	43765	6918.2
Skew	-0.1967	2.0833	0.5545	0.2677	-0.0321	0.5368	0.1272	0.4963	0.1265	0.0566	-0.0142	-0.2288
Kurt	3.6168	9.4042	2.8670	4.9924	2.3532	7.5340	2.7922	5.6987	2.7297	6.5418	3.0761	5.8681
AC(1)	0.0150	0.5290	0.9877	0.3853	0.9817	0.6226	0.9608	0.0966	0.9615	0.2368	0.9735	0.1433
AC(20)	-0.0537	0.3394	0.5264	-0.1450	0.5056	-0.0474	0.2556	-0.0006	0.4445	0.0094	0.4496	0.0326
ADF	0.0000	0.0000	0.0057	0.0000	0.0092	0.0000	0.0000	0.0000	0.0003	0.0000	0.0005	0.0000

Panel D – Eurodollar (ED) – January 2005-May 2008 – 1045 obs.

	Returns	Volatility	FA	ΔFA	FB	ΔFB	FC	ΔFC	FBT	ΔFBT	HF	ΔHF
Mean	0.0003	0.0025	-158630	-555.1	-65481	202.29	-56801	476.92	35828	933.44	9133.9	-35.448
Median	0.0000	0.0010	-130246	16	-29143	115	-68800	443	31921	686	-6448	-1148
St.Dev.	0.0591	0.0046	267864	15625	161298	12341	79341	13035	79327	14571	136728	25395
Skew	0.0148	5.3308	-0.1450	-0.5426	-0.7453	0.6446	0.5171	-1.3694	0.0735	0.1726	0.2378	0.2737
Kurt	9.6360	44.024	1.6864	6.3110	2.8785	13.700	2.8395	23.445	2.5369	38.096	2.5501	11.422
AC(1)	0.1048	0.5459	0.9950	-0.0084	0.9912	0.1369	0.9764	0.0555	0.9707	-0.2504	0.9741	-0.0556
AC(20)	0.0170	0.2102	0.9044	-0.0420	0.7853	0.0596	0.6550	-0.0065	0.6158	0.0932	0.5627	0.0245
ADF	0.0000	0.0000	0.1690	0.0000	0.1541	0.0000	0.0539	0.0000	0.3201	0.0000	0.0008	0.0000

Panel E – Mini-Dow (YM) – January 2005-May 2008 – 1038 obs.

	Returns	Volatility	FA	ΔFA	FH	ΔFH	FO	ΔFO	FBT	ΔFBT	HF	ΔHF
Mean	-0.0438	1.3029	525.22	116.74	10093	-77.655	-1126.4	12.156	-3844.4	15.663	2334.3	-45.628
Median	0.0435	0.3634	-561	222	631.5	-3	-786	10	-4228	-65.5	1489.5	-28
St.Dev.	1.4420	3.1887	15248	2912.3	20662	1749.6	2465.9	547.07	12523	1971.9	10066	2707
Skew	0.5730	6.2088	0.1955	-0.3305	1.2705	-0.4312	-1.3895	0.3450	-0.4860	0.8132	-0.2248	-0.1709
Kurt	20.355	55.944	2.9972	8.5299	3.7821	46.097	6.6388	11.3671	3.8928	30.838	2.4640	7.9691
AC(1)	-0.1346	0.7544	0.9712	0.0407	0.9936	0.1505	0.9673	-0.0508	0.9464	-0.0539	0.9575	-0.1820
AC(20)	-0.0245	0.5054	0.4724	-0.0348	0.9259	-0.0311	0.4832	-0.0161	0.6726	-0.0107	0.7098	0.0249
ADF	0.0000	0.0148	0.0007	0.0000	0.0084	0.0000	0.0276	0.0000	0.0196	0.0000	0.0001	0.0000

ADF: augmented Dickey-Fuller unit root test (p-values). Volatility: two-scale realized volatility in transaction time, Zhang, Mykland and Aït-Sahalia (2005). AD: dealer/merchant; AS: commodity swap dealer; AM: manufacturer; AP: producer; FA: arbitrageurs or brokers/dealers; FB: non U.S. commercial bank; FC: U.S. commercial bank; FF: pension funds; FH: hedge funds (commercial); FO: financial – other; FBT: floor broker/trader; HF: hedge fund (non-commercial). Δ refers to first difference.

Table 3
Long/Short Percentage of Total Open Interest

Panel A – Crude Oil (CL)

	AD	AS	AM	FBT	HF	Total Mean	Total Max	Total Min
Long	0.074	0.417	0.010	0.021	0.233	0.754	0.878	0.524
Short	0.296	0.064	0.102	0.048	0.224	0.734	0.849	0.576

Panel B – Natural Gas (NG)

	AD	AS	AP	FBT	HF	Total Mean	Total Max	Total Min
Long	0.074	0.385	0.008	0.024	0.286	0.777	0.912	0.623
Short	0.159	0.069	0.027	0.046	0.567	0.868	0.999	0.686

Panel C – Corn (C)

	AD	AS	AM	FBT	HF	Total Mean	Total Max	Total Min
Long	0.053	0.413	0.034	0.058	0.198	0.756	0.847	0.611
Short	0.437	0.016	0.048	0.087	0.159	0.746	0.845	0.634

Panel D – €/$ (ED)

	FA	FB	FC	FBT	HF	Total Mean	Total Max	Total Min
Long	0.1427	0.0877	0.0369	0.0428	0.1250	0.4351	0.6799	0.2113
Short	0.2413	0.1274	0.0732	0.0201	0.1220	0.5840	0.7981	0.3911

Panel E – Mini-Dow (YM)

	FA	FH	FO	FBT	HF	Total Mean	Total Max	Total Min
Long	0.2946	0.1625	0.0148	0.1074	0.0979	0.6772	0.8725	0.3463
Short	0.2800	0.0592	0.0282	0.1493	0.0819	0.5987	0.8029	0.2739

Total Mean Max Min: mean, maximum and minimum of the sum of the open interest for the five categories of market participants. It indicates the percentage of total open interest held by these five categories.

Table 4
Correlations – Net Futures Positions

Panel A – Crude Oil (CL)

	AD	AS	AM	FBT	HF
Returns	-0.04 -0.06	0.03 0.05	-0.08* -0.14*	0.01 -0.08*	0.10* 0.32*
Volatility	-0.22* -0.03	0.11* 0.06	0.26* -0.05	-0.09* 0.02	0.02 -0.03*
AS	-0.51* -0.64*	1.00			
AM	0.25* 0.25*	-0.32* -0.41*	1.00		
FBT	0.10* 0.02	-0.36* -0.18*	-0.03 0.04	1.00	
HF	-0.29* -0.23*	-0.41* -0.25*	-0.32* -0.23*	-0.01 -0.13*	1.00

Panel B – Natural Gas (NG)

	AD	AS	AP	FBT	HF
Returns	-0.06* -0.18*	0.02 0.02	-0.02 -0.20*	-0.14* -0.23*	0.04 0.18*
Volatility	0.12* 0.07*	-0.01 -0.06*	0.19* 0.05	-0.03 0.01	-0.09* 0.02
AS	-0.10* -0.34*	1.00			
AP	0.22* 0.09*	-0.21* -0.17*	1.00		
FBT	-0.13* 0.14*	-0.45* -0.18*	0.11* 0.05	1.00	
HF	-0.27* -0.08*	-0.85* -0.62*	-0.07* -0.08*	0.23* -0.30*	1.00

Panel C – Corn (C)

	AD	AS	AM	FBT	HF
Returns	-0.02 -0.37*	0.05 0.00	-0.03 -0.29*	-0.06 0.05	0.00 0.45*
Volatility	0.32* 0.01	-0.38* -0.07	-0.07 -0.05	0.15* 0.08*	-0.05 -0.01
AS	-0.69* -0.54*	1.00			
AM	-0.09* 0.34*	-0.27* -0.23*	1.00		
FBT	0.02 0.05	-0.55* -0.46*	0.39* 0.02	1.00	
HF	-0.64* -0.51*	0.01 -0.13*	0.19 -0.31*	0.22* -0.09*	1.00

Panel D – Eurodollar (ED)

	FA	FB	FC	FBT	HF
Returns	-0.20*	-0.07*	0.04	0.01	0.19*
Volatility	-0.04	0.01	0.01	-0.02	-0.03
FB	-0.07*	1.00			
FC	-0.08*	-0.01	1.00		
FBT	-0.02	0.12*	-0.06	1.00	
HF	-0.33*	-0.09*	-0.22*	0.13*	1.00

Panel E – Mini-Dow (YM)

	FA	FH	FO	FBT	HF
Returns	0.04 0.13*	0.05 0.00	-0.06* -0.30*	-0.06* -0.10*	0.08* 0.21*
Volatility	-0.17* -0.01	-0.20* 0.02	0.16* -0.01*	0.16* -0.03	-0.20* 0.00
FH	-0.32* -0.12*	1.00			
FO	0.09* -0.09*	-0.02 0.02	1.00		
FBT	-0.11* -0.06*	-0.48* -0.48*	-0.31* 0.03	1.00	
HF	-0.24* -0.50*	0.47 -0.00	-0.17* -0.25*	-0.47* -0.23*	1.00

* significance at 10% level. The top number refers to net futures positions in levels while the bottom number refers to the first difference. The €/$ positions in levels are not stationary. Therefore, no correlation is reported.

Table 5
Granger non-Causality Test: p-values –Crude Oil (CL)

Panel A: Returns and Net Futures Positions in Levels – Optimal Lags-Length (5)

	Returns	AD	AS	AM	FBT	HF	All
Returns		0.546	0.621	0.276	0.091	0.624	0.148
AD	0.000*		0.026*	0.226	0.492	0.058	0.000*
AS	0.004*	0.402		0.000*	0.155	0.645	0.000*
AM	0.000*	0.012*	0.000*		0.025*	0.023*	0.000*
FBT	0.035*	0.371	0.108	0.288		0.350	0.000*
HF	0.021*	0.199	0.009*	0.142	0.264		0.000*
All	0.000*	0.002*	0.000*	0.000*	0.008*	0.181	

Panel B: Returns and Net Futures Positions in First Difference – Optimal Lags-Length (4)

	Returns	AD	AS	AM	FBT	HF	All
Returns		0.253	0.362	0.211	0.218	0.533	0.199
AD	0.000*		0.011*	0.317	0.420	0.016*	0.000*
AS	0.001*	0.195		0.000*	0.217	0.590	0.000*
AM	0.000*	0.004*	0.000*		0.052	0.003*	0.000*
FBT	0.017*	0.353	0.011*	0.416		0.252	0.000*
HF	0.013*	0.427	0.030*	0.433	0.380		0.000*
All	0.000*	0.001*	0.000*	0.000*	0.067	0.086	

Panel C: Volatility and Net Futures Positions in Levels – Optimal Lags-Length (5)

	Volatility	AD	AS	AM	FBT	HF	All
Volatility		0.191	0.064	0.086	0.063	0.127	0.001*
AD	0.024*		0.089	0.188	0.093	0.001*	0.000*
AS	0.000*	0.206		0.000*	0.540	0.841	0.000*
AM	0.340	0.000*	0.000*		0.018*	0.023*	0.000*
FBT	0.035*	0.089	0.088	0.468		0.206	0.000*
HF	0.052	0.272	0.004*	0.064	0.148		0.000*
All	0.000*	0.000*	0.000*	0.000*	0.000*	0.004*	

Panel D: Volatility and Net Futures Positions in First Difference – Optimal Lags-Length (5)

	Volatility	AD	AS	AM	FBT	HF	All
Volatility		0.066	0.001*	0.062	0.025*	0.072	0.000*
AD	0.223		0.064	0.209	0.117	0.000*	0.000*
AS	0.001*	0.185		0.000*	0.242	0.557	0.000*
AM	0.556	0.000*	0.000*		0.023*	0.000*	0.000*
FBT	0.063	0.124	0.098	0.394		0.596	0.000*
HF	0.079	0.453	0.028*	0.086	0.284		0.000*
All	0.007*	0.000*	0.000*	0.000*	0.001*	0.000*	

* indicates rejection of the null of non-Granger causality at 5% level.

Table 6
Granger non-Causality Test: p-values –Natural Gas (NG)

Panel A: Returns and Net Futures Positions in Levels – Optimal Lags-Length (4)

	Returns	AD	AP	AS	FBT	HF	All
Returns		0.629	0.578	0.426	0.205	0.796	0.483
AD	0.357		0.004*	0.031*	0.961	0.301	0.000*
AP	0.104	0.097		0.000*	0.805	0.053	0.000*
AS	0.000*	0.163*	0.000*		0.495*	0.311	0.000*
FBT	0.010*	0.098*	0.000*	0.275		0.219	0.000*
HF	0.044	0.049*	0.000	0.395	0.957		0.000*
All	0.001*	0.000*	0.000*	0.000*	0.847	0.061	

Panel B: Returns and Net Futures Positions in First Difference – Optimal Lags-Length (3)

	Returns	AD	AP	AS	FBT	HF	All
Returns		0.448	0.403	0.503	0.345	0.666	0.571
AD	0.206		0.013*	0.009*	0.913	0.841	0.000*
AP	0.124	0.301		0.000*	0.908	0.303	0.000*
AS	0.000*	0.385	0.000*		0.502	0.535	0.000*
FBT	0.019*	0.106	0.001*	0.194		0.308	0.000*
HF	0.036*	0.025*	0.000*	0.652	0.889		0.000*
All	0.000*	0.000*	0.000*	0.000*	0.923	0.240	

Panel C: Volatility and Net Futures Positions in Levels – Optimal Lags-Length (4)

	Volatility	AD	AP	AS	FBT	HF	All
Volatility		0.393	0.119	0.557	0.080	0.037*	0.016*
AD	0.839		0.001*	0.025*	0.993	0.654	0.000*
AP	0.168	0.053		0.000*	0.631	0.147	0.000*
AS	0.725	0.112	0.000*		0.476	0.121	0.000*
FBT	0.763	0.004*	0.000*	0.353		0.063	0.000*
HF	0.325	0.023*	0.000*	0.173	0.991		0.000*
All	0.633	0.000*	0.000*	0.000*	0.806	0.051	

Panel D: Volatility and Net Futures Positions in First Difference – Optimal Lags-Length (3)

	Volatility	AD	AP	AS	FBT	HF	All
Volatility		0.974	0.476	0.065	0.066	0.667	0.052
AD	0.951		0.001*	0.014*	0.996	0.865	0.000*
AP	0.169	0.105		0.000*	0.975	0.244	0.000*
AS	0.391	0.538	0.000*		0.819	0.139	0.000*
FBT	0.477	0.154	0.001*	0.286		0.344	0.000*
HF	0.044	0.015*	0.000*	0.354	0.976		0.000*
All	0.344	0.002*	0.000*	0.000*	0.879	0.437	

* indicates rejection of the null of non-Granger causality at 5% level.

Table 7
Granger non-Causality Test: p-values –Corn (C)

Panel A: Returns and Net Futures Positions in Levels – Optimal Lags-Length (5)

	Returns	AD	AM	AS	FBT	HF	All
Returns		0.358	0.847	0.634	0.863	0.650	0.462
AD	0.032*		0.280	0.100	0.433	0.921	0.001*
AM	0.914	0.600		0.000*	0.922	0.792	0.000*
AS	0.072	0.310	0.000*		0.062	0.689	0.000*
FBT	0.801	0.138	0.001*	0.220		0.045*	0.000*
HF	0.313	0.131	0.003*	0.059	0.962		0.001*
All	0.228	0.007*	0.000*	0.000*	0.134	0.078	

Panel B: Returns and Net Futures Positions in Levels – Optimal Lags-Length (5)

	Returns	AD	AM	AS	FBT	HF	All
Returns		0.285	0.777	0.799	0.823	0.394	0.442
AD	0.004*		0.388	0.544	0.591	0.892	0.002*
AM	0.633	0.745		0.910	0.899	0.861	0.960
AS	0.355	0.607	0.000*		0.352	0.948	0.000*
FBT	0.799	0.056	0.001*	0.059		0.047*	0.000*
HF	0.240	0.327	0.001*	0.101	0.957		0.000*
All	0.100	0.018*	0.000*	0.563	0.483	0.158	

Panel C: Volatility and Net Futures Positions in Levels – Optimal Lags-Length (5)

	Volatility	AD	AM	AS	FBT	HF	All
Volatility		0.273	0.923	0.678	0.152	0.164	0.008*
AD	0.041*		0.220	0.083	0.233	0.898	0.001*
AM	0.103	0.645		0.000*	0.884	0.666	0.000*
AS	0.544	0.665	0.000*		0.044*	0.778	0.000*
FBT	0.198	0.038*	0.000*	0.267		0.047*	0.000*
HF	0.726	0.117	0.004*	0.138	0.991		0.001*
All	0.012*	0.003*	0.000*	0.000*	0.103	0.070	

Panel D: Volatility and Net Futures Positions in First Difference – Optimal Lags-Length (5)

	Volatility	AD	AM	AS	FBT	HF	All
Volatility		0.711	0.892	0.266	0.174	0.330	0.020*
AD	0.034*		0.337	0.147	0.439	0.893	0.010*
AM	0.222	0.722		0.816	0.940	0.795	0.868
AS	0.431	0.774	0.000*		0.246	0.906	0.000*
FBT	0.011*	0.022*	0.000*	0.046*		0.045*	0.000*
HF	0.839	0.168	0.001*	0.234	0.973		0.000*
All	0.004*	0.013*	0.000*	0.158	0.500	0.148	

* indicates rejection of the null of non-Granger causality at 5% level.

Table 8
Granger non-Causality Test: p-values – Eurodollar (ED)

Panel A: Returns and Net Futures Positions in First Difference – Optimal Lags-Length (4)

	Returns	FA	FC	FB	FBT	HF	All
Returns		0.174	0.203	0.226	0.165	0.315	0.478
FA	0.380		0.727	0.671	0.051	0.924	0.144
FC	0.254	0.511		0.861	0.139	0.270	0.196
FB	0.381	0.897	0.001*		0.100	0.654	0.000*
FBT	0.731	0.020*	0.173	0.439		0.228	0.239
HF	0.548	0.005*	0.301	0.594	0.005*		0.001*
All	0.495	0.000*	0.001*	0.169	0.004*	0.411	

Panel B: Volatility and Net Futures Positions in First Difference – Optimal Lags-Length (5)

	Volatility	FA	FC	FB	FBT	HF	All
Volatility		0.053	0.085	0.104	0.058	0.007*	0.025*
FA	0.278		0.192	0.370	0.668	0.279	0.059
FC	0.642	0.015*		0.754	0.285	0.211	0.373
FB	0.575	0.153	0.021*		0.079	0.001*	0.000*
FBT	0.054	0.573	0.147	0.592		0.047*	0.084
HF	0.111	0.846	0.196	0.946	0.002*		0.002*
All	0.239	0.015*	0.001*	0.198	0.000*	0.000*	

* indicates rejection of the null of non-Granger causality at 5% level.

Table 9
Granger non-Causality Test: p-values – Mini-Dow (YM)

Panel A: Returns and Net Futures Positions in Levels – Optimal Lags-Length (2)

	Returns	FA	FO	FH	FBT	HF	All
Returns		0.082	0.074	0.652	0.672	0.127	0.036*
FA	0.089		0.184	0.696	0.377	0.026*	0.000*
FO	0.188	0.083		0.000*	0.023*	0.046*	0.000*
FH	0.022*	0.493	0.000*		0.494	0.756	0.000*
FBT	0.813	0.469	0.314	0.826		0.672	0.228
HF	0.064	0.146	0.185	0.444	0.150		0.003*
All	0.011*	0.108	0.000*	0.000*	0.063	0.080	

Panel B: Returns and Net Total Positions in First Difference – Optimal Lags-Length (3)

	Returns	FA	FO	FH	FBT	HF	All
Returns		0.057	0.010*	0.221	0.471	0.071	0.026*
FA	0.097		0.818	0.590	0.658	0.007*	0.000*
FO	0.165	0.261		0.518	0.171	0.191	0.232
FH	0.070	0.588	0.000*		0.434	0.283	0.000*
FBT	0.237	0.762	0.219	0.918		0.350	0.521
HF	0.090	0.102	0.444	0.332	0.250		0.004*
All	0.038*	0.089	0.000*	0.360	0.362	0.008*	

Panel C: Returns and Net Futures Positions in Levels – Optimal Lags-Length (4)

	Volatility	FA	FO	FH	FBT	HF	All
Volatility		0.053	0.061	0.224	0.712	0.079	0.002*
FA	0.829		0.519	0.534	0.631	0.004*	0.003*
FO	0.116	0.441		0.000*	0.086	0.357	0.000*
FH	0.264	0.756	0.000*		0.460	0.239	0.000*
FBT	0.267	0.968	0.319	0.983		0.451	0.239
HF	0.601	0.145	0.460	0.311	0.442		0.050*
All	0.397	0.258	0.000*	0.000*	0.294	0.005*	

Panel D: Volatility and Net Futures Positions in First Difference – Optimal Lags-Length (4)

	Volatility	FA	FO	FH	FBT	HF	All
Volatility		0.042*	0.162	0.270	0.909	0.043*	0.007*
FA	0.741		0.799	0.153	0.651	0.008*	0.001*
FO	0.370	0.590		0.640	0.275	0.335	0.435
FH	0.069	0.138	0.000*		0.474	0.389	0.000*
FBT	0.016*	0.583	0.213	0.118		0.530	0.011*
HF	0.359	0.134	0.770	0.348	0.325		0.043*
All	0.110	0.089	0.000*	0.010*	0.617	0.008*	

* indicates rejection of the null of non-Granger causality at 5% level.

Figure 1
Price and Realized Volatility

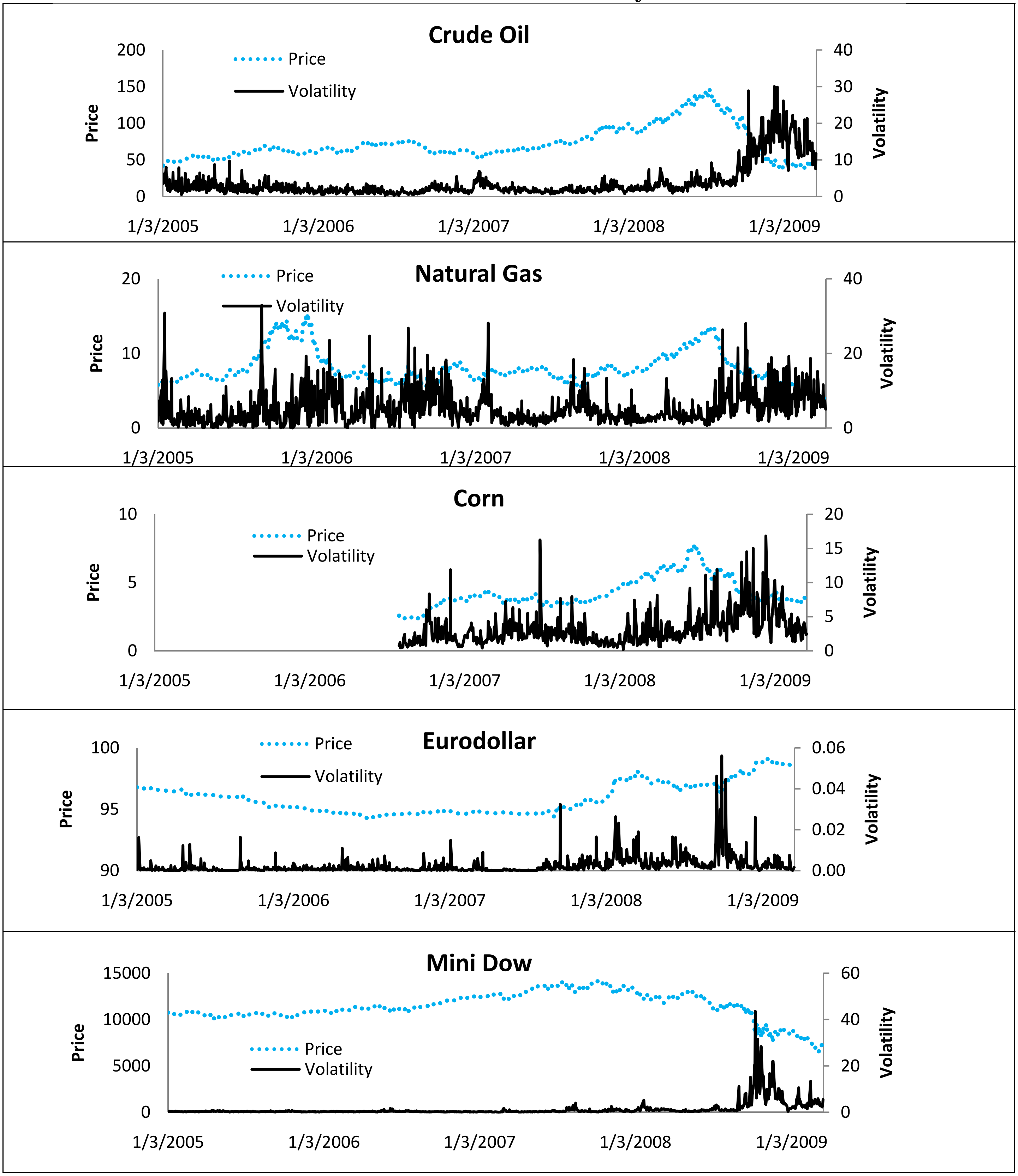


Figure 2
Generalized Impulse Response of Volatility/Returns to One S.D. Innovations in Trader Positions in Levels

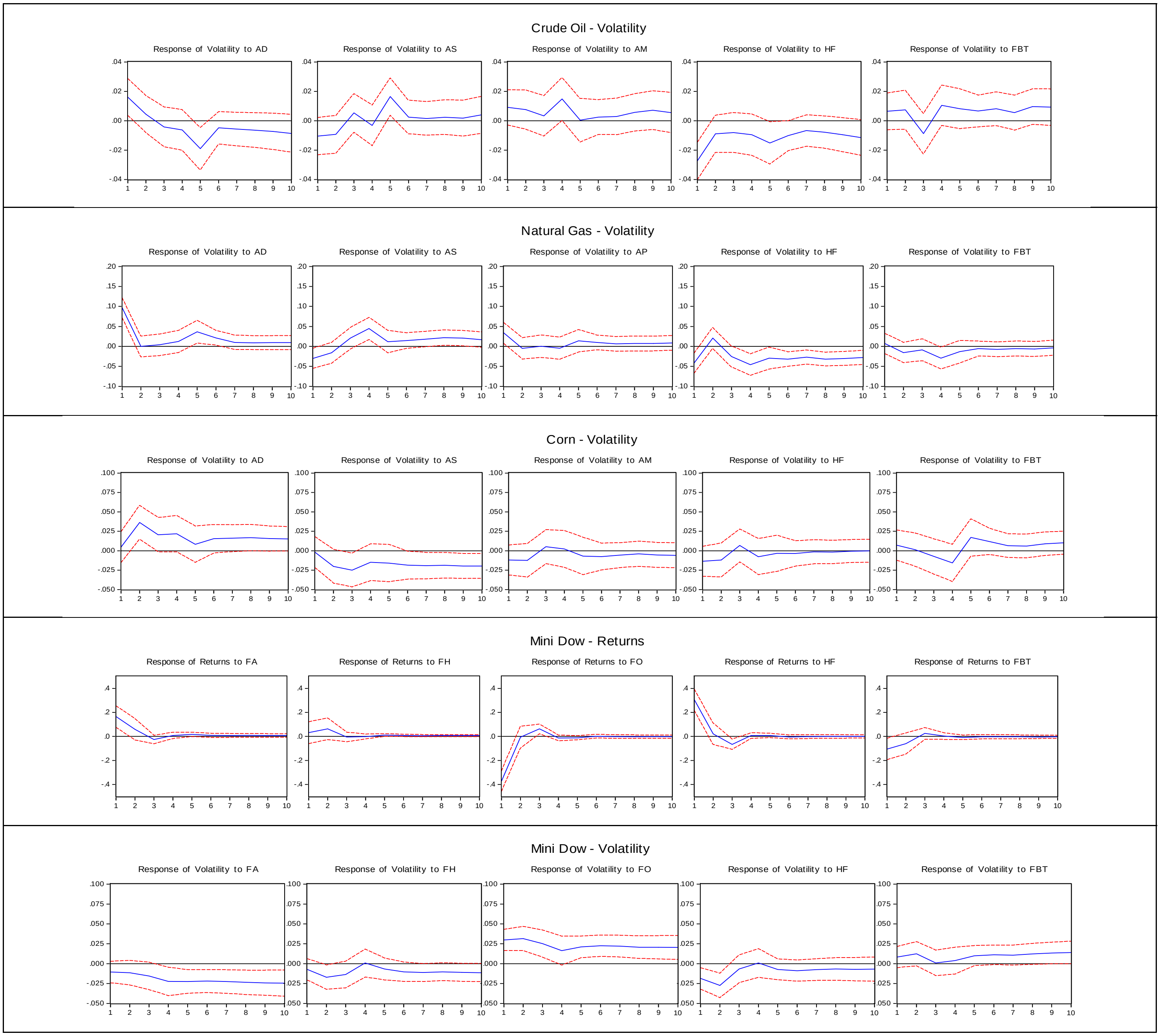
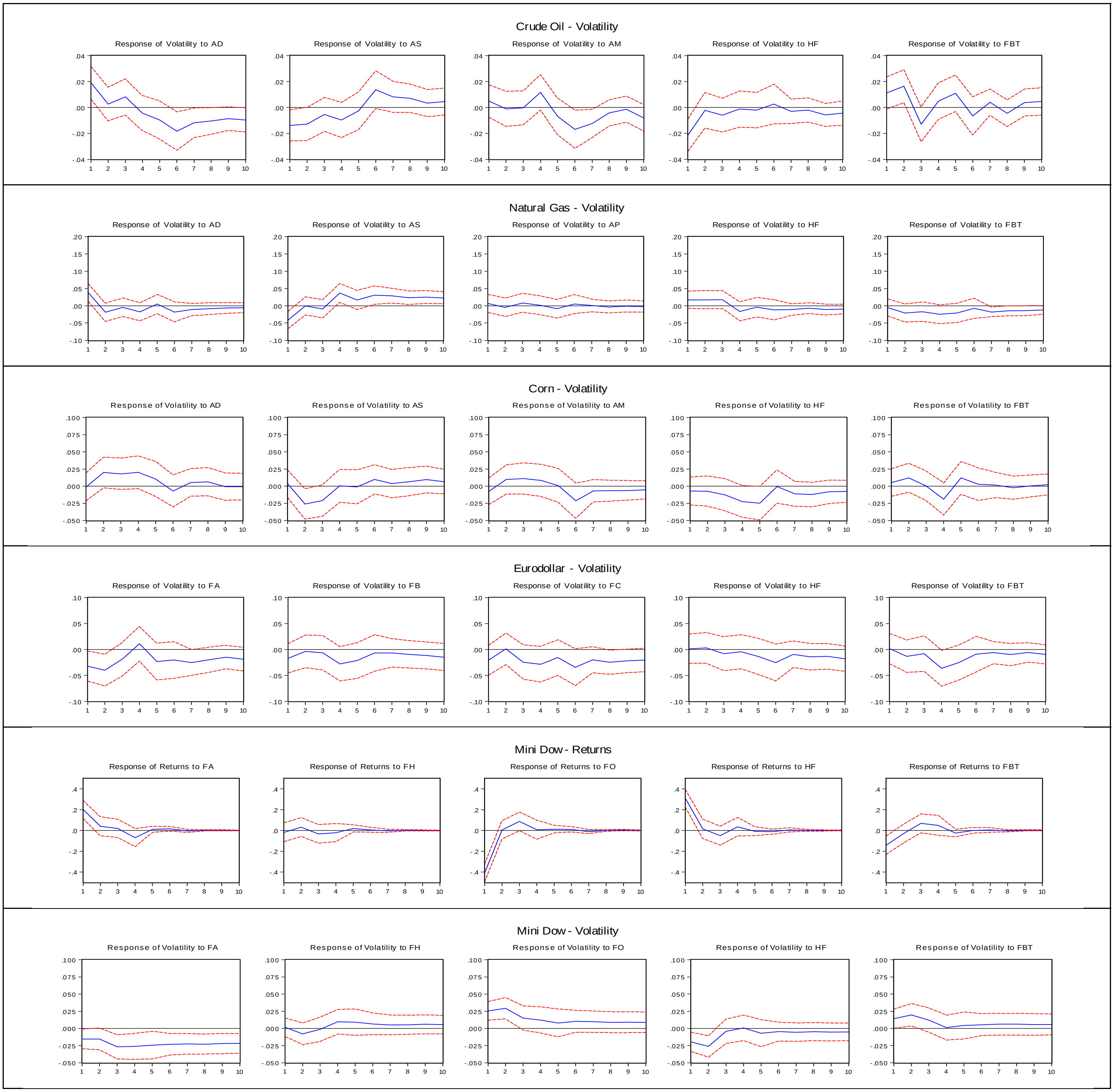


Figure 3

Generalized Impulse Response of Volatility/Returns to One S.D. Innovations in Traders Positions in First Difference



Appendix

List of the trader sub-categories in the CFTC's large-trader reporting system (LTRS)

Commercial		Non-Commercial	
Code	**Description**	**Code**	**Description**
18	Co-Operative	AP	Associated Person
AD	Dealer/Merchant	CPO	Commodity Pool Operator
AM	Manufacturer	CTA	Commodity Trading Advisor
AO	Agricultural/Natural Resources – Other	FB	Floor Broker
AP	Producer	FCM	Futures Commission Merchant
AS	Commodity Swaps/Derivatives Dealer	FT	Floor Trader
FA	Arbitrageur or Broker/Dealer	IB	Introducing Broker
FB	Non U.S. Commercial Bank	MM	Managed Money
FC	U.S. Commercial Bank		
FD	Endowment or Trust	NR	No Registration
FE	Mutual Fund		
FF	Pension Fund		
FG	Insurance Company		
FH	Hedge Fund		
FM	Mortgage Originator		
FO	Financial – Other		
FP	Managed Account or Pool		
FS	Financial Swaps/Derivatives Dealer		
FT	Corporate Treasurer		
LF	Livestock Feeder		
LO	Livestock – Other		
LS	Livestock Slaughterer		

Hedge Funds (HF)

CPO	Commodity Pool Operator
CTA	Commodity Trading Advisor
AP	Associated Person
MM	Managed Money (subset)

Floor Broker and Traders (FBT)

FB	Floor Broker
FT	Floor Trader

CFTC weekly Commitment of Traders (COT) Reports aggregate these sub-categories in two broad groups (except for agricultural which also has index traders): "Commercials", who have declared an underlying hedging purpose, and "Non-commercials", who have not. "Dealer/Merchant" includes wholesalers, exporter/importers, crude oil marketers, shippers, etc. "Manufacturer" includes refiners, fabricators, etc. "Agricultural / Natural Resources – Other" may include, for example, end users. "Commodity Swaps/Derivatives Dealers" aggregate all reporting "Swaps/Derivatives Dealers" and "Arbitrageurs or Broker Dealers", two categories that were merged in the CFTC's internal reporting system part-way through our sample period. "Hedge Funds" aggregate all reporting Commodity Pool Operators, Commodity Trading Advisors, Associated Persons controlling customer accounts as well as other Managed Money traders. "Floor Brokers & Traders" aggregate all reporting floor brokers and floor traders. NR represents those traders that have not yet been categorized or do not fit any other category. Note: FH under the Commercial category includes hedge funds in financial contracts that are shown to be hedging.

The Role of Speculators in the Crude Oil Futures Market

Bahattin Büyükşahin

Jeffrey H. Harris

Abstract: The coincident rise in crude oil prices and increased numbers of financial participants in the crude oil futures market from 2000-2008 has led to allegations that "speculators" drive crude oil prices. As crude oil futures peaked at $147/bbl in July 2008, the role of speculators came under heated debate. In this paper, we employ unique data from the U.S. Commodity Futures Trading Commission (CFTC) to test the relation between crude oil prices and the trading positions of various types of traders in the crude oil futures market. We employ Granger Causality tests to analyze lead and lag relations between price and position data at daily and multiple day intervals. We find little evidence that hedge funds and other non-commercial (speculator) position changes Granger-cause price changes;–the results instead suggest that price changes do precede their position changes.

Keywords: Crude Oil, Futures Markets, Speculators, Granger Causality, Hedge Funds, Commodity Index Traders

JEL Classification: G12, G14, G23

* **Buyuksahin**: Economist, Commodity Futures Trading Commission (CFTC), 1155 21st Street NW, Washington, DC 20485. Email: bbuyuksahin@cftc.gov. **Harris**: Chief Economist, CFTC and Professor of Finance, Alfred Lerner College of Business and Economics, University of Delaware, 320 Purnell Hall, Newark, DE 19716. Email: jharris@cftc.gov. Many thanks to Kirsten Anderson, Celso Brunetti, James Moser, David Reiffen and Michel Robe for helpful comments. This paper reflects the opinions of its authors only, and not those of the U.S. Commodity Futures Trading Commission, the Commissioners, or other staff of the Commission. All remaining errors and omissions, if any, are the authors' sole responsibility.

The summer 2008 spike in crude oil prices to $147/bbl jolted the U.S. economy and severely pinched consumers at the gas pump. In reaction to oil prices, U.S. total oil consumption fell by 6.7 percent from 20.8 million barrels per day in 2005 to 19.4 million barrels a day in 2008. Given the predominance of crude oil in the U.S. economy, the price spike also generated substantial attention from regulators, legislators and market critics who decried the existence of excessive speculation in the crude oil futures markets. Indeed, the rise in participation by non-commercial traders during the preceding eight years (Buyuksahin et al. (2009)) provided great fodder for casual connections with recent price increases. In this paper we apply rigorous econometric techniques to the question as to whether position changes of any particular group of traders was responsible for crude oil futures price changes from 2000-2009.

For perspective, we first calculate Working's (1960) speculative index in the crude oil futures market from 2000 through 2008. Working's index is predicated on the fact that long and short hedgers do not always trade simultaneously or in the same quantity, so that speculators fill the role of satisfying unmet hedging demand in the marketplace. We find that the speculation index has also risen steadily from 2001 through mid-2008 (concurrent with the rise in non-commercial participation), but has been relatively stable in the nearby contract since early 2006.

Utilizing more disaggregated data on daily trader positions, we implement Granger causality tests to determine lead and lag relations between price changes and net position changes of various traders in the crude oil futures markets. We execute Granger causality tests in two sub-periods-- from July 2000 through June 2004, a period marked by relatively stable participation and prices, and from July 2004 through March 2009, the period marked by extreme price movements and increased participation in the crude oil futures markets. We find that the changing net positions of no specific trader groups lead to price changes in either sub-period or over the entire sample period. We also examine net position changes of various combinations of non-commercial and commercial traders and find similar results. No single group, or combination of groups (even those commonly considered speculators) systematically Granger-cause prices in nearby contracts.

Instead, the causality runs from price changes to position changes, suggesting that various groups of traders are generally trend followers. Commercial traders (in total), manufacturers, commercial dealers, producers, swap dealers and managed money traders (hedge funds) are each shown to be trend followers. Notably, non-commercial traders (in total) and the combined group of swap dealers and non-commercial traders also exhibit trend following behavior over the full sample period as well as sub-periods. These results also hold for daily net position changes in futures alone and in the combined position changes from futures and futures-equivalent options positions. These results are also robust for two-, three-, four- and five day measurement intervals for net position and price changes. Although open interest (including non-commercial participation) is greatest in the nearby contract, we also examine price changes and position changes in the first, second, and third deferred contracts, finding similar results.

Our analysis updates and enhances similar findings in the Interagency Task Force Interim Report on Crude Oil (ITF (2008)), which concludes that the sharp increase in crude oil prices through July 2008 can be explained by the fundamentals of the crude oil market. Notably, our update includes an analysis of the significant price collapse (from $147/bbl to below $40/bbl) from July 2008 through March 2009. We show that the price collapse has not been accompanied by a significant drop in the speculation index, casting further doubt on claims that speculator position changes have systematic effects on futures market prices during this period.

Two of the most important functions of futures markets are the transfer of risk and price discovery. In a well-functioning futures market, hedgers interested in reducing their exposure to price risk find counterparties. In a market without speculative interest, long hedgers must find short hedgers with an equal and opposite hedging need. In fact, many traditional hedgers have dual liquidity needs, intending to offset their futures positions before physical delivery of crude oil.

Speculators enhance liquidity and reduce search costs by taking the opposing positions when long hedgers do not perfectly match short hedgers. In this regard, speculators provide immediacy and facilitate the needs of hedgers by mitigating price risk, while adding to overall trading volume, which contributes to more liquid and well-functioning markets.

Of course, excessive speculation has the potential to disrupt markets as well. Shleifer and Summers (1990) note that herding can result from investors reacting to common signals or overreacting to recent news. As de Long et al. (1990) show, rational speculators trading via positive feedback strategies can increase volatility and destabilize prices. Our results, however, complement findings by Boyd et al. (2009) and Brunetti and Buyuksahin (2009) who find that herding among hedge funds is countercyclical and does not destabilize the crude oil futures markets, respectively, during recent years.

In this paper, we identify groups of traders based on self-reported lines of business collected and audited by the CFTC. Commercial traders consist of dealers, producers, manufacturers, and other entities typically involved with crude oil as a commodity. Non-commercial traders include floor brokers and traders and managed money traders (hedge funds). Although non-commercial traders are typically considered speculators, commercial swap dealers who use futures markets to hedge over-the-counter positions are considered speculators by some, since they lack direct exposure to the underlying crude oil commodity. In fact, swap dealers commonly take positions for commodity index funds that view commodities as a distinct asset class, raising concerns that these funds convey the herding mentality from unsophisticated traders into futures markets. Overall, the growth in hedge fund and swap dealer positions in crude oil futures markets (Buyuksahin et al. (2009)) has led to claims that these traders destabilize markets and drive prices inexplicably high. Despite these claims, there is surprisingly limited empirical evidence that this trading activity affects prices or volatility. Notably, however, the CFTC's Staff Report on Swap Dealers and Index Traders

(CFTC (2008)) shows that total swap dealer positions declined over the first six months of 2008 while crude oil futures prices rose from $100 to $140.

One limitation of our analysis is that the distinction between hedging and speculation in futures markets is less clear than it may appear. Traditionally, traders with a commercial interest in or an exposure to a physical commodity have been called hedgers, while those without a physical position to offset have been called speculators. In practice, however, commercial traders may "take a view" on the price of a commodity or may not hedge in the futures market despite having an exposure to the commodity, positions that could be considered speculative.

Traditional speculators can be differentiated based upon the time horizons at which they operate. Scalpers or market makers, operate at the shortest time horizon – sometimes trading within a single second. These traders typically do not trade with a view as to where prices are going, but rather "make markets" by standing ready to buy or sell at a moment's notice. The goal of a market maker is to buy contracts at a slightly lower price than the current market price and sell them at a slightly higher price, perhaps at only a fraction of a cent profit on each contract. Skilled market makers can profit by trading hundreds or even thousands of contracts a day. Market makers provide immediacy to the market. Absent a market maker, a market participant would have to wait until the arrival of a counterparty with an opposite trading interest.

Other types of speculators take longer-term positions based on their view of where prices may be headed. "Day traders" establish positions based on their views of where prices might be moving in the next minutes or hours, while "trend followers" take positions based on price expectations over a period of days, weeks or months. These speculators can also provide liquidity to hedgers in futures markets. Through their efforts to gather information on underlying commodities, the activity of these traders serves to bring information to the markets and aid in price discovery.

While hedging and speculating are often considered opposing activities and are generally identified with commercial and non-commercial traders, in practice both groups can contribute to price discovery in futures markets. Futures prices reflect the opinions of all traders in the market. Moreover, the actions of those who can but choose not to enter the futures market can also contribute to price discovery. For example, a commercial trader holding physical inventory, but choosing not to hedge using futures markets (by taking a short position) not only withholds downward pressure on the futures price, but may also signal that prices are expected to rise in the future.

Activities that occur in other markets and other instruments can also impact futures markets. There are three potential activities that might impact futures trading on U.S. exchanges: (i) the trading of OTC derivatives contracts; (ii) the trading on exempt commercial markets (ECMs); and (iii) the trading on foreign boards of trade. Futures markets comprise only one venue for hedging price risk. In the context of risk management, market participants may be involved concurrently in over-the-counter (OTC) transactions, trades on ECMs, and transactions in foreign markets. Crude oil traders, for example, can hedge cash market positions using a combination of futures, swaps, bilateral forward contracts, and cleared broker and ECM transactions.

The traditional speculative stabilizing theory of Friedman (1953), that profitable speculation must involve buying when the price is low and selling when the price is high, has come under strong criticism. Some argue that there is a possibility that speculative trading might lead to higher prices if speculators increase their accumulation of inventories (Pirrong (2008)). However, as suggested by Hamilton (2009b), crude oil inventories have been significantly lower than historical levels in late 2007 and early 2008 when crude oil price changes were most dramatic.

On the other hand, Davidson (2008) argues that the absence of higher inventories does not necessarily indicate the absence of excess speculation in the market. Using the Marshallian idea the “user cost”, Davidson argues if oil prices are expected to rise in the future more rapidly than current interest rates, then commercial producers can enhance total profits by leaving more oil underground today for future production.[1] If oil producers do take the user costs of foregone profits into account in their profit maximizing production decisions, then producers may limit current production and above ground inventories may not rise. In this regard, Davidson (2008) points out that traditional hedgers, such as oil producers, might be involved in speculation.

Hamilton (2009a, 2009b) and Kilian (2008) suggest that the cause of the 2007-08 oil price increase is the result of stagnant production and strong demand of crude oil, which lowered the short-run price elasticity of oil to historically low levels. Hamilton further suggests that both factors--stagnant production and low short-run price elasticity--are needed for speculation to drive prices too high, but that financial speculation (by non-commercial entities) would cause inventories to rise. He concludes that supply and demand fundamentals provide a more plausible explanation for the 2008 price spike.[2]

Our paper contributes to a rich empirical literature evaluating trader positions and prices in futures markets. Using aggregated public Commitments of Traders (COT) data disseminated by the CFTC, Brorsen and Irwin (1987) and Irwin and Yoshimaru (1999) fail to find a link between hedge fund positions and price volatility and prices, respectively. Brown et al. (2000) find no link between fund positions and falling currency values around the 1997 Asian financial crisis. Although these findings are suggestive, researchers generally acknowledge that since public COT data is highly aggregated, these results should be interpreted with caution. More recent research using disaggregated data from the CFTC Large Trading Reporting System provides further evidence on the relations between trader positions and price movements. Irwin and Holt (2004), for example, find a small but positive relation between hedge fund trading volume and volatility for 13 different futures

[1] User cost can be defined as the present value of future net benefit that is lost due to the use of the resource at present. Of course, user costs relate only to exhaustible resources.
[2] The Interagency Task Force Interim Report on Crude Oil (ITF (2008)) makes similar conclusions.

markets during 1994.[3] Haigh, Hranaiova and Overdahl (2007), using directed graph analysis, show that hedge funds enhance the price discovery function of the crude oil and natural gas futures markets.[4] Brunetti and Buyuksahin (2009) also find that speculative activity in five different futures markets (including crude oil) does not cause price movements, but reduces risk by enhancing market liquidity.

The remainder of the paper proceeds as follows. In section I, we describe our data and methodology. In section II, we analyze Granger causality tests between trader positions and rate of return as well as positions and volatility. We conclude in section III.

I. Data and Methodology

We analyze daily position and pricing data for NYMEX light sweet crude oil (West Texas Intermediate grade, henceforth WTI) futures and options on futures contracts over the time period of July 5, 2000 through March 18, 2009. Figure 1 portrays open interest and the prices for both the nearby contract and the average of prices from all contract maturities. Open interest in crude oil futures peaked in July 2007 and has since declined slightly. However, open interest futures-equivalent options continued to rise until July 2008. Though visually interesting, this inspection of open interest and price data provides little evidence on the relation between these two variables.

The position data utilized in this study comes from the CFTC's Large Trader Reporting System (LTRS) which is a collection of position-level information on the composition of open interest across all futures and options-on-futures contracts for each market. It is collected by the CFTC's market surveillance staff to help the Commission fulfill its mission of detecting and deterring futures market manipulation. These data must be filed daily by traders whose positions

[3] This study suffers from an aggregation problem since they used total hedge fund positions as a proxy for nearby positions.
[4] Boyd et al. (2009) employ the same data set to analyze the existence of herding among hedge funds. They find that the degree of herding in futures markets is similar to equity markets and that the moderate level of herding among hedge funds serves to stabilize prices.

meet or exceed the CFTC's reporting levels. For the WTI oil futures and options market used in this study, this threshold has been 350 contracts since May 16, 2000 and was 300 contracts prior to that date. Many similar positions are voluntarily reported which are included in the database. We find that more than 90% of all WTI futures positions are reported to the CFTC during our sample period (See Tables 1a and 1b).

The CFTC publishes a weekly Commitment of Traders (COT) report in which traders are pooled into two broad categories: "Commercial" and "Non-commercial."[5] A trading entity is generally classified as "Commercial" when it files a statement with the CFTC that indicates it is commercially "engaged in business activities hedged by the use of the futures or option markets." Additionally, in order to ensure that traders are classified accurately and consistently, CFTC staff can exercise judgment in re-classifying a trader based on additional information about the trader's use of the markets (CFTC (2004)). "Non-commercials" are mostly financial traders, such as hedge funds, mutual funds, and floor brokers and traders whose positions are reported even though they are not registered with the CFTC under the Commodity Exchange Act (CEA).

Using the information contained in the publicly-available weekly COT reports for the WTI crude oil futures market, Tables 1a and 1b clearly reveal the overall growth of this market since 2000. The tables show the average open interest in WTI crude oil futures and sum of futures-equivalent (delta-adjusted) options positions for the aggregated commercial, non-commercial and non-reportable trader categories. For each category and year, long and short positions are reported as fractions of the total open interest. In 2008, on the short (*long)* side of the 1,279,534 contracts, 52.7% (*51.0%)* of all positions were held by commercial traders and 14.3% (*16.8%)* were held by reporting non-commercial traders, with the remaining split between 26.8% non-commercial spread positions (i.e., calendar spread positions constructed with long and short futures positions) and 6.2%

[5] COT reports also provide data on the positions of non-reporting traders, which include speculators, proprietary traders and smaller traders. This category comprises the difference between total open interest and the aggregate positions of reporting traders.

(*5.4%)* in outright short (*long)* non-commercial futures positions. Table 1a shows that open interest more than doubled during the entire sample period, from fewer than 500,000 contracts in 2000 to more than 1.2 million contracts in 2007.[6]

One significant finding revealed in Table 1a is that the share of non-commercials in crude oil futures has more than doubled from 15.5% to 41% of the long open interest during our sample period. However, it is also important to note that increased participation of non-commercials (traditional speculators) does not imply excessive speculation. As suggested by Working (1960), the level of speculation is meaningful only in comparison with the level of hedging in the market. Increased speculative positions naturally arise with increased hedging pressure in the market. In order to assess the adequacy of speculative activity in the crude oil market relative to hedging activity, we calculate Working's (1960) speculative index in the nearby contract and for all maturities in the crude oil futures market.[7]

Table 2 presents descriptive statistics on the Working's speculative index for nearby contracts and all maturities from 2004 to 2008. In general, the speculative index displays a higher value in nearby contracts relative to all contracts. For instance, the 1.20 speculative index in the nearby contract during 2000 indicates 20% speculation in excess of what is minimally necessary to meet short hedging needs. The speculative index value has risen over time to average 1.41 in 2008, implying that speculation in excess of minimal short and long hedging needs increased to 41%. This increase in the speculative index can result from speculators either increasing spread trades or short

[6] Using average price of all contracts, the notional value of outstanding contracts was about $12 billion in 2000 and $75 billion in 2009. At the peak of crude oil prices in 2008 (average price is around $101.5), notional value of futures-only contract stood at around $130 billion.

[7] Working's speculative index is calculated as follows:

$$T = \begin{cases} 1 + \dfrac{SS}{HL + HS} & if\ HS \geq HL \\ 1 + \dfrac{SL}{HL + HS} & if\ HL \geq HS \end{cases}$$

where SS is short speculator (non-commercial) positions, SL is long speculator positions, HS is short hedge (commercials) positions and HL is long hedge positions (Sanders et al (2008)).

hedging demand by commercials, especially merchant/dealers, in the sample period has increased. Although potentially alarming, a speculative index of 1.41 is rather comparable to historical index numbers in other markets (see Irwin et al. (2008)). For example, Peck (1981, 1982) reports the speculative index ranging from 1.15 to 1.68 for agricultural products, depending on time period and commodity. As Working (1960) also notes, the speculative index measures excess speculation in technical terms, not in economic terms. Since the speculative index does not necessarily indicate excessive speculation, we apply additional analyses to speculator positions the crude oil futures market.

Figure 2a and 2b present the dynamics of Working's speculative index for nearby and all contracts over our sample period. Although prices and the speculative index appear to generally rise and fall together, the correlation between daily price changes and changes in the speculative index is -0.007 (-0.018) for nearby (all) contracts.[8] The figure shows that even though price has declined from $147 dollar to $35 between July of 2008 and January of 2009, the speculative index has been relatively constant during the same period.

Whereas the public data only identify "Commercial" vs. "Non-commercial" categories of crude oil traders, the data provided for this study decompose these two very broad categories into their respective components. In the crude oil futures market, the main commercial sub-categories are "dealer/merchants", which includes wholesalers, exporter/importers, and crude oil marketers; "manufacturers", which includes refiners and fabricators; "producers"; and "commodity swap dealers", including all reporting swap dealers as well as arbitrageurs/broker dealers (financial swap dealers and arbitrageurs/broker dealer sub-categories were merged with commodity swap dealers partway through our sample data).

Traders in the dealer/merchant, manufacturer and producer sub-categories are sometimes referred to as traditional hedgers. The commodity swap dealer sub-category, whose activity has

[8] Both index and price level are non-stationary so we present the correlation between changes in these variables.

grown significantly since 2000, incorporates the positions of non-traditional hedgers, including "entities whose trading predominantly reflects hedging of over-the-counter (OTC) transactions involving commodity indices—for example, swap dealers holding long futures positions to hedge short OTC commodity index exposure opposite institutional traders such as pension funds" (CFTC, 2006).[9]

The most active non-commercial sub-categories in crude oil futures market are floor brokers and traders, a group including all reporting floor brokers and floor traders; and hedge funds, which comprise all reporting commodity pool operators (CPOs), commodity trading advisors (CTAs), associated persons controlling customer accounts, as well as other managed money traders.[10] Many hedge fund complexes are either advised or operated by CFTC-registered CPOs and/or CTAs and associated persons who may also control customer accounts. Through its LTRS, the CFTC therefore obtains positions of the operators and advisors to hedge funds, even though it is not a requirement that these entities provide the CFTC with the name of the hedge fund (or another trader) they are representing.[11] It is clear that many of the large CTAs, CPOs, and associated persons are considered to be hedge funds and hedge fund operators. Accordingly, we conform to the academic literature and to common financial parlance by referring to the three types of institutions collectively as hedge funds. In addition, for the purposes of this paper, market surveillance staff at the CFTC identified other participants who were not registered in any of these three categories but were known to be

[9] See Figure 3a.

[10] Despite these clear distinctions in groups that comprise hedge funds, a point of terminology is in order. Although hedge fund activity has been a subject of intense scrutiny in recent years by academic researchers, market participants, policy makers and the media, there is no broadly accepted definition of a hedge fund. Nor are hedge funds defined in the statutes governing futures trading.

[11] A commodity pool is defined as an investment trust, syndicate or a similar form of enterprise engaged in trading pooled funds in futures and options on futures contracts. A commodity pool is similar to a mutual fund company, except that it invests pooled money in the futures and options markets. Like securities counterparts, a commodity pool operator (CPO) might invest in financial markets or commodity markets. Unlike mutual funds, however, commodity pools may be either long or short derivative contracts. A CPO's principle objective is to provide smaller investors the opportunity to invest in futures and options markets with greater diversification with professional trade management. The CPO solicits funds from others for investing in futures and options on futures. The commodity-trading advisor (CTA) manages the accounts and is the equivalent of an advisor in the securities world.

managing money – and so we also included these in the hedge fund category (see bottom of Table 2). Lastly, non-registered participants are traders that have not yet been categorized or do not fit any other category and who are not registered under the CEA.

Figures 3a and 3b present the growth of commercial and non-commercial traders, respectively. During the sample period, commodity swap dealers have increased their open interest more than threefold while dealer merchant increased by twofold. On the non-commercial side, the biggest increase in open interest was recorded for hedge funds and non-registered participants.

For each group of traders, we use two measures of the group's daily positions to assess changes in the market. We use the net position of each group's daily net position in futures-only and futures plus adjusted options, which may be net short (-) or long (+). Over time, the net positions of different trader categories display dynamic change. From Table 3a and 3b, we see that the net positions (long – short) of commercial and non-commercial traders fluctuate from year to year in nearby contracts.[12] In general, however, we observe that commodity swap dealers have net futures positions which have steadily increased during the sample period. Non-registered participants also take net long positions over time. These two groups of traders on average take positions in the opposite-direction of the other traders. Contrary to common belief, hedge funds as a group were net short in the nearby contract during the recent run-up of crude oil prices.. In addition, we observe that most trader subcategories' net position in terms of magnitude in the nearby contracts has increased during the sample period, most notably that of commodity swap dealers, which has more than doubled in the nearby futures and more than tripled in all maturities since 2004.

Looking at the time series properties of the price and net positions data, we find that the price variable is non-stationary while net positions of different trader categories in nearby contracts are stationary in both level and first differences (See Table 4). In addition to our different trader types,

[12] The roll-over strategy adopted in this paper is to switch to the new contract when the open interest of the nearby contract (March 2005) is lower than the open interest of the next-to-nearby contract (June 2005). That is to say, when the open interest in first deferred contract is higher than nearby contract, the first deferred contract becomes our nearby contract.

we also construct three aggregate net position variables: Net position of all commercials (COM), non-commercials (NON) and non-commercial plus commodity swap dealers (ANC). Since commodity swap dealers also include commodity index traders, these are also analyzed as part of non-commercial traders. Although CFTC (2008) calculations suggest that in crude oil market not more than 50 percent of swap dealer can be considered as commodity index trader, we will assume that all the swap dealer activities are linked to commodity index trading. Since both net position levels and changes are stationary, we provide our analysis along both dimensions for different trader types.

Our preliminary analysis of the relation between price changes and net positions taken by the different trader types in nearby contracts starts by considering the correlation coefficients. Table 5a and 5b report correlation coefficients between price changes and the positions of different types of traders analyzed in this paper. The reported contemporaneous correlation suggests a positive and significant relation between net positions of managed money traders (hedge funds) and price change in nearby futures contracts. This positive and statistically significant correlation also holds in the case of net position change. The relation between hedge funds positions and price changes displays similar patterns in futures and futures equivalent options contract.

In the case of commodity swap dealers, we do not observe a statistically significant correlation between prices and net position or net position change in nearby contracts. The insignificant correlation between the level of net positions of swap dealers and the price change persists when we include futures equivalent options in our analysis. On the other hand, there is a statistically significant positive correlation between change in net futures plus futures equivalent options positions of swap dealers and the change in the nearby price.

As expected, the correlation between net positions of traditional hedgers and price changes is negative and statistically significant. This implies that traditional hedgers move in the opposite direction of prices. This result holds not only for futures positions but also for combined positions (futures plus delta adjusted options). The simple correlation analysis provides three main results. First, hedge fund net position is moving in the same direction as market prices. Second, traditional commercial hedger net positions are negatively correlated with price changes. Finally, correlation between commodity swap dealer net positions in nearby contracts and price changes is zero as expected, since these traders generally do not change their long positions in nearby contracts.

However, correlations between price changes and net position changes of various groups of market participants do not, and cannot, indicate causation from the position changes of one group of traders to market price changes. A more formal way to analyze the interaction between daily price changes and position changes is to directly examine whether various groups of traders change positions in advance of price changes.

Intuitively, in order to realize gains from price changes, positions must be established prior to those price changes. Prices then may respond to those positions, or more precisely, the signal conveyed on establishing those positions. If specific trader categories were systematically establishing positions in advance of profitable price movements, then a pattern of position changes preceding price changes would emerge. Conversely, evidence of price changes leading position changes would suggest that some market participants adjust their positions to reflect new information. Price changes that systematically precede position changes indicate a trend following behavior by a particular trading group.

A formal way to statistically test for whether one variable leads another are generally known as Granger causality tests. However, Granger causality tests do not prove a causal relation between variables, only a statistical probability of one variable leading another. Nonetheless, Granger causality provides useful information as to whether a trader activity prompts, in a forecasting sense, price movements and/or *vice versa*. In the next subsection, we provide brief description of implementation of Granger causality test in our paper.

Testing Causality

The Granger causality test is based on a bivariate VAR representation of two weakly stationary and ergodic time series $\{X_t\}$ and $\{Y_t\}$:

$$X_t = A(L)X_t + B(L)Y_t + \varepsilon_{X,t}$$

$$Y_t = C(L)X_t + D(L)Y_t + \varepsilon_{Y,t}$$

where *A(L)*, *B(L)*, *C(L)*, *D(L)* are one sided lag polynomials of order *a*, *b*, *c*, and *d*, in the lag operator *L*. The regression errors, $\{\varepsilon_{X,t}\}$ and $\{\varepsilon_{Y,t}\}$, are assumed to be independent and normally distributed with mean zero and constant variance. Testing the non--causality from *Y* to *X* hypothesis*; i.e. the null hypothesis of "Y does not Granger-cause X"* , requires testing whether the past values of Y are useful in the prediction of the current value of X, after controlling for the contribution of past values of X. The null hypothesis of non-causality from Y to X will be rejected if the coefficients on the past values of Y (elements in B(L)) are jointly significantly different from zero. However, this implies unidirectional causality from Y to X. Bidirectional causality requires Granger causality in both directions; in which case, the coefficients on elements in both *B(L)* and *C(L)* are jointly different from zero.

Since the test results are sensitive to the lag selection, it is important to choose the appropriate lag length to ensure that the residuals have no serial correlation, no conditional heteroskedasticity and do not deviate too much from Gaussian white noise. To find the optimal lag used in the estimation, we employ the Schwarz criterion, which suggests one lag in each case.

II. Estimation Results

The impact of commodity index traders and hedge funds in the recent oil price run-up between 2006 and 2008 followed by the late 2008 sharp decline can be studied with price and position data. Our sample period covers both rise and drop in the price of crude oil. In our Granger causality analysis, we analyze the daily price change and position changes by various trader groups and combination of trader groups between July 2000 and March 2009. In addition to daily change, we consider two-, three-, four- and five day price and position changes to see whether the relation displays differences in the dynamics of price.

In the first part of the study, we analyze the relation between the price and net position changes as well as net position changes of different trader types for our full sample. Analyzing price and net position for eleven trader types (eight trader types plus three aggregate types (COM, NON, ANC)) implies (10!*2*2) one-way relations for futures and futures plus futures-equivalent options positions. However, our interest is in the relation between prices and positions rather than relations among positions of various traders. Therefore, we present 44 one-way relations for net position changes and price changes for futures and futures plus delta-adjusted options positions.

Table 6a, 6b and 6c present our results for causality between price changes and net positions as well as net position changes for the nearby futures and futures plus options during our sample period between July 5, 2000 and March 18, 2009. We estimate causality results for individual trader groups as well as for aggregate non-commercial traders, commercial traders, and the combined positions of non-commercial and swap dealer groups (to some, these represent aggregate speculative positions in the crude oil futures market). As shown in Table 6, there are unidirectional causalities from price changes to net position changes as well as to the net positions of most trader types. Results from the nearby contract show no unidirectional or bi-directional causality running from positions or position changes to price changes for any trader type, or any measurement interval (from one to five days).

Specifically, Granger causality results in Table 6a suggest that we reject the null hypothesis of Granger non-causality from price changes to net position changes and price changes to net positions for aggregate trader groups as well. However, the reverse non-causality test cannot be rejected. This result holds for futures as well as futures plus futures-equivalent options contracts.

Except for the positions of non-commercial traders combined with swap dealers, we observe that unidirectional causality from price changes to position is weakening as we increase the number of days in the measurement interval.

A similar pattern of causality is observed for individual trader group in the nearby futures contracts. The non-causality from price changes to net positions and price changes to positions is rejected at least in the daily price change for futures-only and futures plus delta adjusted options position for the biggest two categories of non-commercials: managed money traders (hedge funds) and floor brokers and traders. However, we fail to reject non-causality from position change to price changes for these groups at 5 percent level of significance in both futures and futures plus options contracts. There is a very weak evidence of causality from the level of net futures plus options positions of floor brokers and traders to in price changes at the 5 percent level of significance, but the rejection of non-causality only holds at the margin, that is to say when we increase the significance level to 1 percent, we fail to reject the null of non-causality (See Table 6b).

For commercials, on the other hand, price changes leads net position changes (and level of net positions) of dealer/ merchant (AD), manufacturers (AM) and producers (AP) in nearby futures contracts. When we extend our analysis to include futures equivalent options positions, swap dealer position changes is also preceded by price changes. We do not observe any causality from net position change (or level of net position) of commercial traders to price changes in any of our specification.

In summary, we observe uni-directional causality from the level and net position changes of some types of traders to change price. However, the reverse causality is rejected for all different types of traders.[13] This result holds for non-commercial traders in total, for managed money traders and swap dealers individually, and for the positions of non-commercial traders combined with swap

[13] We also analyze the relation between price and positions of different types of trader in the first, second and third deferred futures as well as futures plus futures equivalent options positions. Our results for these contracts are in line with the nearby contracts. The results are available from authors upon request.

dealers. Notably, we find no statistical evidence over the past eight and a half years that position changes by any group of traders systematically precedes price changes. This result holds both for all net position changes of all net commercial participants and for net positions held by traders in commercial sub-categories: commercial manufacturers, commercial dealers, commercial producers, and other commercial entities.

In fact, many trader groups are shown to be trend followers over the full sample period, including commercial traders in total and manufacturers, commercial dealers, producers, swap dealers and managed money traders individually. Notably, swap dealers and managed money traders as well as the positions of non-commercial traders combined with swap dealers also exhibit trend following behavior over the full sample period.

In the second part of the study, we divided our sample into two sub-periods. The first sub-period is spans the beginning of July 2000 to June 2004; the second sub-period covers the period from July 2004 to March 2009.[14] The first sub-period can be characterized as a relatively stable period in terms of crude oil prices; the crude oil prices fluctuated between 20 and 40 dollars per barrel. The second sub-period is, on the other hand, represented by the continuous rise in the price of oil until July 2008 and a rather rapid decline afterwards. It also coincides with the increased participation of commodity swap dealers in crude oil futures markets.

Tables 7a, 7b and 7c show our Granger- causality results for the first sub- period for aggregate, non-commercial and commercial traders, respectively. The results are in line with those reported for the full sample. The findings suggest a uni-directional causality from position change to price changes for all our aggregate categories, especially in the futures and options combined positions. Individual traders' category results also confirm our full sample results. In this period, the

[14] Our analysis of the period from July 2004 to July 2008 also provided similar results. The significance of this period is the fact that crude oil prices have risen continuously and have reached their peak in July 2008.

net position changes of managed money traders and commodity swap dealers is Granger caused by the price change.

Tables 8a, 8b and 8c provide our causality results for the second sub-period. There is strong evidence of uni-directional causality from price change to net position changes of different trader types. However, we again fail to observe bidirectional causality between price change and net position change of different trader groups. Specifically, the net position changes of non-commercials, commercials as well as non-commercials combined with swap dealers is preceded by price change. Although we observe some weak evidence of causality from the level of net positions of non-commercials combined with swap dealers, we fail to see this causality in the individual groups of this aggregate group.

III. Conclusions

The increased participation of traditional speculators as well as commodity index traders in crude oil futures market raise the question of whether these traders have an impact on market prices. The recent increase and eventually fast decline in crude oil prices has been linked to speculators. Based on our linear Granger causality tests, we fail to find the causality from these traders position to prices. Our results suggest that price changes leads the net position and net position changes of speculators and commodity swap dealers, with little or no feedback in the reverse direction. This uni-directional causality suggests that traditional speculators as well as commodity swap dealers are generally trend followers. However, Granger- causality results should not be interpreted as "cause" and "effect" relation but should be interpreted as lead and lag relation between variables. Therefore, our results should not also be interpreted as price changes causing position changes. It might be possible that both variables could be reacting to the same common factors.

References

Boyd, Naomi, Bahattin Buyuksahin, Michael S. Haigh, and Jeffrey H. Harris, 2009, The impact herding in futures markets, CFTC Working Paper.

Brorsen, B.W. and Irwin, S.H., 1987. Futures funds and price volatility. The Review of Futures Markets 6, 118–135.

Brown, Stephen J., Goetzmann, William N. and Park, James M. 2000, Hedge funds and the Asian currency crisis of 1997, *Journal of Portfolio Management* 26, 95-101.

Brunetti, Celso and Bahattin Buyuksahin, 2009, Is speculation destabilizing?, CFTC Working Paper.

Buyuksahin, Bahattin, Michael S. Haigh, Jeffrey H. Harris, James A. Overdahl and Michel A. Robe, 2009, Fundamentals, trader activity and derivative pricing, CFTC Working Paper.

CFTC, 2008, Staff Report on Swap Dealers and Index Traders.

Davidson, Paul, 2008 Crude oil prices: market fundamentals or speculation?, *Challenge* 51, 1110-118.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers and Robert J. Waldmann, 1990, Positive feedback investment strategies and destabilizing rational speculation, *Journal of Finance* 45, 379-395.

Friedman, Milton, 1953, The case for flexible exchange rates, in Essays in Positive Economics, University of Chicago Press, Chicago, 157-203.

Fung, William, and David A. Hsieh, 2000, Measuring the market impact of hedge funds, *Journal of Empirical Finance* 7, 1-36.

Haigh, Michael S., Jana Hranaiova, and James A. Overdahl, 2007, Price volatility, liquidity provision, and the role of hedge funds in energy futures markets, *Journal of Alternative Investments*, 4, 10-38.

Hamilton, James D., 2005, Oil and the macroeconomy, *The New Palgrave Dictionary of Economics*, *Second Edition*. Steven N. Durlauf and Lawrence E. Blume, Eds. Palgrave Macmillan, 2008.

Hamilton, James D., 2009, Understanding crude oil prices, *Energy Journal*, 30, 179-206.

Hamilton, James D., 2009b, Causes and consequences of the oil shock of 2007-08, University of California—San Diego Working Paper.

Irwin, Scott H., and Bryce R. Holt, 2004, The effect of large hedge fund and CTA trading on futures market volatility, Commodity Trading Advisors: Risk, Performance, Analysis and Selection, Gregoriou, G.N., Karavas, V.N., L'Habitant, F-S. and Rouah, F. eds., John Wiley and Sons.

Irwin Scott H., Merrin, Robert P. and Dwight R. Sanders, 2008, The Adequacy of Speculation in Agricultural Futures Markets: Too Much of a Good Thing? Marketing and Outlook Research Reports #2, University of Illinois at Urbana-Champaign.

Irwin, Scott H., and S. Yoshimaru, 1999, Managed futures, positive feedback trading, and futures price volatility, *The Journal of Futures Markets* 19, 759-776.

Kilian, Lutz, 2008a, The economic effects of energy price shocks, *Journal of Economic Literature*, forthcoming.

Kilian, Lutz. 2008b, Not all oil price shocks are alike: disentangling demand and supply shocks in the crude oil market, *American Economic Review*, forthcoming.

Kilian, Lutz and Cheolbeom Park, 2007, The impact of oil price shocks on the U.S. stock market, CEPR Working Paper 6166, March. Revised, June 2008.

Nofsinger, John R. and Richard W. Sias, 1999, Herding and Feedback Trading by Institutional and Individual Investors, *Journal of Finance* 54, 2263-2295.

Peck, A.E., 1981, The adequacy of speculation on the wheat, corn, and soybean futures markets, *Research in Domestic and International Agribusiness Management*, 17-29.

Peck, A.E., 1982, Estimation of hedging and speculative positions in futures markets revisited, *Food Reseach Institute Studies* 18, 181-195.

Pirrong, Craig, 2008, Stochastic fundamental Volatility, Speculation, and Commodity Storage, University of Houston Working Paper.

Shleifer, Andrei and Lawrence H. Summers, 1990, The noise trader approach to finance, *The Journal of Economic Perspectives* 4, 19-33.

US Interagency Task Force on Markets, 2008, Interim Report on Crude Oil.

Working, Holbrook, 1960, Speculation on hedging markets, *Stanford University Food Research Institute Studies* 1, 185-220.

Table 1a: Open Interest in Crude Oil Futures, 2000-2009

YEAR	Non-commercials (%)			Commercials (%)		Non-Reportables		
	Long	Short	Spread	Long	Short	Long	Short	Total Open Interest
2000	8.9	7.9	6.6	75.0	76.1	9.4	9.3	448754
2001	4.9	11.5	7.7	78.8	70.5	8.6	10.3	438955
2002	10.5	8.2	13.7	64.7	68.9	11.1	9.2	486083
2003	13.3	12.8	9.3	68.0	67.7	9.4	10.2	542454
2004	17.5	12.0	9.6	64.2	69.3	8.8	9.1	689326
2005	14.5	13.2	15.4	62.7	62.2	7.3	9.1	817174
2006	15.6	13.1	19.6	58.9	60.5	6.0	6.8	1063986
2007	14.9	11.6	21.7	58.2	61.0	5.3	5.7	1393664
2008	16.8	14.3	26.8	51.0	52.7	5.4	6.2	1279534
2009	17.5	15.7	23.4	52.9	54.7	6.2	6.2	1200124

Table 1b: Open Interest in Crude Oil Futures and Futures-Equivalent Options, 2000-2009

YEAR	Non-commercials (%)			Commercials (%)		Non-Reportables		
	Long	Short	Spread	Long	Short	Long	Short	Total Open Interest
2000	6.5	3.1	14.1	71.6	74.6	7.8	8.2	618590
2001	3.8	4.8	15.1	74.1	72.1	7.0	8.0	626904
2002	6.4	2.9	21.3	64.3	69.2	8.0	6.6	779618
2003	8.9	4.1	20.5	63.4	67.6	7.2	7.8	830327
2004	12.5	4.2	21.4	59.3	67.4	6.8	7.0	1033835
2005	9.4	5.1	27.2	58.2	61.3	5.2	6.3	1344618
2006	10.1	6.3	30.3	55.4	58.7	4.2	4.6	1740532
2007	9.3	5.3	30.8	56.4	60.1	3.5	3.7	2409755
2008	8.2	4.7	41.4	47.6	50.8	2.8	3.1	2887494
2009	7.6	4.1	36.9	52.6	56.1	2.9	2.9	2888548

Notes: **Table 1a and 1b** provides average open interest in futures and futures plus futures equivalent options, respectively, since 2000. Open interest data are from the weekly Commitment of Traders Reports from July 5, 2000 through April 28, 2009. We report open interest figures for the total positions (i.e., futures and the sum of futures and *futures-equivalent* options positions, respectively) of commercial and non-commercial traders. When the CFTC publishes its weekly Commitment of Traders Report, reporting traders are categorized into two broad groups: "Commercials" (right panel), who have declared an underlying hedging purpose, and "Non-commercials" (left panel), who have not. For each category, the long and short positions are reported as fractions of the overall open interest. For example, on the short [*long*] side of the 1,279,534 open interest in 2008, 52.7% [*51.0%*] of all positions were held by commercial traders and 14.3% [*16.8%*] were held by reporting non-commercial traders, with the rest split between 26.8% in spread positions (i.e., calendar spread positions constructed with long and short futures positions) held by reporting non-commercial traders and 6.2% [*5.4%*] in outright short [*long*] futures positions held by non-reporting traders.

Table 1c: Working's Speculations Index, 2004-2008

Table 2: Working's (1960) Speculative Index in Crude Oil Futures Market, 2004-2008

YEAR	Mean	Median	Max	Min.	Std. Dev.
	Speculative Index, 2004-2008 (Nearby Contract)				
2004	1.20	1.20	1.35	1.11	0.04
2005	1.21	1.22	1.39	1.10	0.05
2006	1.37	1.37	1.56	1.19	0.08
2007	1.39	1.39	1.57	1.27	0.07
2008	1.41	1.40	1.56	1.31	0.05
Average	1.32	1.33	1.57	1.10	0.11
	Speculative Index, 2004-2008 (All Contracts)				
2004	1.17	1.17	1.21	1.15	0.01
2005	1.23	1.23	1.28	1.15	0.03
2006	1.28	1.28	1.32	1.23	0.02
2007	1.30	1.27	1.42	1.22	0.07
2008	1.39	1.39	1.44	1.33	0.02
Average	1.27	1.26	1.44	1.15	0.08

Table 2 provides descriptive statistics for Working's (1960) Speculative Index for nearby and all contracts between 2004-2008. This index is calculated as follows:

$$T = \begin{cases} 1 + \dfrac{SS}{HL + HS} & if\ HS \geq HL \\ 1 + \dfrac{SL}{HL + HS} & if\ HL \geq HS \end{cases}$$

where SS is short speculator (non-commercial) positions, SL is long speculator positions, HS is short hedge (commercials) positions and HL is long hedge positions (Sanders et al (2008)).

Table 3a: Average Daily Net Futures Positions of the Major WTI Traders (Nearby Contract)

	Dealers/ Merchants	Manufacturers	Producers	Swap Dealers	Other	Hedge Funds	Floor Brokers & Traders	Non-Registered Participants	Price
2000	-12103.4	-11065.2	193.5	44574.2	485.4	13282.4	-2849.7	-7263.8	31.4
2001	-242.0	-8023.9	-56.6	36617.0	-21.6	-8572.2	-5621.6	-3094.6	25.9
2002	-25157.3	-17017.6	-5065.7	42677.9	343.3	15317.3	-5340.4	1224.5	26.1
2003	-27127.7	-23783.3	-6468.4	39030.0	390.6	29331.6	-11990.6	1784.7	30.8
2004	-47185.0	-29237.9	-10743.9	53885.8	290.3	44992.9	-9660.6	1259.6	41.4
2005	-59738.0	-30733.3	-9663.2	85620.3	281.1	25491.0	-7285.3	3357.7	57.0
2006	-55527.7	-25246.4	-9550.7	90792.0	-269.3	1645.5	-9455.5	12728.4	66.8
2007	-66087.7	-27365.2	-8073.3	117983.2	-1209.3	-18643.1	-4633.2	19320.7	72.5
2008	-55788.9	-16530.7	-4955.6	100288.8	-638.6	-11052.5	-6791.5	5350.2	99.8
2009	-107037.5	-18750.0	-9221.4	96796.2	3827.6	16804.8	-9918.9	34299.3	43.4

Table 3b: Average Daily Net Futures plus Futures Equivalent Options Positions of the Major WTI Traders (Nearby Contract)

	Dealers/ Merchants	Manufacturers	Producers	Swap Dealers	Other	Hedge Funds	Floor Brokers & Traders	Non-Registered Participants	Price
2000	-14800.1	-13516.8	411.4	47243.0	31.6	12987.3	-209.5	-4995.2	31.4
2001	-1370.5	-10210.9	-79.4	32901.5	199.7	-8424.9	-266.1	-458.9	25.9
2002	-27997.5	-17971.0	322.5	40356.6	-4814.4	14721.8	-802.6	2940.9	26.1
2003	-33038.4	-26372.3	332.8	34121.2	-7110.4	30542.7	-1104.1	4284.5	30.8
2004	-51427.4	-31373.2	-41.7	49384.9	-11116.7	45123.8	-67.3	3955.4	41.4
2005	-60036.7	-30286.9	-736.2	81930.1	-10036.7	23014.8	-1793.9	5991.6	57.0
2006	-57039.8	-26691.2	-1825.8	89927.4	-10049.6	1865.0	-5685.6	15020.4	66.8
2007	-67627.1	-26511.1	-1379.5	122404.5	-8662.4	-20401.7	-2859.9	15367.0	72.5
2008	-54854.1	-16093.7	-937.5	93219.6	-5043.0	-11758.4	-2729.8	7805.0	99.8
2009	-108569.4	-18174.8	3776.6	88249.5	-9226.0	19963.6	-6241.2	38260.3	43.4

Table 2a and 2b present the annual average net position of eight types of large traders between 2000 and 2009 in the WTI nearby futures and futures plus futures equivalent options, respectively. Prior to August 2003, the “NC” category sums the positions of presently inactive commercial traders. However we ignore NC category in our discussions.

Table 4: Augmented Dickey Fuller Test for Prices and Positions Data in Futures-Only and Futures plus Futures Equivalent Options in Crude Oil Market (2000-2009)

	Futures-Only		Futures and Futures Equivalent Options	
	Nearby Contract		Nearby Contract	
	Level	First Difference	Level	First Difference.
Price	-0.98	-23.36	-0.98	-23.37
Dealers/ Merchants	-9.36	-11.75	-9.57	-9.16
Manufacturers	-12.46	-4.89	-13.14	-5.48
Producers	-8.20	-7.73	-7.99	-7.64
Commodity Swaps/ Derivative Traders	-9.21	-7.22	-9.85	-9.38
Other	-1.71	-3.73	-2.53	-3.40
Managed Money Traders	-5.51	-5.95	-5.64	-7.42
Floor Brokers and Traders	-4.65	-4.54	-7.15	-6.84
Non-Registered Participants	-5.03	-5.11	-5.77	-7.75
All Commercials	-6.13	-5.55	-6.81	-8.76
Non-Commercials	-6.41	-4.59	-7.21	-8.20
All Non-Commercials	-9.72	-12.25	-9.81	-10.35

Table 4 presents the unit root tests on the price and net positions for the eight types of large traders between 2000 and 2009 in the WTI futures and futures plus futures equivalent options, respectively. The critical value for ADF test statistics are -3.43, -2.86 and -2.56 for 1, 5 and 10 percent level of significance. If the calculated value is lower than critical value, then the series is said to be stationary at the relevant level of significance.

Table 5a: Correlations: Net Futures Positions (Nearby Contract)

	Price	Dealers/ Merchants	Manu-facturers	Producers	Swap Dealers	Other	Hedge Funds	Floor Brokers & Traders	Non-Registered Participants	Comm-ercial	NonComm-ercial
Price Change	1.000										
Dealer/ Merchants	-0.021	1.000									
Manufacturers	-0.063	0.420	1.000								
Producers	-0.029	0.422	0.480	1.000							
Commodity Swaps/ Derivatives Dealers	-0.010	-0.680	-0.378	-0.317	1.000						
Other	-0.030	-0.175	0.062	-0.035	-0.039	1.000					
Managed Money Traders	0.095	-0.182	-0.362	-0.305	-0.410	0.231	1.000				
Floor Brokers &Traders (FBT)	0.004	0.127	0.094	0.094	-0.184	-0.346	-0.164	1.000			
Non-Registered Participants (NRP)	-0.018	-0.456	-0.176	-0.205	0.269	-0.089	-0.230	0.229	1.000		
All Commericals (COM)	-0.065	0.277	0.356	0.309	0.425	-0.176	-0.880	-0.109	-0.153	1.000	
Non-Commercials (NON)	0.088	-0.342	-0.409	-0.366	-0.338	0.102	0.850	0.191	0.257	-0.965	1.000
All Non-Commericals plus Swap Dealers (ANC)	0.054	-0.911	-0.667	-0.575	0.726	0.037	0.222	-0.040	0.449	-0.291	0.401

Table 5a presents the correlation between price and net position changes for the eight types of large traders between 2000 and 2009 in the WTI nearby futures contracts.

Table 5b: Correlations: Change in Net Futures Positions (Nearby Contract)

	Price	Dealers/ Merchants	Manu-facturers	Producers	Swap Dealers	Other	Hedge Funds	Floor Brokers & Traders	Non-Registered Participants	Comm-ercial	NonComm-ercial
Price Change	1.000										
Dealer/ Merchants	-0.134	1.000									
Manufacturers	-0.158	0.246	1.000								
Producers	-0.105	0.176	0.216	1.000							
Commodity Swaps/ Derivatives Dealers	0.018	-0.548	-0.385	-0.264	1.000						
Other	-0.145	-0.031	0.035	0.031	-0.006	1.000					
Managed Money Traders	0.339	-0.400	-0.312	-0.190	-0.176	-0.070	1.000				
Floor Brokers &Traders (FBT)	-0.068	0.067	0.083	0.020	-0.182	0.005	-0.184	1.000			
Non-Registered Participants (NRP)	-0.061	-0.226	-0.086	-0.051	0.160	0.078	-0.279	0.108	1.000		
All Commercials (COM)	-0.216	0.525	0.335	0.193	0.253	0.032	-0.784	-0.077	-0.093	1.000	
Non-Commercials (NON)	0.281	-0.501	-0.331	-0.210	-0.141	-0.024	0.778	0.182	0.313	-0.851	1.000
All Non-Commercials plus Swap Dealers (ANC)	0.219	-0.801	-0.547	-0.363	0.692	-0.022	0.427	-0.012	0.355	-0.419	0.617

Table 5b presents the correlation between price changes and net position changes for the eight types of large traders between 2000 and 2009 in the WTI nearby futures contracts.

Table 5c: Correlations: Net Futures and Futures Equivalent Positions (Nearby Contract)

	Price	Dealers/ Merchants	Manu- facturers	Producers	Swap Dealers	Other	Hedge Funds	Floor Brokers & Traders	Non-Registered Participants	Comm- ercial	NonComm -ercial
Price Change	1.000										
Dealer/ Merchants	-0.033	1.000									
Manufacturers	-0.066	0.412	1.000								
Producers	-0.039	0.454	0.487	1.000							
Commodity Swaps/ Derivatives Dealers	0.015	-0.662	-0.358	-0.347	1.000						
Other	-0.051	-0.020	0.108	0.134	-0.211	1.000					
Managed Money Traders	0.089	-0.235	-0.387	-0.305	-0.414	0.116	1.000				
Floor Brokers &Traders (FBT)	0.024	0.307	0.069	0.077	-0.320	0.078	0.102	1.000			
Non-Registered Participants (NRP)	-0.071	-0.454	-0.124	-0.235	0.356	0.024	-0.247	-0.401	1.000		
All Commercials (COM)	-0.050	0.320	0.379	0.316	0.405	-0.189	-0.932	-0.091	-0.023	1.000	
Non-Commercials (NON)	0.067	-0.377	-0.435	-0.393	-0.326	0.137	0.939	0.073	0.083	-0.972	1.000
All Non-Commercials plus Swap Dealers (ANC)	0.063	-0.912	-0.659	-0.618	0.734	-0.106	0.273	-0.258	0.404	-0.306	0.403

Table 5c presents the correlation between price and net position changes for the eight types of large traders between 2000 and 2009 in the WTI nearby futures plus futures equivalent options.

Table 5d: Correlations: Change in Net Futures and Futures Equivalent Positions (Nearby Contract)

	Price	Dealers/ Merchants	Manu- facturers	Producers	Swap Dealers	Other	Hedge Funds	Floor Brokers & Traders	Non-Registered Participants	Comm- ercial	NonComm -ercial
Price Change	1.000										
Dealer/ Merchants	-0.139	1.000									
Manufacturers	-0.164	0.263	1.000								
Producers	-0.146	0.195	0.219	1.000							
Commodity Swaps/ Derivatives Dealers	0.098	-0.569	-0.399	-0.276	1.000						
Other	-0.255	0.064	0.045	0.048	-0.060	1.000					
Managed Money Traders	0.314	-0.432	-0.310	-0.210	-0.143	-0.163	1.000				
Floor Brokers &Traders (FBT)	-0.052	0.041	0.014	0.015	-0.175	0.038	-0.084	1.000			
Non-Registered Participants (NRP)	-0.162	-0.251	-0.100	-0.063	0.173	0.110	-0.305	-0.054	1.000		
All Commercials (COM)	-0.167	0.551	0.357	0.209	0.197	0.092	-0.801	-0.124	-0.117	1.000	
Non-Commercials (NON)	0.230	-0.556	-0.364	-0.243	-0.108	-0.104	0.856	0.150	0.164	-0.914	1.000
All Non-Commercials plus Swap Dealers (ANC)	0.237	-0.840	-0.571	-0.389	0.725	-0.120	0.479	-0.036	0.251	-0.476	0.606

Table 5d presents the correlation between price and net position changes for the eight types of large traders between 2000 and 2009 in the WTI nearby futures plus futures equivalent options.

Table 6a: Granger Causality Tests: Price and Position Change (Nearby)

	Non-Commercials (Futures Only)				Non-Commercials (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.001)**	0.466	(0.227)	**0.000**	**(0.000)**	0.805	(0.376)
2	0.083	(0.670)	0.363	(0.185)	**0.001**	(0.046)	0.645	(0.246)
3	0.693	(0.952)	0.593	(0.172)	0.062	(0.208)	0.163	(0.372)
4	0.164	(0.080)	0.342	(0.187)	0.858	(0.941)	0.101	(0.394)
5	0.270	(0.137)	0.139	(0.254)	0.527	(0.615)	0.040	(0.496)
	Commercials (Futures Only)				Commercials (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.002)**	0.873	(0.358)	**0.000**	**(0.000)**	0.643	(0.452)
2	0.077	(0.927)	0.398	(0.259)	**0.001**	(0.022)	0.645	(0.287)
3	0.785	(0.552)	0.429	(0.360)	0.104	(0.315)	0.342	(0.476)
4	0.161	(0.027)	0.097	(0.406)	0.642	(0.953)	0.057	(0.598)
5	0.140	(0.067)	0.043	(0.481)	0.659	(0.723)	0.027	(0.649)
	Non-Commercials and Swap Dealers (Futures Only)				Non-Commercials and Swap Dealers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	(0.019)	0.983	(0.552)	**0.000**	**(0.000)**	0.313	(0.376)
2	**0.000**	(0.054)	0.946	(0.348)	**0.000**	(0.005)	0.973	(0.171)
3	**0.002**	(0.263)	0.209	(0.425)	**0.000**	(0.053)	0.153	(0.378)
4	0.031	(0.837)	0.417	(0.497)	**0.000**	(0.341)	0.376	(0.432)
5	0.008	(0.530)	0.293	(0.440)	**0.000**	(0.109)	0.305	(0.377)

Table 6a presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 6b: Granger Causality Tests (Non-Commercials): Price and Position Change

	Managed Money Traders (Futures Only)				Managed Money Traders (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.000)**	0.991	(0.234)	**0.000**	**(0.000)**	0.813	(0.229)
2	**0.001**	(0.116)	0.245	(0.113)	**0.000**	(0.051)	0.170	(0.113)
3	0.039	(0.348)	0.956	(0.235)	0.012	(0.153)	0.990	(0.242)
4	0.867	(0.284)	0.656	(0.288)	0.388	(0.793)	0.624	(0.298)
5	0.717	(0.731)	0.223	(0.405)	0.299	(0.670)	0.215	(0.396)
	Floor Brokers and Traders (Futures Only)				Floor Brokers and Traders (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.004**	**(0.002)**	**0.007**	(0.317)	0.435	(0.168)	0.439	(0.044)
2	0.199	(0.138)	0.198	(0.690)	0.615	(0.725)	0.990	(0.088)
3	0.477	(0.519)	0.075	(0.234)	0.228	(0.309)	0.643	(0.046)
4	0.388	(0.218)	0.154	(0.239)	0.461	(0.819)	0.447	(0.062)
5	0.348	(0.189)	0.372	(0.357)	0.382	(0.875)	0.725	(0.113)

Table 6b presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 6c: Granger Causality Tests (Commercials): Price and Position Change

	Dealer/Merchants (Futures Only)				Dealer/Merchants (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.001)**	0.254	(0.844)	**0.000**	**(0.000)**	0.133	(0.696)
2	**0.010**	(0.096)	0.805	(0.846)	**0.000**	**(0.006)**	0.933	(0.399)
3	0.152	(0.346)	0.151	(0.916)	**0.008**	(0.063)	0.179	(0.765)
4	0.667	(0.933)	0.226	(0.926)	0.089	(0.324)	0.286	(0.841)
5	0.508	(0.670)	0.100	(0.989)	0.047	(0.147)	0.157	(0.710)
	Manufacturers (Futures Only)				Manufacturers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.001)**	0.155	(0.155)	**0.000**	**(0.005)**	0.216	(0.166)
2	**0.000**	(0.096)	0.171	(0.082)	**0.000**	**(0.007)**	0.249	(0.080)
3	**0.003**	(0.346)	0.805	(0.248)	**0.001**	(0.099)	0.726	(0.215)
4	**0.004**	(0.933)	0.895	(0.359)	**0.001**	(0.177)	0.868	(0.321)
5	**0.010**	(0.670)	0.912	(0.297)	**0.003**	(0.097)	0.850	(0.304)
	Producers (Futures Only)				Producers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.013	(0.017)	0.086	(0.670)	**0.006**	(0.147)	0.099	(0.609)
2	0.239	(0.043)	0.280	(.0577)	0.132	(0.302)	0.310	(0.505)
3	0.587	(0.241)	0.219	(0.380)	0.419	(0.816)	0.252	(0.328)
4	0.365	(0.383)	0.354	(0.671)	0.250	(0.837)	0.413	(0.598)
5	0.065	(0.295)	0.742	(0.690)	0.031	(0.486)	0.865	(0.568)
	Other (Futures Only)				Other (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.809	(0.141)	0.543	(0.772)	0.648	(0.833)	0.945	(0.946)
2	0.554	(0.345)	0.074	(0.877)	0.881	(0.806)	0.236	(0.991)
3	0.196	(0.822)	0.048	(0.749)	0.952	(0.792)	0.313	(0.779)
4	0.319	(0.848)	0.010	(0.719)	0.782	(0.570)	0.114	(0.694)
5	0.854	(0.490)	0.167	(0.893)	0.543	(0.520)	0.858	(0.722)
	Commodity Swaps/Derivative Dealers (Futures Only)				Commodity Swaps/Derivative Dealers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.186	(0.427)	0.456	(0.533)	**0.000**	(0.218)	0.437	(0.972)
2	0.076	(0.585)	0.507	(0.696)	**0.000**	(0.072)	0.763	(0.856)
3	0.146	(0.542)	0.333	(0.595)	**0.001**	(0.132)	0.463	(0.994)
4	0.117	(0.637)	0.767	(0.576)	**0.003**	(0.250)	0.972	(0.970)
5	0.055	(0.786)	0.749	(0.732)	**0.002**	(0.131)	0.965	(0.834)

Table 6c presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 7a: Granger Causality Tests: Price and Position Change: Sample Period 2000-2004

	Non-Commercials (Futures Only)				Non-Commercials (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.002**	(0.082)	0.121	(0.270)	**0.000**	(0.066)	0.116	(0325)
2	0.045	(0.729)	0.224	(0.519)	0.011	(0.772)	0.207	(0.580)
3	0.723	(0.098)	0.054	(0.365)	0.976	(0.072)	0.051	(0.412)
4	0.153	**(0.003)**	0.042	(0.213)	0.368	(0.002)	0.052	(0.262)
5	0.043	**(0.000)**	0.016	(0.164)	0.156	(0.000)	0.027	(0.217)
	Commercials (Futures Only)				Commercials (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.003**	(0.019)	0.217	(0.201)	**0.001**	(0.015)	0.261	(0.258)
2	0.012	(0.615)	0.494	(0.515)	**0.003**	(0.548)	0.501	(0.585)
3	0.802	(0.084)	0.118	(0.297)	0.853	(0.082)	0.14	(0.361)
4	0.142	**(0.001)**	0.039	(0.152)	0.351	**(0.001)**	0.059	(0.205)
5	0.027	**(0.000)**	0.011	(0.121)	0.111	**(0.000)**	0.017	(0.166)
	Non-Commercials and Swap Dealers (Futures Only)				Non-Commercials and Swap Dealers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	(0.643)	0.074	(0.167)	**0.000**	(0.968)	0.064	(0.125)
2	0.019	(0.140)	0.064	(0.245)	**0.000**	(0.291)	0.078	(0.226)
3	0.686	**(0.007)**	0.069	(0.161)	0.092	(0.012)	0.078	(0.146)
4	0.842	**(0.001)**	0.112	(0.091)	0.309	**(0.002)**	0.124	(0.082)
5	0.748	**(0.001)**	0.088	(0.067)	0.462	**(0.002)**	0.107	(0.072)

Table 7a presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 7b: Granger Causality Tests (Non-Commercials): Price and Position Change: Sample Period 2000-2004

	Managed Money Traders (Futures Only)				Managed Money Traders (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.004**	(0.447)	0.118	(0.193)	**0.004**	(0.405)	0.155	(0.186)
2	0.134	(0.470)	0.123	(0.351)	0.105	(0.540)	0.165	(0.352)
3	0.408	**(0.007)**	0.047	(0.226)	0.508	**(0.010)**	0.068	(0.222)
4	0.074	**(0.000)**	0.056	(0.150)	0.116	**(0.000)**	0.076	(0.152)
5	0.029	**(0.000)**	0.023	(0.113)	0.043	**(0.000)**	0.035	(0.188)
	Floor Brokers and Traders (Futures Only)				Floor Brokers and Traders (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.901	(0.972)	0.901	(0.652)	0.752	(0.938)	0.433	(0.330)
2	0.217	(0.039)	0.833	(0.673)	0.460	(0.059)	0.43	(0.376)
3	0.009	**(0.003)**	0.989	(0.933)	0.091	(0.012)	0.152	(0.928)
4	**0.007**	**(0.001)**	0.769	(0.897)	0.048	(0.004)	0.238	(0.690)
5	0.024	**(0.008)**	0.963	(0.834)	0.088	(0.017)	0.238	(0.724)

Table 7b presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 7c: Granger Causality Tests (Commercials): Price Change and Position Change: Sample Period 2000-2004

	Dealer/Merchants (Futures Only)				Dealer/Merchants (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	(0.130)	0.520	(0.398)	**0.000**	(0.601)	0.479	(0.481)
2	**0.001**	(0.912)	0.564	(0.709)	**0.000**	(0.649)	0.579	(0.831)
3	0.190	(0.142)	0.417	(0.444)	0.048	(0.189)	0.450	(0.547)
4	0.695	(0.001)	0.314	(0.265)	0.318	**(0.008)**	.0321	(0.334)
5	0.920	(0.005)	0.089	(0.188)	0.667	**(0.009)**	0.100	(0.252)
	Manufacturers (Futures Only)				Manufacturers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.005**	(0.586)	0.267	(0.192)	0.000	(0.752)	0.210	(0.120)
2	0.872	(0.106)	0.170	(0.197)	0.368	(0.198)	0.140	(0.147)
3	0.172	(0.033)	0.080	(0.098)	0.561	(0.061)	0.070	(0.080)
4	0.134	(0.025)	0.065	(0.081)	0.463	(0.044)	0.063	(0.067)
5	0.046	**(0.009)**	0.135	(0.077)	0.236	(0.021)	0.120	(0.070)
	Producers (Futures Only)				Producers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.928	(0.762)	0.183	(0.806)	0.667	(0.364)	0.355	(0.885)
2	0.967	(0.875)	0.209	(0.873)	0.698	(0.600)	0.263	(0.962)
3	0.610	(0.469)	0.104	(0.874)	0.416	(0.290)	0.162	(0.959)
4	0.666	(0.517)	0.268	(0.963)	0.560	(0.374)	0.445	(0.965)
5	0.503	(0.856)	0.476	(0.910)	0.490	(0.967)	0.715	(0.940)
	Other (Futures Only)				Other (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.655	(0.999)	0.085	(0.125)	0.192	(0.498)	0.063	(0.057)
2	0.440	(0.196)	0.145	(0.148)	0.244	(0.133)	0.200	(0.102)
3	0.163	(0.048)	0.164	(0.320)	0.098	(0.035)	0.189	(0.245)
4	0.309	(0.069)	0.206	(0.502)	0.261	(0.109)	0.275	(0.418)
5	0.118	(0.006)	0.084	(0.612)	0.084	(0.007)	0.159	(0.508)
	Commodity Swaps/Derivative Dealers (Futures Only)				Commodity Swaps/Derivative Dealers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	(0.053)	0.279	(0.393)	0.011	(0.074)	0.211	(0.162)
2	**0.000**	(0.085)	0.128	(0.228)	0.052	(0.157)	0.135	(0.121)
3	**0.002**	(0.156)	0.288	(0.228)	0.257	(0.196)	0.296	(0.136)
4	0.031	(0.215)	0.449	(0.247)	0.615	(0.258)	0.435	(0.137)
5	0.211	(0.377)	0.440	(0.265)	0.966	(0.469)	0.437	(0.188)

Table 7c presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 8a: Granger Causality Tests: Price and Position Change: Sample Period: 2004-2009

	Non-Commercials (Futures Only)				Non-Commercials (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.025	(0.115)	0.371	(0.148)	**0.000**	**(0.001)**	0.884	(0.275)
2	0.180	(0.738)	0.252	(0.139)	**0.004**	(0.051)	0.496	(0.193)
3	0.625	(0.759)	0.806	(0.121)	0.037	(0.065)	0.275	(0.292)
4	0.293	(0.278)	0.696	(0.111)	0.536	(0.400)	0.263	(0.255)
5	03538	(0.456)	0.408	(0.161)	0.223	(0.123)	0.131	(0.346)
	Commercials (Futures Only)				Commercials (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.001**	(0.014)	0.975	(0.250)	**0.000**	**(0.000)**	0.661	(0.349)
2	0.258	(0.940)	0.313	(0.210)	**0.007**	(0.024)	0.571	(0.244)
3	0.688	(0.920)	0.590	(0.276)	0.066	(0.095)	0.426	(0.401)
4	0.334	(0.192)	.0277	(0.252)	0.349	(0.227)	0.160	(0.418)
5	0.402	(0.402)	0.169	(0.321)	0.251	(0.106)	0.101	(0.473)
	Non-Commercials and Swap Dealers (Futures Only)				Non-Commercials and Swap Dealers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	(0.025)	0.686	(0.087)	**0.000**	**(0.000)**	0.525	(0.045)
2	**0.000**	(0.042)	0.603	(0.044)	**0.000**	**(0.001)**	0.627	(0.016)
3	**0.002**	(0.158)	0.428	(0.061)	**0.000**	**(0.009)**	0.302	(0.061)
4	0.019	(0.512)	0.760	(0.066)	**0.000**	(0.076)	0.685	(0.056)
5	**0.003**	(0.277)	0.598	(0.066)	**0.000**	(0.015)	0.584	(0.060)

Table 8a presents the Granger causality results for price and position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 8b: Granger Causality Tests (Non-Commercials): Price and Position Change: Sample Period 2004-2009

	Managed Money Traders (Futures Only)				Managed Money Traders (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.000)**	0.921	(0.134)	**0.000**	**(0.000)**	0.767	(0.128)
2	**0.002**	(0.063)	0.148	(0.061)	**0.000**	(0.024)	0.099	(0.060)
3	0.023	(0.089)	0.798	(0.142)	**0.005**	(0.026)	0.780	(0.143)
4	0.538	(0.990)	0.964	(0.149)	0.180	(0.381)	0.981	(0.150)
5	0.379	(0.395)	0.500	(0.235)	0.111	(0.095)	0.459	(0.223)
	Floor Brokers and Traders (Futures Only)				Floor Brokers and Traders (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.002**	**(0.001)**	**0.004**	(0.229)	0.449	(0.203)	0.324	(0.037)
2	0.109	(0.049)	0.181	(0.575)	0.743	(0.917)	0.873	(0.081)
3	0.200	(0.186)	0.0524	(0.188)	0.387	(0.446)	0.440	(0.049)
4	0.153	(0.052)	0.115	(0.205)	0.726	(0.961)	0.299	(0.063)
5	0.184	(0.056)	0.305	(0.292)	0.540	(0.945)	0.569	(0.117)

Table 8b presents the Granger causality results for price and position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Table 8c: Granger Causality Tests (Commercials): Price and Position Change: Sample Period 2004-2009

	Dealer/Merchants (Futures Only)				Dealer/Merchants (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.003)**	0.273	(0.523)	**0.000**	**(0.000)**	0.127	(0.217)
2	0.077	(0.109)	0.957	(0.354)	**0.004**	**(0.006)**	0.997	(0.116)
3	0.267	(0.237)	0.180	(0.553)	0.028	(0.025)	0.185	(0.324)
4	0.782	(0.668)	0.337	(0.486)	0.156	(0.094)	0.401	(0.321)
5	0.496	(0.328)	0.219	(0.421)	0.054	(0.030)	0.303	(0.251)
	Manufacturers (Futures Only)				Manufacturers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.000**	**(0.008)**	0.068	(0.049)	**0.000**	(0.002)	0.097	(0.051)
2	**0.000**	**(0.008)**	0.061	(0.024)	**0.000**	(0.001)	0.091	(0.023)
3	**0.001**	(0.046)	0.428	(0.086)	**0.000**	(0.015)	0.364	(0.074)
4	**0.001**	(0.072)	0.608	(0.124)	**0.000**	(0.024)	0.622	(0.107)
5	**0.001**	(0.033)	0.380	(0.111)	**0.000**	**(0.007)**	0.726	(0.117)
	Producers (Futures Only)				Producers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.008**	(0.154)	0.164	(0.198)	**0.002**	(0.111)	0.143	(0.425)
2	0.205	(0.433)	0.476	(0.422)	0.074	(0.317)	0.489	(0.341)
3	0.458	(0.860)	0.443	(0.287)	0.241	(0.781)	0.447	(0.233)
4	0.275	(0.952)	0.603	(0.511)	0.159	(0.909)	0.603	(0.426)
5	0.082	(0.764)	0.971	(0.565)	0.041	(0.756)	0.996	(0.453)
	Other (Futures Only)				Other (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	0.742	(0.412)	0.797	(0.428)	0.792	(0.716)	0.840	(0.469)
2	0.458	(0.412)	0.149	(0.544)	0.974	(0.917)	0.353	(0.555)
3	0.112	(0.287)	0.102	(0.489)	0.735	(0.843)	0.446	(0.438)
4	0.223	(0.379)	0.025	(0.521)	0.936	(0858)	0.165	(0.429)
5	0.672	(0.808)	0.377	(0.703)	0.692	(0.901)	0.924	(0.479)
	Commodity Swaps/Derivative Dealers (Futures Only)				Commodity Swaps/Derivative Dealers (Futures and Options)			
Day Change	ΔPrice→ΔPosition		ΔPosition→ΔPrice		ΔPrice→ΔPosition		ΔPosition→ΔPrice	
1	**0.004**	(0.123)	0.632	(0.934)	**0.000**	(0.150)	0.620	(0.284)
2	**0.006**	(0.015)	0.741	(0.707)	**0.000**	(0.057)	0.985	(0.204)
3	0.040	(0.073)	0.485	(0.922)	**0.000**	(0.151)	0.637	(0.360)
4	0.043	(0.070)	0.930	(0.982)	**0.002**	(0.256)	0.848	(0.437)
5	0.024	(0.035)	0.914	(0.810)	**0.002**	(0.153)	0.857	(0.295)

Table 8c presents the Granger causality results for price and net position changes. It also shows the Granger-causality results for price change and the level of net position in parenthesis. Bolded probabilities indicate the rejection of Granger non-causality at 1 percent level of significance.

Figure 1: Open Interest and Price of Crude Oil

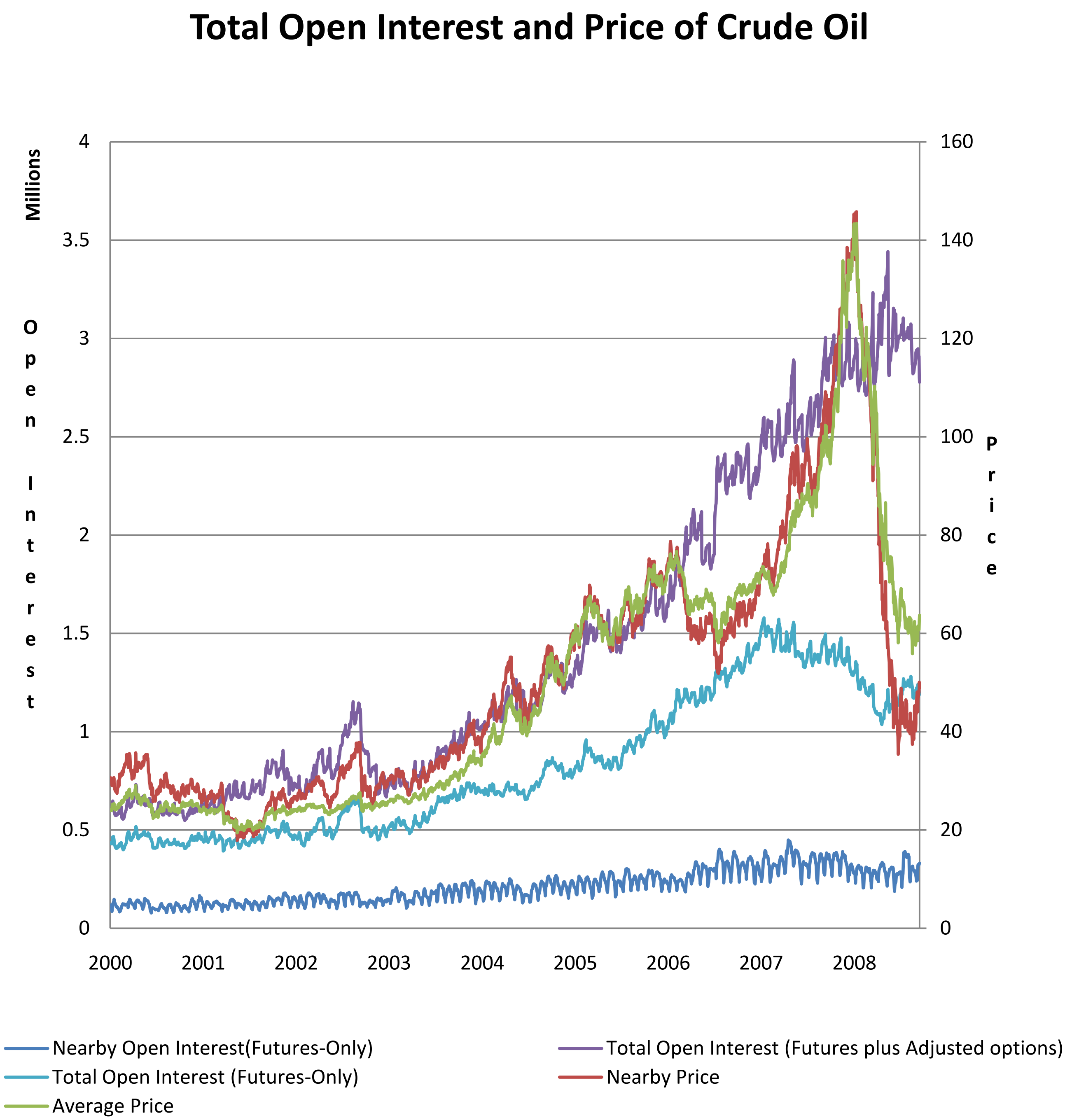


Figure 2a: Working's Speculative Index, 2000-2009 (Nearby Futures)

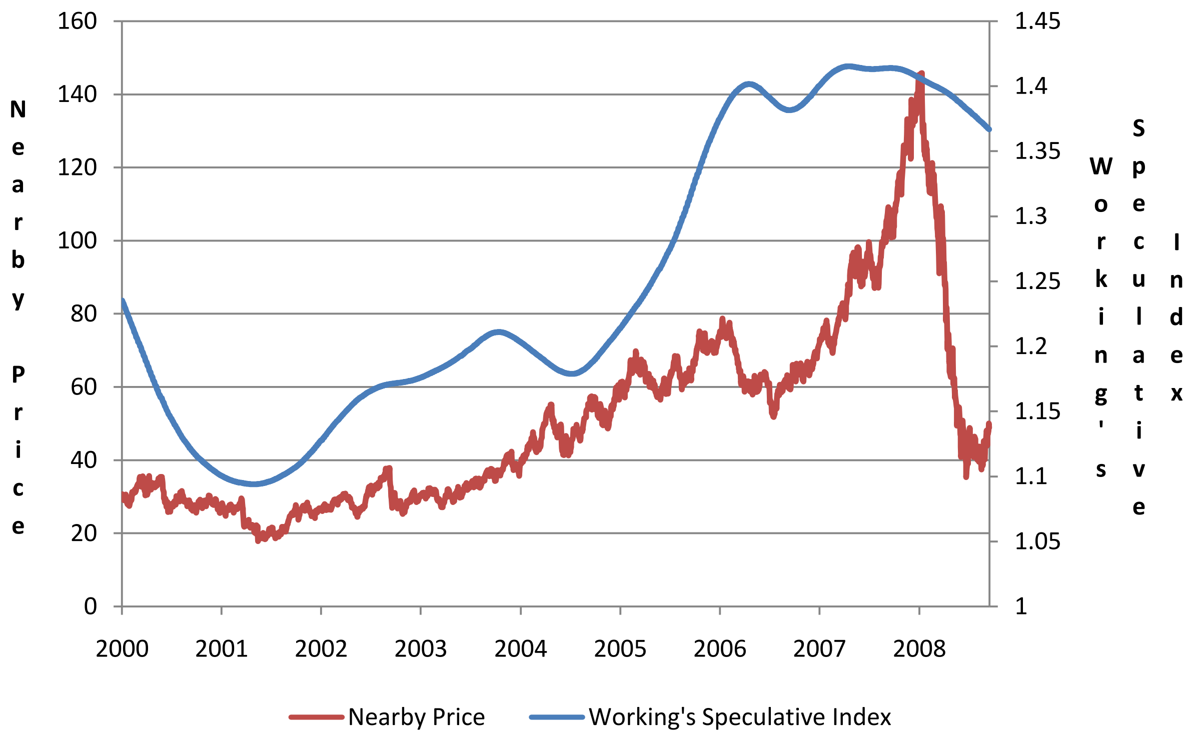


Figure 2b: Working's Speculative Index, 2000-2009 (All Maturities)

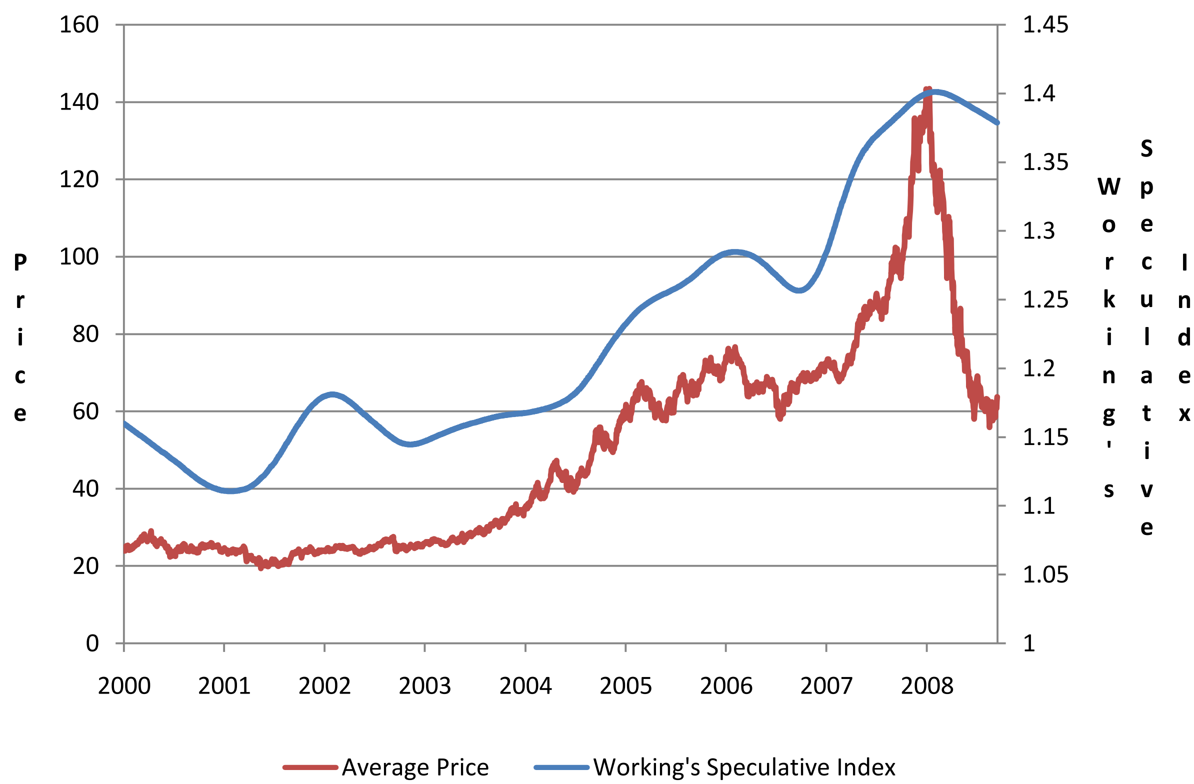


Figure 3a: Growth of Commercial Traders Open Interest

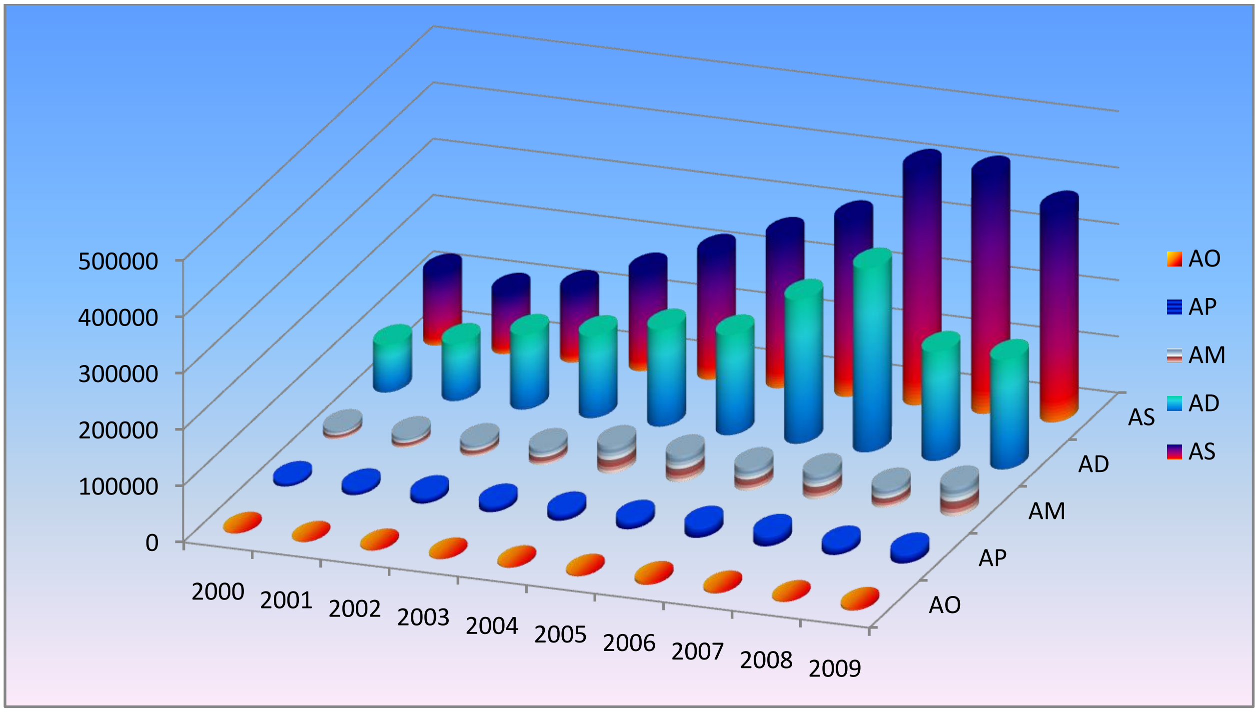
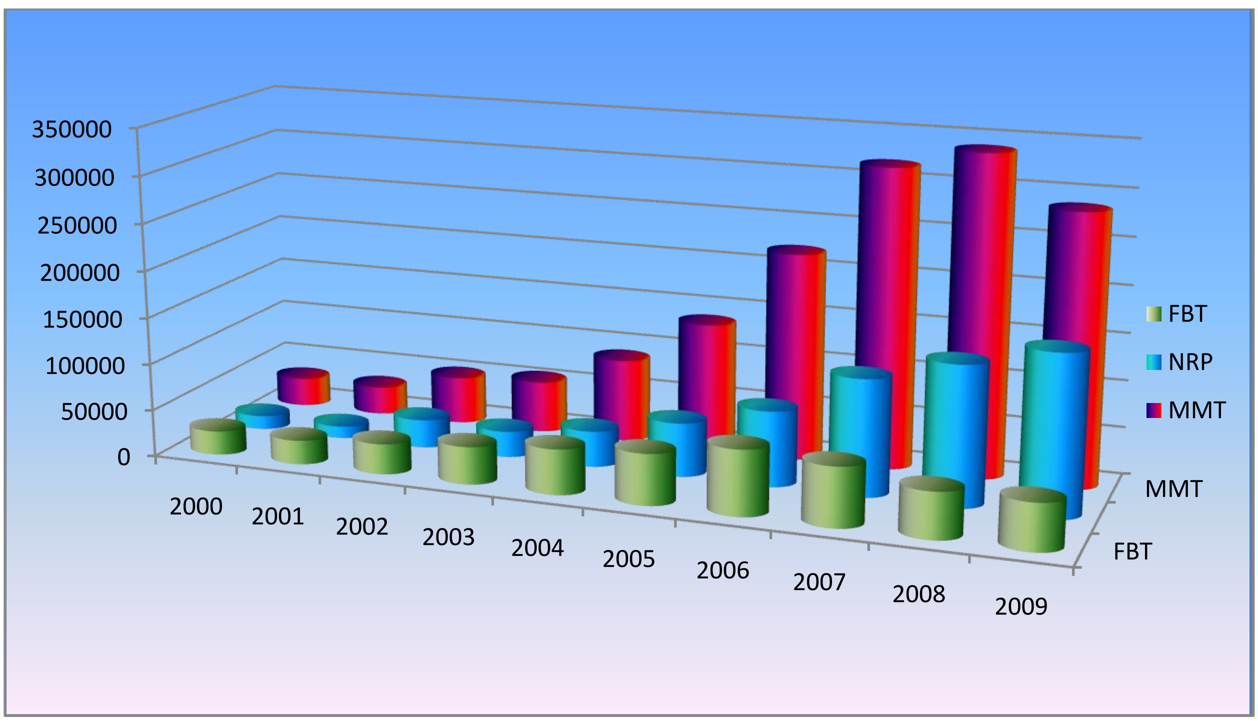


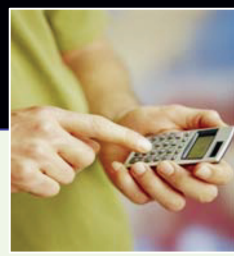
Figure 3b: Growth of Non-Commercial Traders Open Interest



Interim Report on

Crude Oil

Interagency Task Force on Commodity Markets

Interim Report of
the ITF

July 2008

July 2008

TABLE OF CONTENTS

List of Figures

Introduction

The prices of crude oil and other commodities have become a key concern of consumers, businesses, and policymakers in the United States and abroad. In light of the challenges posed by high commodity prices, several Federal agencies are engaged in the analysis of developments in commodity markets. In an effort to develop, consolidate, and disseminate this knowledge, the Commodity Futures Trading Commission (CFTC or Commission) invited staff from several Federal agencies to participate in an Interagency Task Force on Commodity Markets (Task Force or ITF). The other Task Force participants include staff from the Departments of Agriculture, Energy, and the Treasury, the Board of Governors of the Federal Reserve System, the Federal Trade Commission, and the Securities & Exchange Commission.[1] Each of these agencies brings unique experience and expertise to bear on the analysis of commodity markets.

The Task Force is chaired by CFTC staff, which has responsibility for overseeing the U.S. commodity futures and commodity options markets. The Task Force is examining conditions in the commodity markets and will report further on its work later this year. Given the intense interest generated by the recent surge in crude oil prices, the Task Force is issuing an interim staff report limited to the crude oil market. This staff report is preliminary in nature, and the Task Force will continue to study the crude oil market as part of its longer-term activities.

We hereby submit the Interagency Task Force's *Interim Report on Crude Oil*.

[1] Although the staff from these agencies participated in the Task Force, agency principals, Commissions, and Commissioners did not specifically authorize or vote to approve the findings of this interim report.

Executive Summary

In June 2008, the Commodity Futures Trading Commission (CFTC or Commission) formed an Interagency Task Force on Commodity Markets (Task Force or ITF). The Task Force draws on a broad range of government expertise on the fundamental factors and market forces affecting commodity markets. In light of the recent increases in energy prices and the resulting concerns of the public and policymakers, the Task Force has prepared this interim report on crude oil, which offers a preliminary assessment of fundamental and market factors affecting the crude oil market between January 2003 and June 2008.

The Task Force's preliminary assessment is that current oil prices and the increase in oil prices between January 2003 and June 2008 are largely due to fundamental supply and demand factors. During this same period, activity on the crude oil futures market – as measured by the number of contracts outstanding, trading activity, and the number of traders – has increased significantly. While these increases broadly coincided with the run-up in crude oil prices, the Task Force's preliminary analysis to date does not support the proposition that speculative activity has systematically driven changes in oil prices.

The world economy has expanded at its fastest pace in decades, and that strong growth has translated into substantial increases in the demand for oil, particularly from emerging market countries. On the supply side, the production of oil has responded sluggishly, compounded by production shortfalls associated with geopolitical unrest in countries with large oil reserves. As it is very difficult to rely on substitutes for oil in the short term, very large price increases have occurred as the market balances supply and demand.

If a group of market participants has systematically driven prices, detailed daily position data should show that that group's position changes preceded price changes. The Task Force's preliminary analysis, based on the evidence available to date, suggests that changes in futures market participation by speculators have not systematically preceded price changes. On the contrary, most speculative traders typically alter their positions following price changes, suggesting that they are responding to new information – just as one would expect in an efficiently operating market.

The Task Force will continue to develop its analysis of crude oil and expand its work to cover other commodities in the coming months. New data from the CFTC's Special Calls on the activities of commodity swap dealers and commodity index traders is expected to become available for review during this time. In addition, an examination of prices in other commodities is expected to further enhance understanding of commodity markets.

Fundamentals and Crude Oil Prices

On the demand side, world economic activity has expanded at close to 5 percent per year since 2004, marking the strongest performance in two decades. Between 2004 and 2007, global oil consumption grew by 3.9 percent, driven largely by rising demand in emerging markets that are both growing rapidly and shifting toward oil-intensive activities. Also, some of the fastest growing nations also rely on price subsidies that hold down the prices of oil and refined products such as gasoline, which further boosts oil consumption.

While global demand has proven strong, oil production growth has not kept pace. In the past three years, non-Organization of Petroleum Exporting Countries (OPEC) production growth has slowed to levels well below historical averages, and world surplus capacity has fallen below historical norms. Preliminary inventory data also shows that Organisation for Economic Co-operation and Development (OECD) stocks have fallen below 1996-2002 levels. Moreover, supply disruptions have adversely affected both world oil production and exports.

The imbalance between scarce supply and growing demand, and expectations that this imbalance will persist in the future, have led to upward pressure on oil prices and greater market reactions to any actual or perceived disruptions in available supply. Under such tight market conditions, it is often the case that only large price increases can re-establish equilibrium between supply and demand. Consequently, large or rapid movements in oil prices are not inconsistent with the fundamentals of supply and demand; such price movements, by themselves, do not indicate that prices have become divorced from fundamentals. Further, if speculative positions, rather than fundamentals, were pushing prices upward, then inventories would be expected to rise. To date, there is no evidence of such an accumulation; in fact, known inventory levels actually have declined.

Analysis of Crude Oil Futures Markets

Activity in crude oil futures and options contracts has been increasing since 2004. During that period, the number of contracts outstanding (known as "open interest") has more than tripled, and the number of traders has almost doubled. The fastest growth in open interest has been recorded among non-commercial traders – often called "speculators" – holding spread positions combining long positions in one month with short positions in another month. Thus, while the long positions of non-commercial traders have increased, the short positions of non-commercial traders also have increased. Additionally, although the net long positions of non-commercial traders have increased somewhat since 2004 – which some market observers have hypothesized has pushed prices up – the proportion of those positions has been relatively constant as a share of open interest over the last few years, undercutting that hypothesis.

Much of the attention related to participants in futures markets has focused on the role of commodity index investment funds and the commodity swap dealers that often act as their intermediaries. During the period studied, January 2003 through June 2008, pension funds and other investors have increasingly used index funds as vehicles to participate in commodity markets. Some observers have suggested that this rapid inflow of investments through index funds has been a cause of oil price increases. The CFTC has issued Special Calls for data about this activity, but only partial responses have been received as of the date of publication of this interim report. An analysis of the data from these Special Calls will be made available in September.

The data currently at hand – which incorporates non-public surveillance information – includes positions held by commodity swap dealers. Commodity swap dealers offer institutional investors contracts whose returns are linked to a variety of commodity indices. Broadly speaking, after netting their index fund clients' positions against the positions of their other clients, these dealers use futures contracts to hedge the risk remaining from this business. Thus, the activity of commodity index participants should become evident in the position changes of commodity swap dealers.

Non-public CFTC trading data shows that commodity swap dealers have held roughly balanced long and short positions in the crude oil market over the last year and actually held a net short position over the first five months of 2008 – that is, swap dealers' futures positions would have benefited more from price decreases than from price increases like the ones experienced in the last few months. Moreover, any upward price pressure exerted by the long positions of swap dealers' commodity index clients has largely been offset by the short positions of the dealers' other clients.

The Task Force's preliminary analysis also suggests that changes in the positions of swap dealers and non-commercial traders most often followed price changes. This result does not support the hypothesis that the activity of these groups is driving prices higher. The Task Force has found that the activity of market participants often described as "speculators" has not resulted in systematic changes in price over the last five and a half years. On the contrary, most speculative traders typically alter their positions following price changes, suggesting that they are responding to new information – just as one would expect in an efficiently operating market. In particular, the positions of hedge funds appear to have moved inversely with the preceding price changes, suggesting instead that their positions might have provided a buffer against volatility-inducing shocks.

The Task Force will continue working on the analysis of commodity markets and issue further findings later this year.[2]

[2] Matters of illegal manipulation of commodity prices are outside the scope of this interim report.

Fundamentals of Crude Oil

Background

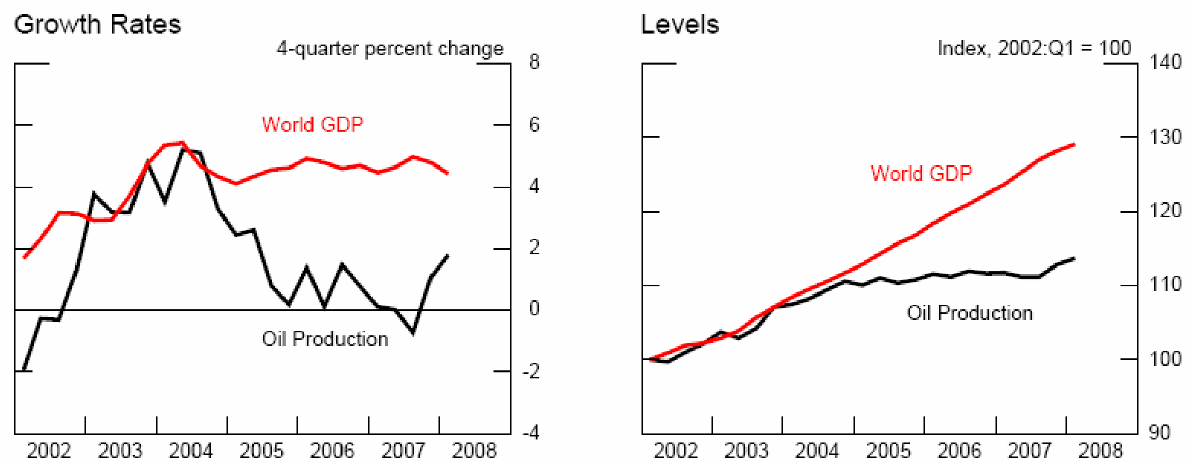
Recent crude oil price increases are an extension of oil market developments originating in the 1990s. At that time, relatively high inventories and ample surplus production capacity served to limit oil price fluctuations. When spot market prices moved up or down, futures contracts requiring delivery in distant months generally traded close to $20 per barrel, consistent with a market expectation that producers would ensure that spot prices would eventually return to that level. However, as leading OPEC members shifted toward a tight inventory policy and global oil demand recovered from the slowing effect of Asia's financial crisis, the global market balance tightened and inventories declined sharply at the beginning of the present decade. Oil prices rose to $30 per barrel in what might be seen as the first leg of the upward trend. By 2003, inventories were drawn down sufficiently such that subsequent increases in global demand stretched oil production to levels near capacity. The large, unexpected jump in world oil consumption growth in 2004, fostered by strong growth in economic activity in Asia, reduced excess production capacity significantly. Now, in mid-2008, despite high prices, world oil consumption growth remains strong, overall non-OPEC production growth continues to slow, and OPEC oil production has not grown sufficiently to fill the gap. In addition, geopolitical risks create considerable uncertainty about future supplies.

Demand

Global Economic Activity

The key driver of oil demand has been robust global economic growth, particularly in emerging market economies. As shown in Figure 1, world gross domestic product (GDP) growth (with countries weighted by oil consumption shares) has averaged close to 5 percent per year since 2004, marking the strongest performance in two decades.

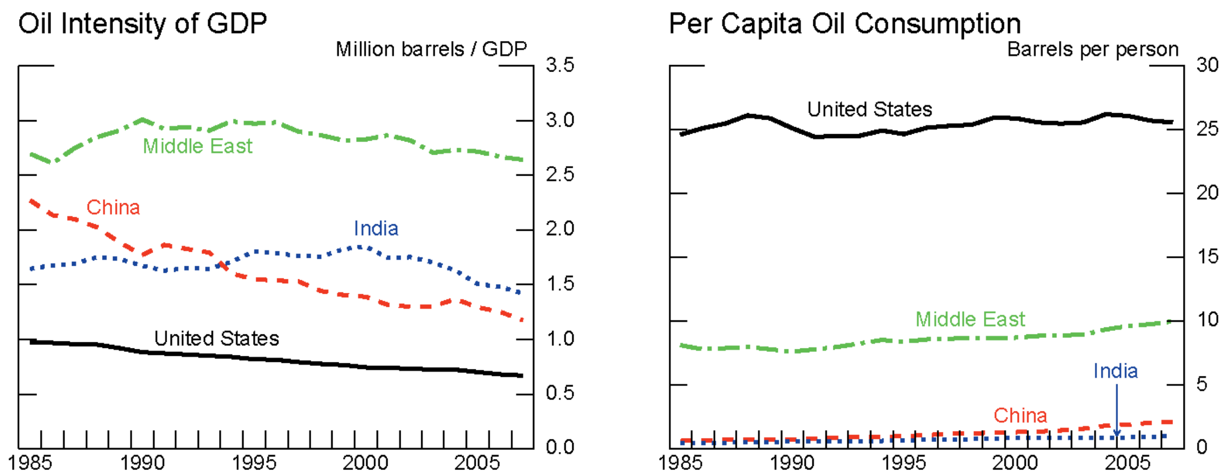
Figure 1 World GDP and Oil Production



Source: Federal Reserve Board and International Energy Agency. World GDP aggregate weighted by world oil consumption shares.

In addition to the pace of world economic activity, oil demand has been further supported by the composition of growth across countries. As shown in Figure 2, China, India, and the Middle East use substantially more oil to produce a dollar's worth of real output than the United States. These economies are among the fastest growing in the world; together they have accounted for nearly two-thirds of the rise in world oil consumption since 2004. Moreover, these economies still consume relatively little oil on a per capita basis. Over the longer term, as these economies continue to develop and incomes rise, per capita energy use is likely to increase further.

Figure 2 Oil Intensity

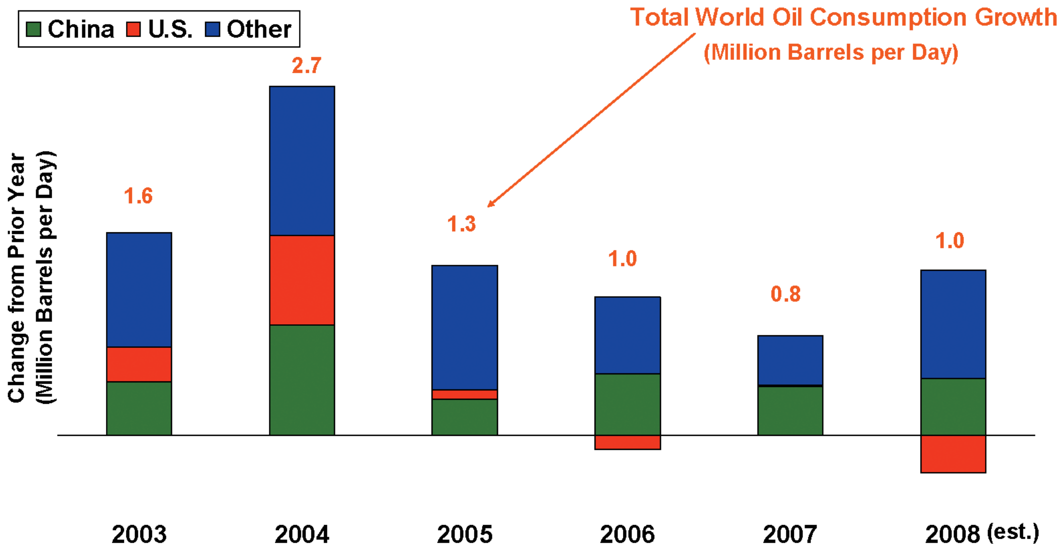


Source: International Monetary Fund and International Energy Agency. GDP is real GDP for each country in billions of 2000 U.S. dollars.

Increasing Consumption

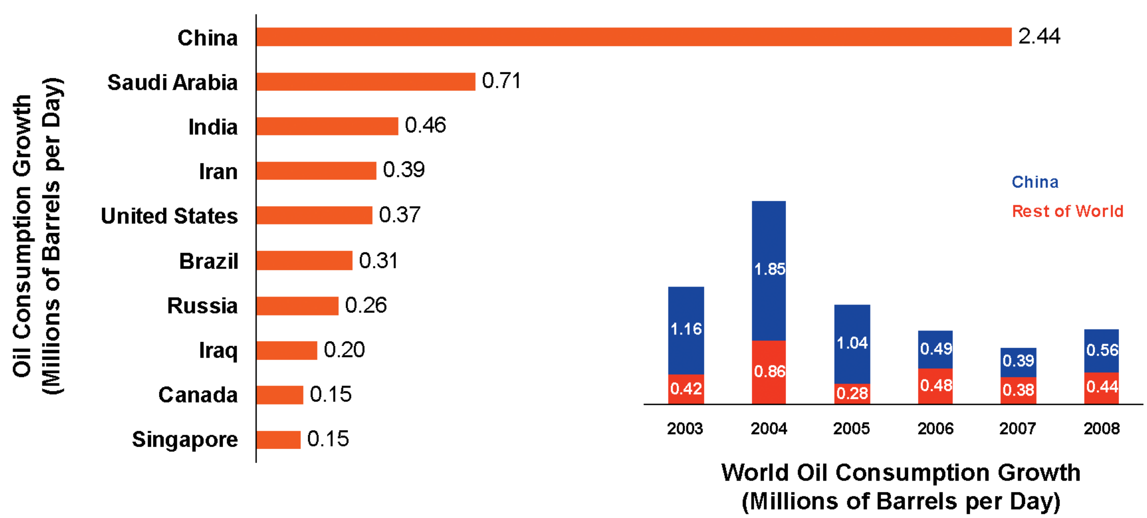
The rise in global economic activity has been accompanied by corresponding growth in world oil consumption. Since 2003, world oil consumption growth has averaged 1.8 percent per year, representing an estimated 1 million barrels per day in 2008. Non-member countries of the OECD, especially China, India, and the Middle East, represent the largest part of this growth. (Figures 3 and 4) Despite higher prices, growth in world oil consumption remains strong.

Figure 3 Annual Growth in World Oil Consumption



Source: Energy Information Administration, *Short-Term Energy Outlook June 2008*

Figure 4 Oil Consumption Growth by Country from 2003 to 2008



Source: Energy Information Administration

Price Controls and Subsidies

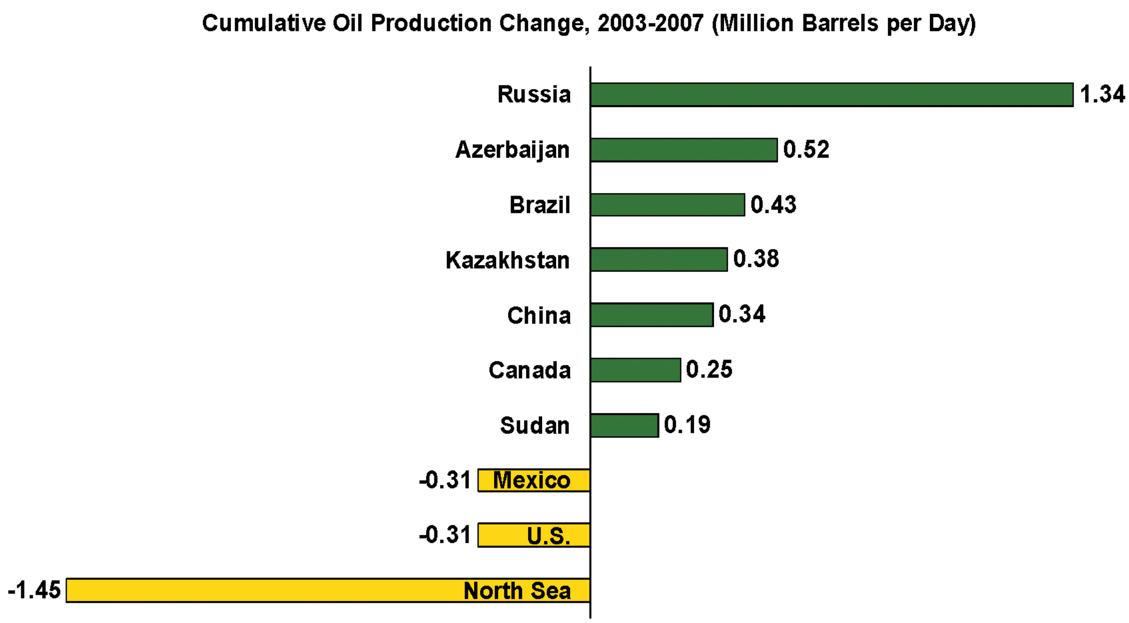
Many emerging market and developing economies use subsidies and other administrative measures to control domestic fuel prices. These administered prices are generally set below global market prices and, therefore, artificially boost the demand for oil. Indeed, essentially all of the increase in global oil consumption this year is expected to be in countries where fuel prices are subsidized and demand is not fully responsive to price signals. Price controls and subsidies interfere with the economic link between market prices and consumption.

Supply

Stagnant Production

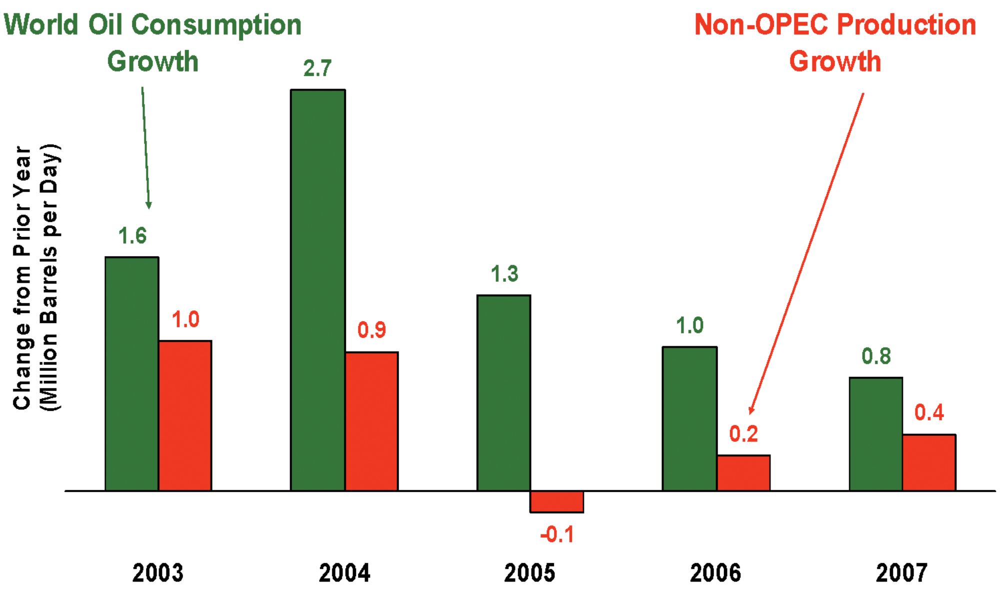
While global demand has remained strong, overall non-OPEC production growth has slowed. In the past three years, non-OPEC production growth has been well below rates seen earlier this decade. World oil consumption growth has simply outpaced non-OPEC production growth every year since 2003. This imbalance increases reliance upon OPEC production and/or inventories to fill the gap. However, since 2003, OPEC oil production has grown by only 2.4 million barrels per day while the "call on OPEC" (defined as the difference between world consumption and non-OPEC production) increased by 4.4 million barrels per day. As a result, the world oil market balance has tightened significantly. (Figures 5 and 6)

Figure 5 Non-OPEC Supply Growth



Source: Energy Information Administration, *Short-Term Energy Outlook June 2008*

Figure 6 Increasing Reliance on OPEC Production

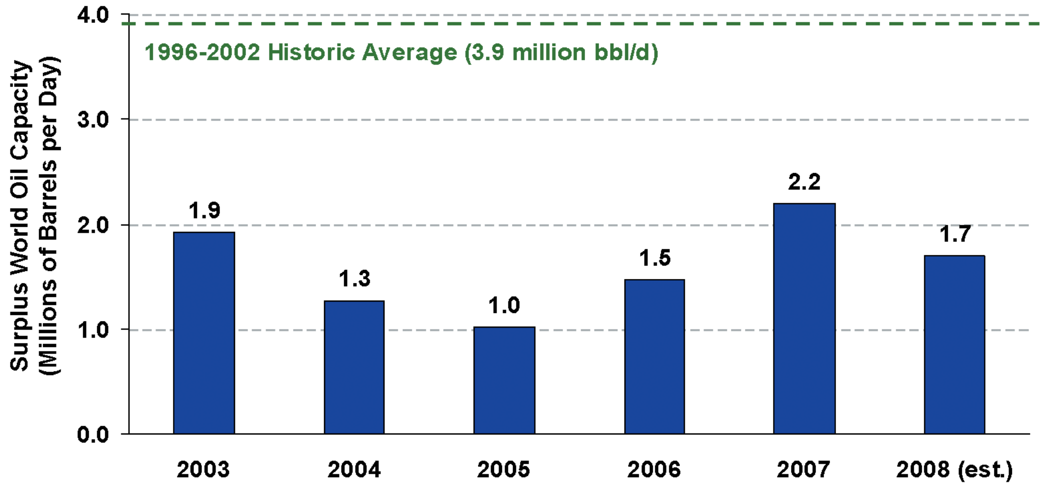


Source: Energy Information Administration, *Short-Term Energy Outlook June 2008*

Concentrated Spare Capacity

World surplus production capacity remains low (the estimated 1.35 million barrels per day in June 2008 is equivalent to less than 2 percent of consumption, an amount well below the 1996-2003 annual average of 3.9 million barrels per day). This puts upward pressure on prices and leaves world oil markets vulnerable to supply disruptions. (Figure 7) In addition, this surplus capacity is highly concentrated in a few countries, with Saudi Arabia holding almost all of this capacity. Without significant surplus capacity, market participants can no longer rely on increased production from key members of OPEC to offset supply disruptions and restore balance without the need for significant price changes (as was the case in the 1990s). The combination of these factors means that prices react strongly to actual or perceived supply disruptions.

Figure 7 Lower Surplus World Oil Production Capacity

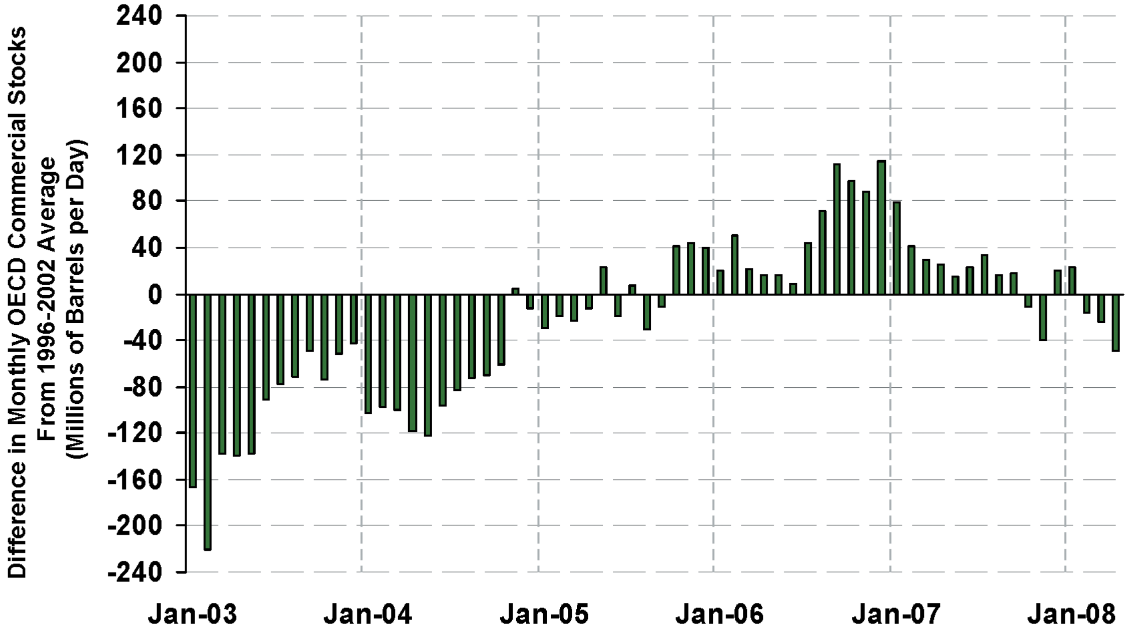


Source: Energy Information Administration, *Short-Term Energy Outlook June 2008*

Low Inventories

OECD stocks were at record lows in 2003, following a major strike by oil workers in Venezuela. (Figure 8) Preliminary OECD inventory data for the first part of 2008 shows that OECD stocks have again fallen below levels seen in 1996-2002. Because oil use has been growing over time, inventories are even tighter when considered on a "days of supply" basis (defined as dividing inventories by the level of consumption). In addition, U.S. inventories for crude oil and key petroleum products are relatively low. After remaining relatively high for much of 2006 and the first half of 2007, U.S. crude oil inventories have fallen toward the bottom end of the average range. Crude oil and petroleum product stocks in other OECD regions exhibit the same declining trend.

Figure 8 OECD Commercial Stocks



Source: Energy Information Administration, *Short-Term Energy Outlook June 2008 and* latest IEA data.

Geopolitical Uncertainty

There is currently a high degree of uncertainty in world oil markets due to fears about the adequacy of oil supplies in the future. Current world oil supplies are highly concentrated, and much of those supplies are held by nations that limit access to private investment, thereby preventing full development of production through enhanced expertise and technology. In 2007, the top 10 oil producers represented about half of total world production. In addition, geopolitical risk surrounds many of these top producers, either because of current supply disruptions (Iraq, Nigeria) or the perceived threat of a disruption (Iran, Venezuela). Finally, as noted previously, there is little surplus production capacity available to offset any disruption.

Supply disruptions are a frequent occurrence in the oil industry. During the past 24 months, there have been almost two dozen supply disruptions, lasting from a few days to many weeks, which affected world oil production and exports. These disruptions were caused by power failures, worker strikes, pipeline leaks and explosions, cyclones and hurricanes, saboteurs, and civil wars. More than half of these disruptions resulted in oil production outages exceeding 100,000 barrels per day. The most significant of these to oil markets resulted from the ongoing strife in Iraq and Nigeria. These disruptions have varied in size over time, with Iraq losing more than 500,000 barrels per day of exports in March 2008 and Nigeria reaching more than 1.4 million barrels per day of shut-in production at one point in April 2008.

Actual supply disruptions directly affect world oil markets due to a loss of physical barrels available to the market. Concern over the impact of potential supply disruptions is reinforced by the limited amount of spare production capacity available. As long as potential disruptions, either realized (as in Iraq and

Nigeria) or perceived (as in concerns about the potential loss of supply from Iran), exceed the amount of additional production capacity that can be brought online quickly, geopolitical concerns will weigh heavily on oil markets.

Price-Inelastic Supply and Demand

The current short-run demand for oil is relatively price inelastic, meaning the quantity demanded does not change much relative to price changes (it takes a very large price increase to reduce the quantity demanded significantly). In the short run, the supply of oil is inelastic as well: the quantity supplied is not responsive to changes in market price, due to low spare capacity, the inability to bring new supplies online quickly, and relatively low inventories to draw down. If both supply and demand are not very responsive to prices, it takes large price increases to return markets to equilibrium if they get out of balance temporarily.

As noted previously, world oil production has remained relatively flat in recent years as global economic growth has kept demand strong. Consequently, oil prices have risen to keep world oil consumption in line with production (the two must be equal aside from changes in inventories). As oil demand is very insensitive to moves in oil prices in the near term, the rise in oil prices has been disproportionately large in order to offset the robust, income-driven rise in demand.

An implication of these structural features of the oil market is that large and rapid movements in oil prices are not, by themselves, evidence that prices are behaving in a manner that is inconsistent with the fundamentals of demand and supply. Indeed, in such tight market conditions, relatively small changes in demand and supply should be expected to lead to large price swings. That said, there is a certain degree of uncertainty regarding the true state of market fundamentals at any point in time.

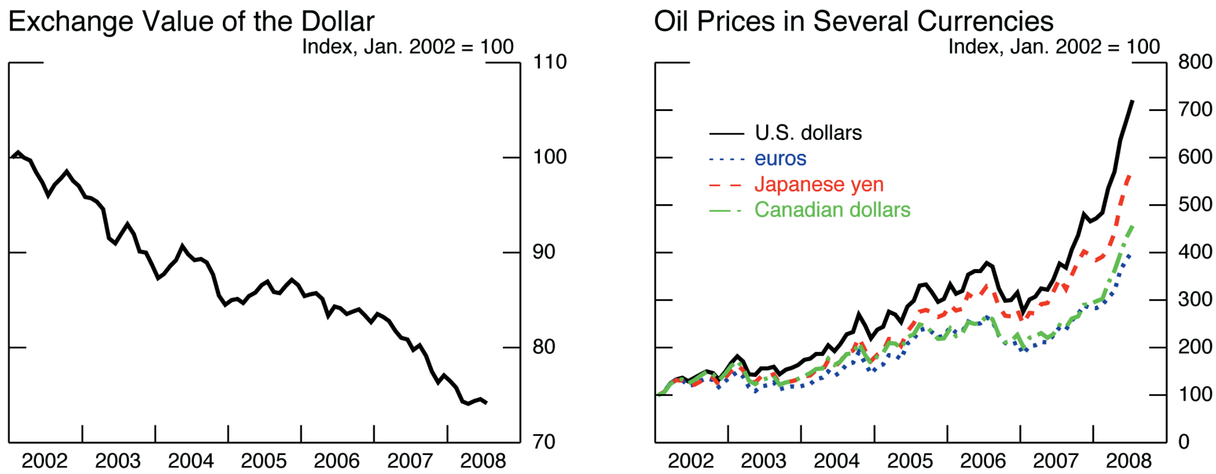
Macroeconomic Variables

Exchange Rates

The relationship between exchange rates and oil prices is complex, and the causality can run both from exchange rates to oil prices and from oil prices to exchange rates. Typically, a depreciation of the dollar would be expected to lead to a rise in the dollar price of oil. As oil is priced in dollars, a lower exchange value of the dollar reduces the foreign-currency price and thus boosts demand. To clear the market, the dollar price of oil must then rise, assuming (reasonably) that supply is not perfectly elastic.

Empirical studies do not reveal a clear, precisely estimated relationship between oil prices and the exchange value of the dollar. The available evidence suggests that oil prices respond approximately proportionately to changes in the dollar when all other economic factors are held constant. In other words, a 10 percent depreciation of the nominal, trade-weighted, multilateral exchange value of the dollar is associated with a 10 percent rise in the dollar price of oil when other factors are held constant. That finding suggests that the depreciation of the dollar since 2002 has contributed to the rise of the dollar price of oil, but can explain only a portion of the overall run-up. This point is also evident in Figure 9, which graphs the spot price of West Texas Intermediate crude oil in several currencies. Clearly, oil prices have risen sharply regardless of the currency of denomination. Moreover, from mid-March through June 2008, the dollar was stable, whereas oil prices increased appreciably.

Figure 9 Oil Prices and Exchange Rates



Source: Federal Reserve Board. The measure of the dollar is the broad nominal index, and the oil price is spot West Texas Intermediate crude oil.

An additional linkage between exchange rates and oil prices may arise through the production decisions of key oil exporters. Oil exporters suffer a decline in the purchasing power of their revenues when the dollar depreciates. To defend their international purchasing power, these producers could, in principle, seek an offsetting increase in the dollar price of oil by curtailing supply.

Shocks specific to the oil market can also feed back into exchange rates. As the United States is both a major producer and consumer of oil, increases in oil prices tend to lead to depreciations against the currencies of major oil exporters and appreciations against the currencies of major oil importers. Empirically, these bilateral exchange rate movements often tend to cancel out, resulting in little net change in the multilateral value of the dollar. During the past few years, however, the nominal value of U.S. oil imports has soared, resulting in a significantly wider trade deficit than would have otherwise occurred. This widening may have exacerbated concerns about the sustainability of the current account deficit, thereby putting downward pressure on the dollar.

Interest Rates

The relation between interest rates and oil prices can vary, as it depends on the interactions of many economic variables. A decline in interest rates by itself might be expected to raise oil prices to some extent, suggesting a negative correlation between these two variables. But if the decline in interest rates is in reaction to a downturn in economic activity, oil prices may very well fall in response to that weaker demand, resulting in a positive correlation.

One mechanism by which declines in interest rates could push up oil prices is through a reduction in the costs associated with storing oil and other commodities. An implication of this hypothesis is that inventories of oil should tend to rise when interest rates decline. Such increases, however, are not evident in the available data.

Another channel through which lower U.S. interest rates could drive up oil prices is by leading to excessively expansionary policies and faster increases in oil demand in countries that peg their currencies to or manage their currencies against the dollar. In the current setting, the stance of monetary policy in the United States, which has come in response to concerns about the domestic economic outlook, may not be appropriate for many fast-growing, commodity-intensive economies. In practice, however, much uncertainty surrounds the extent to which foreign central banks have matched U.S. monetary policy moves, the effect of this on foreign economic growth, and its ultimate influence on commodity prices.

Commodity Futures Markets

The Role of Commodity Futures Markets

Futures Contract Design, Risk Management, and Price Discovery[3]

A futures contract is an agreement between two parties to buy and sell a given amount of a commodity at an agreed upon date in the future, at an agreed upon price and at a given location. For example, the New York Mercantile Exchange (NYMEX) West Texas Intermediate (WTI) December 2008 oil contract is an agreement to deliver 1000 barrels (42 thousand gallons) of oil at Cushing, Oklahoma during December 2008. The buyer (or long trader) and the seller (or short trader) agree to a price when they enter into the contract. Unless offset, these contracts require their counterparties to deliver or to take physical delivery of a commodity.[4] A party whose contract remains open at its expiration date is obligated to make or take delivery as promised.

Futures contracts are instruments primarily designed to manage risk - they are identical in all aspects except for the contracted price; they are generally traded on exchanges; cleared through designated clearinghouses; and often may be settled in cash rather than requiring physical delivery. Due to their standardization, crude oil futures contracts are not generally suited to allocate the physical commodity. For example, to serve a mainly allocative role, crude oil futures contracts would need to offer multiple locations for physical delivery. In fact, between 2003 and May 2008, only about 2 percent of oil futures contracts resulted in physical delivery.

Because futures contracts are standardized in all respects other than price, futures markets are ideal for aggregating a multiplicity of opinions about the expected price of a commodity at different points in time. It is often easier for a common view on an expected price to emerge at a futures exchange than among dispersed producers and consumers of a physical (cash) commodity. For that reason, futures markets are an important source of price information - prices are often said to be "discovered" in futures markets and then communicated to participants in certain cash markets.

The price discovery function of futures markets is extremely valuable in terms of planning business activities and for allocating commodity price risk. The availability of publicly-observed futures prices for several years into the future makes it possible to recognize, plan, and finance needed adjustments in supply and demand early on. This, in turn, may help reduce price volatility. For example, price volatility is generally higher in markets without a successful futures contract, such as those for fertilizers, coal, tea, and onions. For example, while onion futures contracts are explicitly banned by law, it has been reported that cash prices for onions rose 400 percent between October 2006 and April 2007, fell 96 percent by March 2008, and then rebounded 300 percent by April 2008.

Hedging and Speculation

The distinction between hedging and speculation in futures markets is less clear than it may appear. Traditionally, those with a commercial interest in or an exposure to a physical commodity have been called hedgers, while those without such an exposure have been called speculators. In practice, however,

[3] *Glossary of Futures Markets Terms* is provided at the end of this report.
[4] Not all futures contracts require physical delivery.

hedgers may be "taking a view" on the price of a commodity, and even those who are not participating in the futures market despite having an exposure to the commodity could be considered speculators.

Traditional speculators enter into futures contracts with the intention of reversing their positions before they would be required to deliver (short positions) or to accept physical delivery (long positions) of a commodity. As such, speculators serve important market functions – immediacy of execution, liquidity, and information aggregation.

Traditional speculators could further be differentiated depending on the time horizons during which they operate. Speculators known as scalpers or market makers operate at the shortest time horizon – sometimes trading within seconds. These traders typically do not trade with a view as to where prices are going. Instead, they provide immediacy of execution to others wishing to trade. That is, they "make markets" by standing ready to buy or sell at a moment's notice. These market makers will usually offset their positions soon after entering into them. The goal of a market maker is to buy contracts at slightly lower prices than the current market price and sell them at slightly higher prices, perhaps at only a fraction of a cent profit on each contract. By trading hundreds or even thousands of contacts a day, skilled market makers can earn a profit. Absent a market maker, a market participant would have to wait until the arrival of another party with an opposite trading interest.

Other types of speculators take longer term positions based on their view of where prices may be headed. These speculators may anticipate price trends lasting from minutes or hours to days, weeks or months and take positions accordingly. At the monthly horizon, these speculators often trade in the futures markets with spread positions—taking long positions in one month while taking short positions in another. Through their efforts to gather information on underlying commodities, the activity of these traders serves to bring information to the markets and aid in price discovery. These speculators are also important to the market in that they often supply overall liquidity to hedgers in futures market.

While hedgers are not generally associated with price discovery activities, these commercial interests often do play an important price discovery role. In essence, futures prices are a consensus of the opinions of those who enter the market. Moreover, the actions of those who choose not to enter the futures market are also quite important for price discovery. For example, a commercial trader holding physical inventory, but choosing not to hedge this inventory with a short position in the futures market, will withhold a downward pressure on the price.

Futures markets are not the only way for traders to manage exposure to commodities. Crude oil options on futures can also be used to manage crude oil exposures. In fact, traders who combine options and futures positions can speculate on price ranges and volatility changes in addition to the direction of expected futures price changes.

A robust over-the-counter (OTC) market exists to trade oil contracts as well. Activities that occur in the OTC market can affect U.S. futures markets as well. Intermediaries in the OTC market often use futures contracts to manage the price exposures inherent in their OTC activities, for instance. Commodity swap dealers, in particular, offer complex and tailored swap contracts to clients in the OTC markets. As intermediaries, these swap dealers can often offset the long positions of one client with the short positions of another client. Where mismatches exist, however, the swap dealer may be exposed to price risk as the counterparty to an unmatched trade. In these instances, swap dealers increasingly look to the futures markets to manage this risk. Indeed, for this reason, the CFTC has long considered swap dealers as hedgers in the futures markets.

Publicly Available Information about U.S. Futures Markets

To provide the public with information on the activity of traders in the futures and options markets, the CFTC publishes a weekly Commitments of Traders (COT) report. The report is released every Friday at 3:30 p.m. Eastern time and contains a summary of traders' positions as of the close of business on the previous Tuesday for each market in which 20 or more traders hold positions equal to or above the large trader reporting levels established by the CFTC.[5]

The summary of market activity contained in the weekly COT reports is available in a variety of formats—*i.e.*, long and short format, as well as in futures-only and futures-and-options-combined format—and are available on the CFTC's website. Beginning in 2007, the CFTC also began publishing a supplemental report for selected agricultural markets showing all the information in the short format report plus the positions of traders classified as "index traders." These supplemental reports have been produced specifically to shed light on index trader activity in the U.S. futures markets. The CFTC recognizes the value of increased transparency as financial entities increasingly participate in commodity markets.[6]

The information regarding the reportable positions of traders contained in the COT reports is drawn from the reports that the CFTC receives daily from clearing members, futures commission merchants, and foreign brokers. If, at the daily market close, a reporting firm has a trader with a position at or above the CFTC's reporting level in any single futures month or option expiration, the firm reports that trader's entire position in all futures and options expiration months in that commodity, regardless of size. The aggregate of all traders' positions reported to the CFTC usually represents 70 to 90 percent of the total open interest in any given market. From time to time, the CFTC will raise or lower the reporting levels in specific markets to strike a balance between collecting sufficient information to oversee the markets and minimizing the reporting burden on the futures industry. During the past five years, the COT reports for crude oil capture well over 90 percent of total open interest.

When an individual reportable trader is identified to the CFTC, the trader is classified either as "commercial" or "non-commercial." All of a trader's reported futures positions in a commodity are classified as commercial if the trader uses futures contracts in that particular commodity for hedging as defined in CFTC regulations. Generally, this definition reflects a matching of a futures position with a commercial market risk and does not consider the motivation for entering into a hedge. A trading entity generally gets classified as a "commercial" trader by filing a statement with the CFTC, on a standard reporting form, that it is commercially "…engaged in business activities hedged by the use of the futures or option markets." To ensure that traders are classified with accuracy and consistency, CFTC staff may exercise judgment in re-classifying a trader if it has additional information about the trader's use of the markets.[7]

---

5 Reporting levels can be found in CFTC regulations and can be accessed from the CFTC's website, www.cftc.gov.

6 For more information on the CFTC's Supplemental report see, "Commodity Futures Trading Commission: Commission Actions in Response to the 'Comprehensive Review of the Commitments of Traders Reporting Program' (June 21, 2006)," available at the CFTC's website, www.cftc.gov.

7 The analysis in this report is based on data updated through July 18, 2008.

A trader may be classified as a commercial trader in some commodities and as a non-commercial trader in other commodities. A single trading entity cannot be classified as both a commercial and non-commercial trader in the same commodity. Nonetheless, a multi-functional organization that has more than one trading entity may have each trading entity classified separately in a commodity. For example, a financial organization trading financial futures may have a banking entity whose positions are classified as commercial and have a separate money-management entity whose position are classified as non-commercial.

In classifying traders as commercial or non-commercial rather than hedgers and speculators, the CFTC recognizes that the ultimate motivations for trading futures by commercial and non-commercial traders cannot be observed. That is, while a commercial trader may be matching a futures position against a cash market price risk, it is not known whether such a trader is doing so on a routine basis in order to minimize ongoing price risks or doing so selectively based on specific market expectations. Thus, some of the trading information captured by the commercial trading category may reflect activity that could be characterized more as speculative rather than hedging.

Analysis of Crude Oil Futures Markets[8]

Broad Trends in the Participant Structure of Crude Oil Futures Markets

According to the publicly-available Commitments of Traders (COT) reports, activity in the West Texas Intermediate (WTI) light sweet crude oil contracts has grown markedly since 2000. In the last three and a half years alone, open interest across all available contract maturities (the number of contracts open at the end of each day) in WTI futures and futures-equivalent (or "adjusted") option contracts traded on the New York Mercantile Exchange (NYMEX) has more than tripled from around 900,000 contracts in January 2004 to more than 2.9 million contracts in June 2008. During the same period, the number of large traders has also grown – almost doubling since January 2004, from approximately 220 to just under 400 reporting traders. These figures speak to the competitiveness and depth of the crude oil futures markets in the U.S.

The COT reports also present the breakdown of the overall open interest between commercial and non-commercial traders grouped into long, short, and spread positions. While all types of positions have grown during the last three and a half years, the COT data suggests that it is the spread positions of non-commercial traders that have had the fastest growth rate. While overall open interest has tripled since 2004, non-commercial spread positions have increased six-fold. Notably, spread positions involve long positions in one month combined with short positions in another month so that spread traders are speculating on differences between futures prices in different months rather than the overall price level of crude oil.

Since 2004, both the long and short positions of non-commercial traders have increased. Over that time period, the positions of non-commercial traders have been net long and have also increased; however, the proportion of those positions has been relatively constant as a share of open interest over the last few

[8] This section largely summarizes findings in an upcoming CFTC research paper analyzing changes in the level and composition of end-of-day open interest in the U.S. crude oil futures market. See Büyükşahin, Haigh, Harris, Overdahl and Robe: "Market Growth and Trader Participation in Futures Markets," CFTC – Office of the Chief Economist Working Paper, forthcoming, August 2008.

years, undercutting the hypothesis that an increase in the net long positions by non-commercial traders has pushed prices up recently.

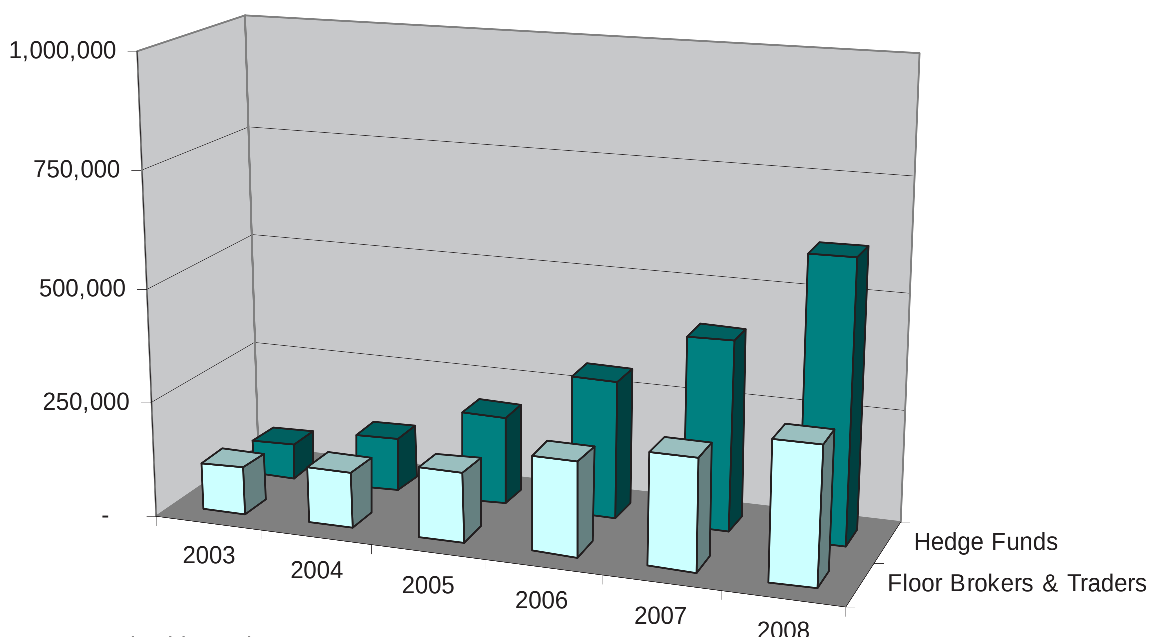
Detailed Structure of Crude Oil Futures Markets

Whereas the publicly available data only identifies "commercial" and "non-commercial" categories of participants in the crude oil futures market, the COT report is built upon confidential CFTC data collected for market surveillance purposes that allows for a more precise categorization.

For both analytical and presentational purposes, this confidential data was aggregated into broad sub-categories. Sub-categories for *commercial* participants include commercial producers, commercial manufacturers, commercial dealers, and swap dealers. Sub-categories for *non-commercial* participants include hedge funds and floor brokers and traders. These six commercial and non-commercial sub-categories account for approximately 80 percent of open interest in the crude oil futures market.

Figures 10 and 11 show that the increases in both commercial and non-commercial activity, as previously summarized in publicly available COT data, are broad-based. Among the non-commercial participants, both hedge funds and floor brokers and traders exhibit robust growth in open interest.

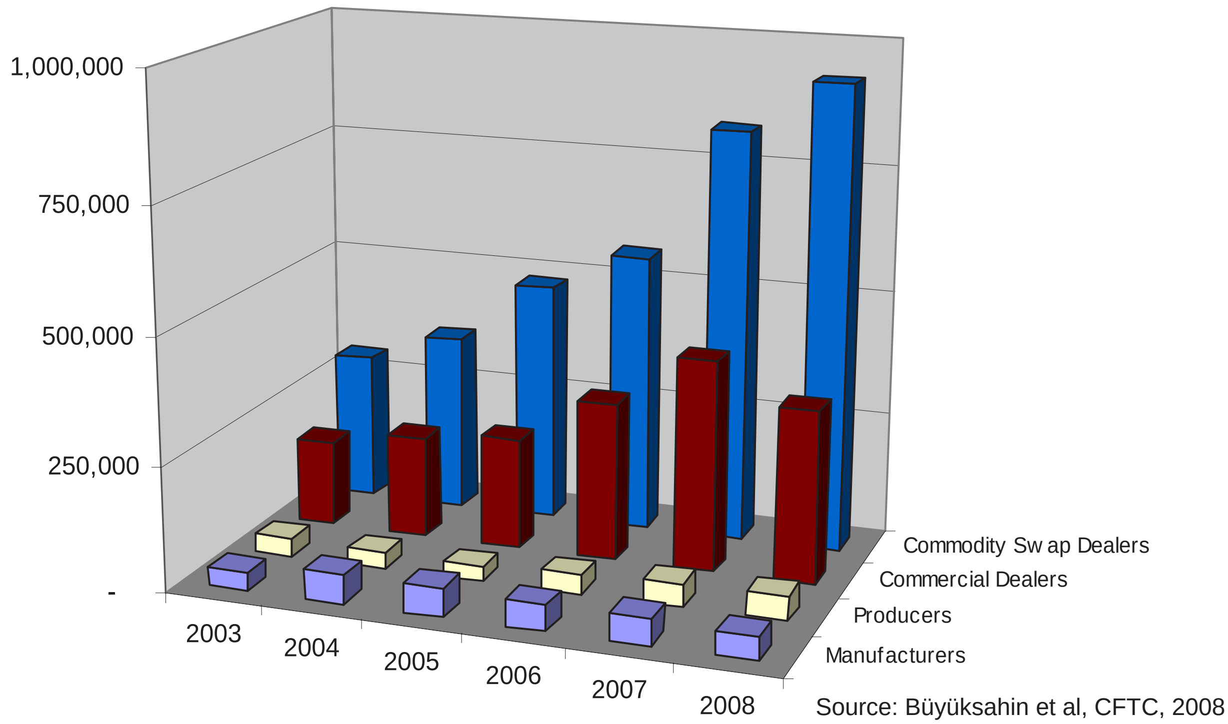
Figure 10 WTI Average Open Interest by Non-Commerical Participants, 2003-2008



Source: Büyüksahin et al, CFTC, 2008

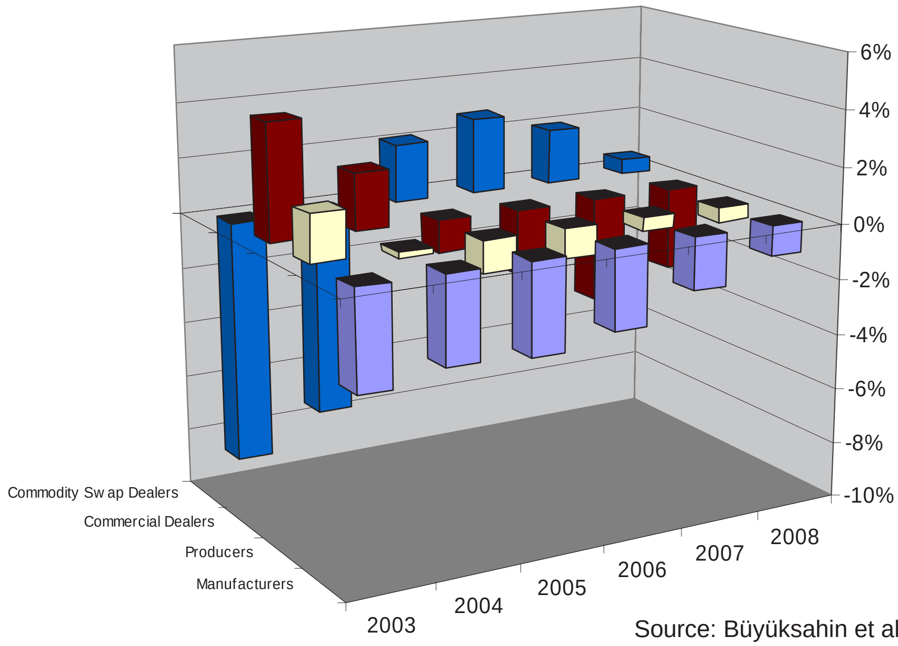
Among commercial traders, much of the growth in open interest comes from greater activity by two categories – commodity swap dealers and commercial dealers. While commercial dealers utilize futures trading to manage price risk for the purchase and sale of physical commodities, commodity swap dealers use futures markets to manage price risk stemming from their OTC swap business (as discussed previously) and also to handle the majority of commodity index trades in the futures markets. To improve market transparency, in June 2008, the CFTC issued a Special Call for, among other things, disaggregated information concerning OTC swaps from swap dealers and commodity index traders.

Figure 11 WTI Average Open Interest by Commercial Participants, 2003-2008



Commodity index funds have grown significantly during the past few years, bringing significant long positions to commodity markets. In the futures markets, these funds have typically been long-only funds, buying near-term futures contracts and rolling their positions into more distant months as the delivery month approaches. Commodity index funds are often utilized by pension funds and other large institutions that seek commodity exposure to diversify existing portfolios of stocks and bonds and this exposure is provided by swap dealers. Although commodity swap dealers' gross positions have grown significantly, swap dealers' *net* positions decreased substantially between 2006 and June 2008. (Figure 12) This suggests that flows from commodity index funds have been offset by other swap dealer activity and thus have not necessarily contributed to the recent price increases in crude oil.

Figure 12 WTI Net Positions of Commercial Participants, January 2003 to June 2008



Source: Büyüksahin et al, CFTC, 2008

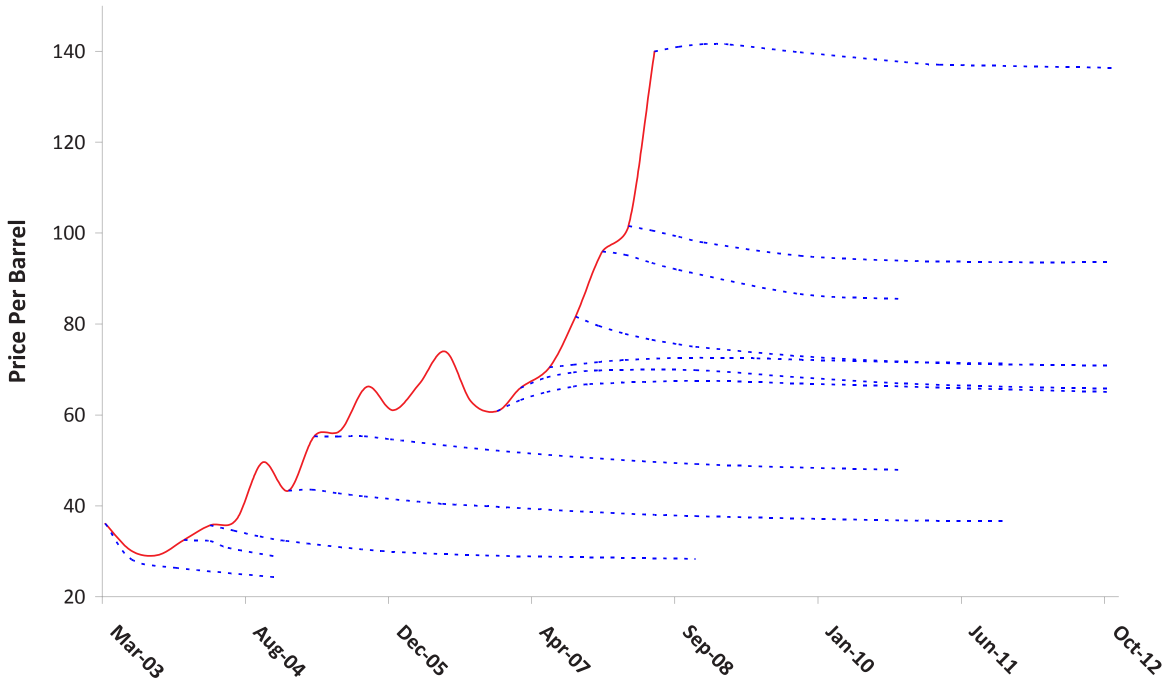
Across all maturities, the aggregate position of swap dealers in WTI crude oil futures contracts was only marginally net long as of the end of June 2008 and was *net short* on average during the first five months of 2008. This means that swap dealers' futures positions, on balance, were poised to benefit more from a fall in crude oil prices than from a rise in crude oil prices.

Term Structure of Futures Prices

The term structure of futures prices depicts a series of prices for contracts that mature at given dates in the future. It is similar to a yield curve for Treasury bonds in the way information is both presented and interpreted. Futures are said to be in "contango" when prices rise with maturity and in "backwardation" when prices fall with maturity. Over time, the whole term structure may shift upward or downward, as well as rotate.

Figure 13 presents a time series of the term structure of crude oil futures prices between March 2004 and May 2008. The solid red line depicts the evolution of the cash (spot) price of crude oil, while each dashed curves shows the terms structure of crude oil futures prices at selected points in time.

Figure 13 Term Structure of Crude Oil Prices

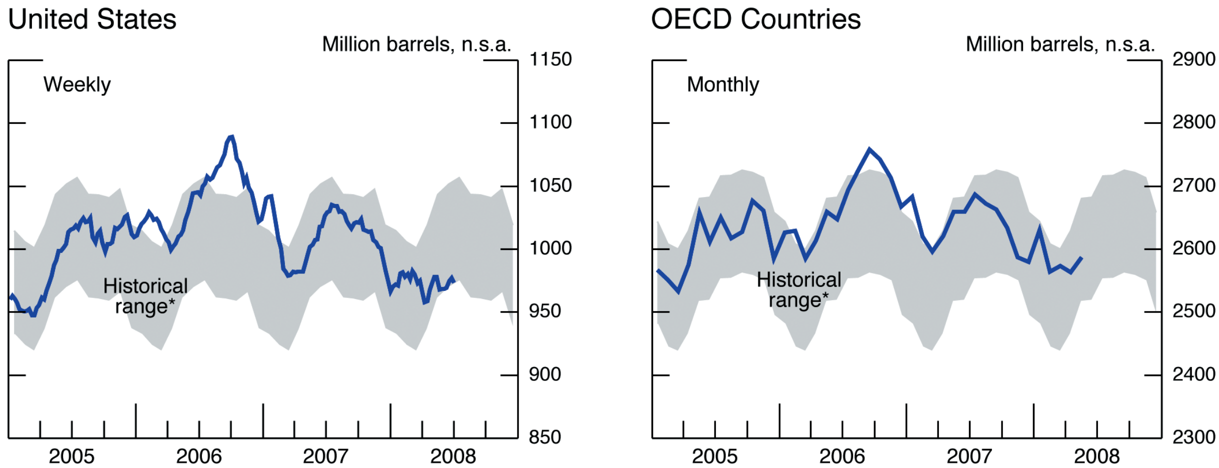


Source: Energy Information Administration and the Commodity Futures Trading Commission. Prices for futures contracts shown are for liquid markets (1000 or more contracts).

According to Figure 13, during the last four years, the term structure has been steadily shifting upward. With a few exceptions, futures prices have been mostly in backwardation, that is, distant prices have been lower than near-term prices. The shape of the term structure provides information about inventories to market participants. Expectations of higher prices in the future are generally viewed as a signal to build up physical inventories.

Crude oil inventories can also shed light on whether the price run-up depicted in Figure 13 reflects mostly fundamental supply and demand factors. Artificially high prices will create an imbalance between supply and demand that should lead to inventory accumulation. However, as shown in Figure 14, inventories of crude oil and petroleum products in the United States and in OECD countries have generally declined over the past year. Based on these inventory figures, current prices, although high, are not prompting the inventory accumulation that would be associated with artificially high prices.

Figure 14 Private Crude Oil and Petroleum Product Inventories



Source: Energy Information Administration of the U.S. Department of Energy and International Energy Agency.
*5-year average level +/- 1 standard deviation.

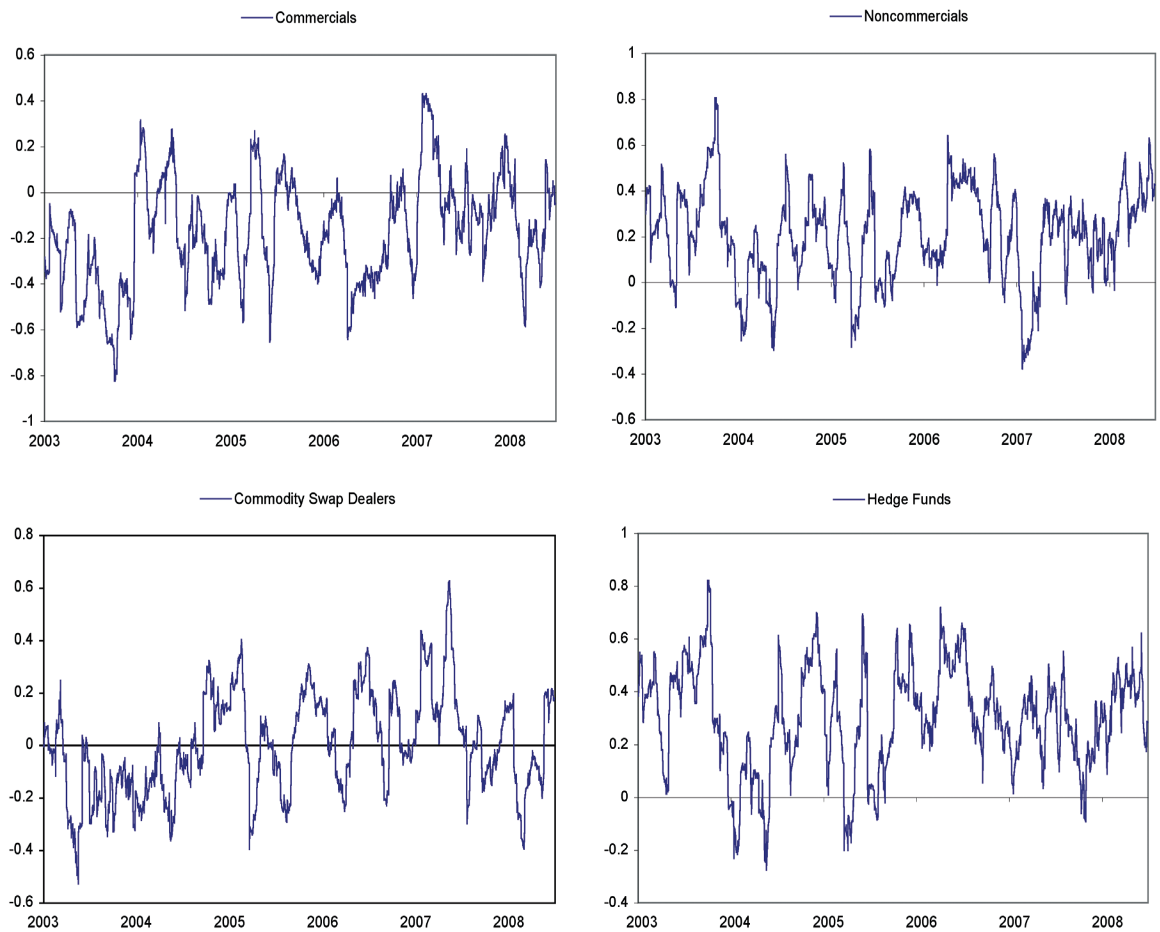
Speculators and Market Prices: Assessing Contemporaneous Relations

Correlations measure the strength and direction of a statistical relation between two variables. If changes in positions from one day to the next of any category of traders are associated with daily changes in prices, then a pattern in contemporaneous correlations should emerge. Figure 15 presents a time series of contemporaneous correlations between daily front month crude oil futures prices and daily net position changes of different trader categories.[9]

According to the top half of Figure 15, during the past five and a half years, changes in commercial traders' net positions have been largely negatively correlated with crude oil price changes (meaning that position changes have moved in the opposite direction from price changes), albeit with a high degree of volatility over time. Non-commercial position changes, on the other hand, have been generally positively correlated with price changes (meaning that position changes have moved in the same direction as price changes).

[9] Correlations displayed here represent the 30-day historical moving average correlations of position changes (by trader category) with price changes.

Figure 15 Correlations between Changes in Prices and Changes in Net Positions



Source: Commodity Futures Trading Commission

The bottom half of Figure 15 presents correlations for the largest two sub-categories of non-commercial and commercial traders – hedge funds and swap dealers. Correlations between hedge fund position changes and price changes (bottom right panel) largely mirror those of non-commercial traders in general (top right panel). In contrast, swap dealer correlations (bottom left panel) are significantly different, centering around zero during the past five and a half years.

According to the above analysis, between 2003 and 2008, the correlations between position changes and price changes tend to be quite variable. While it is true that the positions of non-commercial traders in general, and hedge funds in particular, often move in the same direction as prices, these correlations, standing alone, do not provide definitive information about causation. Thus, further assessment of the dynamic relations between position changes and price changes is warranted.

Speculators and Market Prices: Assessing Dynamic Relations

Proving causation between positions changes and market prices is a difficult task. A formal way to analyze the interaction between daily price changes and position changes is to examine directly whether various groups of traders change positions in advance of price changes.[10]

Intuitively, in order to realize gains from price changes, positions must be established prior to those price changes. Prices then may respond to those positions, or more precisely, the signal conveyed on establishing those positions. If specific trader categories were systematically establishing positions in advance of profitable price movements, then a pattern of position changes preceding price changes would emerge. Conversely, evidence of price changes leading position changes would suggest that some market participants actively adjust their positions to reflect new information. Price changes that systematically precede position changes indicate reactive behavior by a particular trading group.

Figure 16 displays the analysis of daily price changes and position changes by various trader groups and combinations of trader groups between January 2003 and June 2008. Over the full time period, there is little evidence that daily position changes by any of the trader sub-categories systematically precede price changes. This result holds for all potential categories of speculators—for non-commercial traders in total, for hedge funds and swap dealers individually, and for the positions of non-commercial traders combined with swap dealers.

This result is to be expected in a well-functioning market. In some circumstances, changes in positions of commercial participants (excluding swap dealers) occasionally have an impact on price changes (as they bring valuable information into the market), but there is no systematic evidence that changes in net positions of commercial traders systematically precede price changes. This result holds for all net position changes of commercial participants in the aggregate and for net position changes of manufacturers, producers, and commercial dealers. This result also holds for all net position changes of swap dealers.

In fact, many trader groups are shown to adjust their positions in response to price changes over the full sample period, including commercial traders in the aggregate and manufacturers, commercial dealers, producers, and hedge funds individually. A reaction in the positive direction indicates that trader positions increase (decrease) following a price increase (decrease) on the previous day. A reaction in the negative direction indicates that trader positions decrease (increase) following a price increase (decrease) on the previous day.

[10] The formal tests employed here are known as Granger Causality tests. A technical description of the tests is given in the Appendix. Granger Causality tests were performed for different trader categories, over different holding periods, for different sample periods, in one and both directions. Trading activity in the nearby crude-oil contract averages about 50 percent of all trading activity and is a significant proportion of all open positions ranging from 18 to 30 percent of total open interest. Position changes are defined as changes in aggregated futures plus delta-adjusted options positions. Note that Granger Causality tests do not prove a causal relation between variables, only a statistical probability that, over a long enough period of time, one variable leads another.

Figure 16 Granger Causality Tests relating Daily Position Changes to Price Changes in the NYMEX WTI Crude Oil Futures Contract from January 2000 to June 2008

Trader Classification		Hypothesized Direction of Causality					
		Price Changes lead Position Changes			**Position Changes lead Price Changes**		
		Direction	Significant?	P Value	Direction	Significant?	P Value
All Commercials (includes Manufacturers, Commercial Dealers, Producers, Other Commercial Traders, and Swap Dealers)		+	**Yes**	**0.028**	.	*No*	*0.896*
	Manufacturers	+	**Yes**	**0.048**	.	*No*	*0.191*
	Commercial Dealers	+	**Yes**	**0.040**	.	*No*	*0.908*
	Producers	+	**Yes**	**0.032**	.	*No*	*0.449*
	Other Commercial Traders	.	*No*	*0.918*	.	*No*	*0.391*
	Swap Dealer	.	*No*	**0.114**	.	*No*	*0.832*
All Non-Commercials (includes Hedge Funds, Floor Brokers & Traders)		.	*No*	*0.062*	.	*No*	*0.764*
	Hedge Funds	-	**Yes**	**0.003**	.	*No*	*0.585*
	Floor Brokers & Traders	.	*No*	*0.741*	.	*No*	*0.494*
All Non-Commercials combined with Swap Dealers		.	*No*	0.062	.	*No*	*0.947*

Source: Commodity Futures Trading Commission

These results are representative and have been subject to a variety of robustness checks. Importantly, the results remain qualitatively similar during the most recent price run-up between January 2006 and June 2008. In addition, tests uncover no evidence that position changes by trader categories that might be deemed speculative are systematically leading price changes over 2-, 3-, 4- and 5-day intervals.

While these statistical tests present the most complete examination to date of the relation between position changes and price changes, they – like all statistical tests – have some limitations. First, the analysis was performed for trader groups rather than individual traders. Consequently, these tests would not be able to detect if the positions of some traders within a trading category have much greater influence over prices than the positions of other traders in that category. Second, the tests utilize end of day position data. Thus, the tests may not capture any intraday position-price relationships. Finally, the tests were performed on aggregated net position changes in the nearby contracts alone (defining nearby as the futures contract with the largest open interest). As a result, the tests do not reflect a systematic effect of position changes at different maturities on either the prices of the nearby futures contract or on the whole term structure of futures prices.

That said, if the actions of particular groups of traders had systematically driven the recent oil price increases, the tests performed should have made it quite apparent. Again, it is useful to note that while the tests do not find that changes in daily positions systematically lead changes in prices, such a finding would not necessarily imply that position changes were responsible for the price changes. Nevertheless, the lack of significant position changes leading price changes is informative.

Taken as a whole, these statistical correlations and tests are consistent with the view that current oil prices are being driven by fundamental supply and demand factors.

Concluding Remarks

In this interim report, the Interagency Task Force on Commodity Markets examined both fundamental factors and trading activity in the crude oil futures market during the period January 2003 through June 2008.

Fundamentals have changed in important ways during the past few years. Demand for oil has shifted upward, reflecting strong economic growth in commodity-intensive, emerging market economies, notably China, India and the Middle East. Some nations provide subsidies that hold down fuel prices, thereby further boosting oil consumption. At the same time, supply has not kept pace. World oil production has increased only slightly over the past few years. Consequently, oil prices have risen to keep world oil consumption in line with production (the two must be equal aside from changes in inventories). As oil demand is very insensitive to moves in oil prices in the near term, the rise in oil prices has been disproportionately large in order to offset the robust, income-driven rise in demand. In addition, the decline in the foreign exchange value of the dollar also has contributed somewhat to the increase in the dollar price of oil.

These new demand and supply realities have contributed to an increased interest to participate in futures markets. Commercial entities seeking to avoid exposure to changes in the prices of crude oil they will purchase or sell are motivated to establish hedges. In addition, some participants perceive holding long crude oil futures positions as offering protection from further declines in the dollar. Still others utilize futures positions to ameliorate risk from their other portfolio holdings.

A robust increase in trading activity in the crude oil futures market had largely occurred during the same time that the price of crude oil was rising. This prompted a need to examine if the behavior of some market participants had a possible impact on the price of crude oil. This study examined whether there is any statistically significant evidence that the trading activity of commercial and non-commercial traders and their sub-categories—commercial producers, commercial manufacturers, commercial dealers, swap dealers, hedge funds, and floor brokers and traders—had a systematic influence on the price of crude oil.

To date, there is no statistically significant evidence that the position changes of any category or sub-category of traders systematically affect prices. This is to be expected in well-functioning markets. On the contrary, there is evidence that non-commercial entities alter their position following price changes. This is also expected because new prices convey information affecting the prospects and the risks of those entities. This being an interim report, the Task Force intends to examine these findings further as it continues its work. However, to this point of the examination, the evidence supports the position that changes in fundamental factors provide the best explanation for the recent crude oil price increases. Observed increases in the speculative activity and the number of traders in the crude oil futures market do not appear to have systematically affected prices.

Moreover, if speculative activity has pushed oil prices above the levels consistent with physical supply and demand, increases in inventories should emerge as higher prices reduce consumption and investment in productive capacity is encouraged. Although this process may take time to unfold, inventories of crude oil and petroleum products, according to available data, have declined significantly over the past year. The view that financial investors have pushed prices above fundamental values is also difficult to square with the fact that prices for other commodities that do not trade on established futures markets (such as coal, steel, and onions) have risen sharply as well.

The Task Force will continue its examination of the dynamics of the crude oil futures market and other commodity markets and will report further on its work later this year.[11]

[11] In June 2008, the CFTC issued requests for disaggregated information – Special Calls – to swap dealers and commodity index traders. Data submitted in response to the special calls is expected to enable a detailed analysis of index trading and over-the-counter swaps across a wide variety of futures markets. This analysis, in turn, would enable the CFTC to gauge the effectiveness of current rules and regulations governing the dynamics of futures markets.

Appendix

Granger Causality Tests

A formal way to statistically test for whether one variable leads another are known as Granger Causality tests (see Granger, C. W. J., 1969, Investigating causal relations by econometric models and cross-spectral methods, Econometrica 37, 424-438).

Granger Causality tests reported above are performed by employing bivariate regressions in the form of

$$\Delta p_t = \alpha_0 + \sum_{l=1}^{k} \alpha_l \Delta p_{t-l} + \sum_{l=1}^{k} \beta_l \Delta NP_{t-l} + \varepsilon_t$$

$$\Delta NP_t = \gamma_0 + \sum_{l=1}^{k} \gamma_l \Delta NP_{t-l} + \sum_{l=1}^{k} \eta_l \Delta p_{t-l} + \omega_t$$

where Δp is the change in nearby price; ΔNP is the change in net nearby positions of the specific trader category; and l is the optimal lag chosen. Applying the Akaike Information Criterion, one lag in each equation was found to be sufficient.

The first equation asks whether changes in net positions at the end of each reporting day reliably predict changes in settlement prices given the prior change in settlement price. The second equation asks whether changes in settlement price reliably predict changes in end-of-day net positions given the prior change in positions.

The test is whether the variance of residuals from the respective unrestricted equation is significantly less than the variance of residuals from the corresponding restricted equation.

Results utilize 1378 daily price change and position change observations sampled from January 1, 2003 through June 30, 2008. Position changes are defined by net daily position changes in the nearby futures plus delta-adjusted options contract. P-values are reported for F-tests and indicate probabilities that the variance of residuals from the respective unrestricted equation differs from the variance of the corresponding restricted equation.

Glossary of Futures Markets Terms

Backwardation: Market situation in which futures prices are progressively lower in the distant delivery months. (Backwardation is the opposite of contango).

Bid: An offer to buy a specific quantity of a commodity at a stated price.

Board of Trade: Any organized exchange or other trading facility for the trading of futures and/or option contracts.

Cash Market: The market for the cash commodity (as contrasted to a futures contract) taking the form of either an organized, self-regulated central market (*e.g.*, a commodity exchange) or a decentralized over-the-counter market.

CFTC Form 40: The form used by large traders to report their futures and option positions and the purposes of those positions.

Clearing: The procedure through which the clearing organization becomes the buyer to each seller of a futures contract or other derivative, and the seller to each buyer for clearing members.

Clearing Member: A member of a clearing organization. All trades of a non-clearing member must be processed and eventually settled through a clearing member.

Clearing Organization or Clearing House: An entity through which futures and other derivative transactions are cleared and settled. It is also charged with assuring the proper conduct of each contract's delivery procedures and the adequate financing of trading. A clearing organization may be a division of a particular exchange, an adjunct or affiliate thereof, or a freestanding entity.

Commercial: A trader involved in the production, processing, or merchandising of a commodity.

Commitments of Traders Report (COT): A weekly report from the CFTC providing a breakdown of each Tuesday's open interest for markets in which 20 or more traders hold positions equal to or above the reporting levels established by the CFTC. Open interest is broken down by aggregate commercial, non-commercial, and non-reportable holdings.

Commodity Index: An index or average, which may be weighted, of selected commodity prices, intended to be representative of the markets in general or a specific subset of commodities, *e.g.*, grains or livestock.

Commodity Pool Operator (CPO): A person engaged in a business similar to an investment trust or a syndicate and who solicits or accepts funds, securities, or property for the purpose of trading commodity futures contracts or commodity options and who generally must register with the CFTC as a CPO.

Commodity Swap: A swap in which the payout to at least one counterparty is based on the price of a commodity or the level of a commodity index.

Contango: Market situation in which prices in succeeding delivery months are progressively higher than in the nearest delivery month; the opposite of backwardation.

Counterparty: The opposite party in a bilateral agreement, contract, or transaction, such as a swap.

Day Trader: A trader who takes positions and then offsets them during the same trading session prior to the close of trading.

Dealer/Merchant (AD): A large trader that declares itself a "Dealer/Merchant" on CFTC Form 40, which provides as examples "wholesaler, exporter/importer, shipper, grain elevator operator, crude oil marketer."

Derivative: A financial instrument, traded on or off an exchange, the price of which is directly dependent upon (*i.e.*, "derived from") the value of one or more underlying securities, equity indices, debt instruments, commodities, other derivative instruments, or any agreed upon pricing index or arrangement (*e.g.*, the movement over time of the Consumer Price Index or freight rates). Derivatives involve the trading of rights or obligations based on the underlying product, but do not directly transfer property. They are used to hedge risk or to exchange a floating rate of return for fixed rate of return. Derivatives include futures, options, and swaps. For example, futures contracts are derivatives of the physical contract and options on futures are derivatives of futures contracts.

Electronic Trading Facility: A trading facility that operates by an electronic or telecommunications network instead of a trading floor and maintains an automated audit trail of transactions.

Eligible Commercial Entity: An eligible contract participant or other entity approved by the CFTC that has a demonstrable ability to make or take delivery of an underlying commodity of a contract; incurs risks related to the commodity; or is a dealer that regularly provides risk management, hedging services, or market-making activities to entities trading commodities or derivative agreements, contracts, or transactions in commodities.

Eligible Contract Participant: An entity, such as a financial institution, insurance company, or commodity pool, that is classified by the Commodity Exchange Act as an eligible contract participant based upon its regulated status or amount of assets. This classification permits these persons to engage in transactions (such as trading on a derivatives transaction execution facility) not generally available to non-eligible contract participants, *i.e.*, retail customers.

Exchange-Traded Fund (ETF): An investment vehicle holding an asset such as a commodity that issues shares that are traded like a stock on a securities exchange.

Exempt Commercial Market: An electronic trading facility that trades exempt commodities on a principal-to-principal basis solely between persons that are eligible commercial entities.

Floor Broker: A person with exchange trading privileges, who, in any pit, ring, post, or other place provided by an exchange for the meeting of persons similarly engaged, executes for another person any orders for the purchase or sale of any commodity for future delivery.

Foreign Board of Trade: A futures exchange located outside the United States.

Forward Contract: A cash transaction common in many industries, including commodity merchandising, in which a commercial buyer and seller agree upon delivery of a specified quality and quantity of goods at a specified future date. Terms may be more "personalized" than is the case with standardized futures contracts (*i.e.*, delivery time and amount are as determined between seller and buyer). A price may be agreed upon in advance, or there may be agreement that the price will be determined at the time of delivery.

Futures Commission Merchant (FCM): Individuals, associations, partnerships, corporations, and trusts that solicit or accept orders for the purchase or sale of any commodity for future delivery on or subject to the rules of any exchange and that accept payment from or extend credit to those whose orders are accepted.

Futures Contract: An agreement to purchase or sell a commodity for delivery at a specified time in the future: (1) at a price that is determined at initiation of the contract; (2) that obligates each party to the contract to fulfill the contract at the specified price; (3) that is used to assume or shift price risk; and (4) that may be satisfied by delivery or offset.

Hedge Exemption: An exemption from speculative position limits for bona fide hedgers and certain other persons who meet the requirements of exchange and CFTC rules.

Hedge Fund: A private investment fund or pool that trades and invests in various assets such as securities, commodities, currency, and derivatives on behalf of its clients, typically wealthy individuals.

Hedger: A trader who enters into a position in a futures market opposite to a position held in the cash market to minimize the risk of financial loss from an adverse price change; or who purchases or sells futures as a temporary substitute for a cash transaction that will occur later. One can hedge either a long cash market position (*e.g.*, one owns the cash commodity) or a short cash market position (*e.g.*, one plans on buying the cash commodity in the future).

Hybrid Instruments: Financial instruments that possess, in varying combinations, characteristics of forward contracts, futures contracts, option contracts, debt instruments, bank depository interests, and other interests. Certain hybrid instruments are exempt from CFTC regulation.

Large Traders: A large trader is one who holds or controls a position in any one future or in any one option expiration series of a commodity on any one exchange equaling or exceeding the exchange or CFTC-specified reporting level.

Liquidity: An aspect of a market indicating that selling and buying can be accomplished with minimal effect on price. The more liquid a market is, the easier it is to execute large trades with minimal price impact.

Long: (1) One who has bought a futures contract to establish a market position; (2) a market position that obligates the holder to take delivery; (3) one who owns an inventory of commodities.

Managed Money Traders (MMTs): Futures market participants who engage in futures trades on behalf of investment funds or clients. While MMTs are commonly equated with hedge funds, they may include Commodity Pool Operators and other managed accounts as well as hedge funds. While CFTC Form 40 does not provide a place to declare oneself a Managed Money Trader, a large trader can declare itself a "Hedge Fund (H)" or "Managed Accounts and Commodity Pools."

Manufacturer (AM): A large trader that declares itself a "Manufacturer" on CFTC Form 40, which provides as examples "refiner, miller, crusher, fabricator, sawmill, coffee roaster, cocoa grinder." In the crude oil and product futures and option markets, Manufacturers are likely to be refiners.

Margin: The amount of money or collateral deposited by a customer with his broker, by a broker with a clearing member, or by a clearing member with a clearing organization. The margin is not partial payment on a purchase. Also called Performance Bond. (1) Initial margin is the amount of margin required by the broker when a futures position is opened; (2) Maintenance margin is an amount that must be maintained on deposit at all times. If the equity in a customer's account drops to or below the level of maintenance margin because of adverse price movement, the broker must issue a margin call to restore the customer's equity to the initial level. Exchanges specify levels of initial margin and maintenance margin for each futures contract, but futures commission merchants may require their customers to post margin at higher levels than those specified by the exchange.

Market Maker: In the futures industry, a trader who, in speculating for his own account, provides bids and offers for commercial users of the market.

Nearbys: The nearest delivery months of a commodity futures market.

Nearby Delivery Month: The month of the futures contract closest to maturity.

Non-commercial: A trader other than a commercial, that is, a trader that is not involved in the production, processing, or merchandising of the commodity it is trading.

Offer: An indication of willingness to sell at a given price; opposite of bid, the price level of the offer may be referred to as the "ask."

Offset: Liquidating a purchase of futures contracts through the sale of an equal number of contracts of the same delivery month, or liquidating a short sale of futures through the purchase of an equal number of contracts of the same delivery month.

Open Interest: The total number of futures contracts long or short in a delivery month or market that has been entered into and not yet liquidated by an offsetting transaction or fulfilled by delivery.

Option: A contract that gives the buyer the right, but not the obligation, to buy (call) or sell (put) a specified quantity of a commodity or other instrument at a specific price within a specified period of time, regardless of the market price of that instrument.

Over-the-Counter (OTC): The trading of commodities, contracts, or other instruments not listed on any exchange. OTC transactions can occur electronically or over the telephone.

Position Accountability: A rule adopted by an exchange requiring persons holding a certain number of outstanding contracts to report the nature of the position, trading strategy, and hedging information of the position to the exchange, upon request of the exchange. See Speculative Position Limit.

Position Limit: See **Speculative Position Limit**.

Price Discovery: The process of determining the price level for a commodity based on supply and demand conditions. Price discovery may occur in a futures market or cash market.

Producer (AP): A large trader that declares itself a "Producer" on CFTC Form 40, which provides as examples, "farmer" and "miner." A firm that extracts crude oil or natural gas from the ground would also be considered a Producer.

Reporting Level: Sizes of positions set by the exchanges and/or the CFTC at or above which commodity traders or brokers who carry these accounts must make daily reports about the size of the position by commodity, by delivery month, and whether the position is controlled by a commercial or non-commercial trader.

Scalper: A speculator who buys and sells rapidly, with small profits or losses, holding his positions for only a short time during a trading session. Typically, a scalper will stand ready to buy at a fraction below the last transaction price and to sell at a fraction above, *e.g.*, to buy at the bid and sell at the offer or ask price, with the intent of capturing the spread between the two, thus creating market liquidity.

Short: (1) The selling side of an open futures contract; (2) a trader whose net position in the futures market shows an excess of open sales over open purchases.

Special Call: A request pursuant to CFTC Regulation 18.05 for further details regarding a large trader's futures and cash market positions.

Speculative Position Limit: The maximum position, either net long or net short, in one commodity future (or option) or in all futures (or options) of one commodity combined that may be held or controlled by one person (other than a person eligible for a hedge exemption) as prescribed by an exchange and/or by the CFTC.

Speculator: In commodity futures, a trader who does not hedge, but who trades with the objective of achieving profits through the successful anticipation of price movements.

Spot: Market of immediate delivery of and payment for the product.

Spot Commodity: (1) The actual commodity as distinguished from a futures contract; (2) sometimes used to refer to cash commodities available for immediate delivery.

Spot Month: The futures contract that matures and becomes deliverable during the present month.

Spot Price: The price at which a physical commodity for immediate delivery is selling at a given time and place.

Spread: The purchase of one futures delivery month against the sale of another futures delivery month of the same commodity; the purchase of one delivery month of one commodity against the sale of that same delivery month of a different commodity; or the purchase of one commodity in one market against the sale of the commodity in another market, to take advantage of a profit from a change in price relationships. The term spread is also used to refer to the difference between the price of a futures month and the price of another month of the same commodity. A spread can also apply to options.

Swap: In general, an OTC contract for the exchange of one asset or liability for a similar asset or liability for the purpose of lengthening or shortening maturities or otherwise shifting risks. See **Commodity Swap.**

Swap Dealer (AS): An entity such as a bank or investment bank that markets swaps to end users. Swap dealers often hedge their swap positions in futures markets. Alternatively, an entity that declares itself a "Swap/Derivatives Dealer" on CFTC Form 40.

Yield Curve: A graphic representation of market yield for a fixed income security plotted against the maturity of the security. The yield curve is positive when long-term rates are higher than short-term rates.

Notes

Notes

For further information about this interim report, contact the Commodity Futures Trading Commission's Office of External Affairs at 202-418-5080 or via email at TaskForce@cftc.gov.

An electronic version of the Interagency Task Force on Commodity Markets' *Interim Report on Crude Oil* is available on the Internet at www.cftc.gov.