SHEEP IN WOLVES' CLOTHING?

Speculators and Price Volatility in Petroleum Futures

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Introduction

The role of speculators in energy futures markets has received a great deal of scrutiny in recent years. For example, in response to pressure from the U.S. Department of Energy over heating-oil price increases, the chairman of Amerada Hess pointed to speculators as responsible [Sullivan 1996]. During the Gulf Crisis of 1990-91, some observers proposed shutting down these markets for a "cooling-off period" [U.S. Senate 1991].

In a series of consulting reports and articles in energy publications (only the latter are cited here), Krapels [1995, 1996, 1997, 1999], and Verleger [1995] have related speculative activity to price fluctuations in petroleum markets (see also Dale and Zyren [1996]). Utilizing *Commitments of Traders* (*COT*) data (described below), they demonstrate a strong correlation between aggregate non-commercial net open interest and the level of oil prices.[1] These findings have received attention in the trade press [e.g., *PIW* 1995, 1998, Arnold 1995, Keefe 1996, 1998], and have been used to support positions held by both industry supporters and detractors of futures markets.

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[1] In the *COT* data (and the discussion below), futures traders are classified as "commercial" if they are active in cash markets for the given commodity, and "noncommercial" otherwise. Noncommercials are the group usually identified as speculators.

These articles have helped to focus attention on entry into energy futures markets by large, sometimes well-capitalized speculators – commodity pools and hedge funds. Unfortunately, the articles do not approach the issue in a systematic fashion, nor do they reflect the finance literature that bears on it. The objective of this piece is to present a survey and critical assessment of this recent industry literature on price behavior and speculative activity in petroleum futures markets. The analysis below aims at casting the discussion in the broader framework of the research literature on the role of speculators in derivatives markets.

Controversy over the behavior of speculators in futures markets goes back to the early days of trading. Claims that self-interested speculative behavior is detrimental to markets for the underlying commodity (called "cash markets"[2] in this paper) fall into three categories.[3] First, speculators drive prices away from fundamental values, a process referred to as a "bubble" in the modern finance literature.[4] Second, speculators manipulate the market.[5] Third, speculators are

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[2] Petroleum-market terminology further breaks down cash markets into "spot," "forward," "dated," "term," "contract," etc., depending on the time and place discussed. These terms will be used where needed.

[3] Any trader with enough capital can affect a market by building up a large enough position, but in general such positions cannot be liquidated profitably. Speculative behavior detrimental *ex ante* to a trader's own self-interest is not discussed here.

[4] For a discussion of bubbles, see the symposium in the Spring 1990 issue of the *Journal of Economic Perspectives*, especially Flood and Hodrick [1990].

poorly informed about the petroleum business,[6] and trade in reaction to supply and demand shocks by extrapolating past trends ("technical analysis") or by watching each other ("herding"), rather than on the basis of market fundamentals.

Even if the above claims were true, there is no reason to believe that speculation would result in an average *level* of commodity prices either higher or lower than would occur in its absence. Rather, it is average *volatility* that would rise with speculative activity if the above claims were indeed true.[7] Claims of trading-induced volatility have led to numerous proposals to discourage speculative

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[5] "Manipulation" here refers to 1) traders with market power affecting prices by spreading false news regarding their intentions or behavior, 2) traders with inside information about market fundamentals making false announcements regarding factors likely to affect market fundamentals (e.g., OPEC decisions), 3) traders buying up the stock of the commodity in inelastic supply, and reselling it at a monopoly profit (e.g., the Salomon brothers Treasury Bond corner of 1991; see Jordan and Jordan [1996]), or 4) delivery squeezes, wherein traders accumulate larger forward positions than the available supply of the cash commodity, and demand delivery, as has occurred periodically in the Brent crude oil forward market, according to Møllgaard [1997]. Recent discussions of manipulation in commodity markets can be found in Pirrong [1995] and Williams [1995].

[6] In this report "poorly informed" refers to the condition wherein commercial (i.e., cash-market) participants have access to information regarding changes in market fundamentals more rapidly or cheaply than do speculators. Evidence supporting such information asymmetry in the oil market can be found in Phillips and Weiner [1994].

[7] This fact has not prevented those with vested interests in high (respectively, low) commodity prices from blaming price levels on speculation. For example, during the Gulf Crisis of 1990-91, complaints about price volatility from oil consumers were often disguised claims that prices were too high relative to fundamentals. In an example from the other side, crude oil producers attributed the price decline of the late 1870s to the rise of speculation in crude oil futures on the Oil City and New York exchanges. The Petroleum Producers' Union, a 19th-century trade group, listed among the causes of low prices "the manipulation of stocks by speculators and buyers to depress price to suit their purposes, which are always adverse to the interests of producers" [Petroleum Producers' Union 1878].

activity through transaction taxes,[8] increased margins, price limits, and reserve requirements based on trading activity.

More dramatic policies include trading restrictions (e.g., circuitbreakers), and shutting down financial markets entirely, either for a "cooling off period," until the crisis is judged to have passed, or indefinitely, on the grounds that trading was making cash markets more volatile. Such policies have been implemented in several cases.[9]

The U.S. Commodity Futures Trading Commission (CFTC) ordered suspension of trading in wheat futures for two days after the U.S. grain embargo of the USSR in January 1980, following the Soviet invasion of Afghanistan. Onion-futures trading was banned by Congress in 1958 on grounds that it was responsible for onion-price volatility. Under the Commodity Exchange Act of 1936, Congress banned options trading on all commodities traded on futures exchanges at the time.

In the case of petroleum futures examined here, the empirical regularities in the data – higher levels of open interest and trading associated with greater volatility

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[8]Sometimes referred to as "throwing sand in the wheels of finance;" see Eichengreen, Tobin, and Wyplosz [1995].

[9]See Markham [1987] for a detailed discussion of derivatives regulation.

on average – are not in question. Their interpretation, however, is unclear. Any trader or organization with sufficient capital can influence prices by accumulating a large enough open position in the market, as demonstrated by the Hunts' activity in the silver spot and futures markets in 1979-80. As also demonstrated by the Hunt case, however, such speculative positions are not necessarily profitable.[10]

It is important to remember that even if speculators can raise prices by buying up futures contracts, they cannot unload these positions at the higher price without a change in market fundamentals. The very action of unwinding their large positions will cause prices to fall. Therefore, the widely observed correlation between the size of non-commercial positions cannot tell us anything about the profitability of such positions, nor whether speculators are making the market more or less efficient, or disrupting it, as was sometimes claimed during the Gulf Crisis.

The relationship between prices and speculative positions cannot even tell us whether speculators are influencing the market, for two basic reasons. First, as in any derivatives market, total open interest must sum to zero -- every long position must be balanced by a short position. Correlations between non-commercial positions and prices imply similar correlations (with opposite sign)

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[10]Williams [1995] provides an extensive discussion of the Hunt case.

between commercial positions and prices. The data cannot distinguish between a story that hedgers move market prices (and speculators merely take the other side of their trades) and the opposite one, wherein speculators are behind price movements [Krapels, 1997b].

Changes in market fundamentals are the second reason that correlations between non-commercial open interest and prices say nothing about the influence of speculation on the market. News that affects current or future supply or demand (e.g., weather forecasts, inventory changes, refinery shutdowns, political developments in major oil exporting countries) is likely to affect both oil prices and the desired futures positions of both hedgers and speculators. For example, falling prices as a result of warmer-than-normal weather may result in speculators reducing their short positions in order to realize profits (as futures contracts previously sold at higher prices are bought back at lower prices). Without the information on news entering the market, this could be mistaken as speculation causing prices to fall.

Motivations for Speculative Trading

In order to assess claims regarding speculative influences on oil price and volatility, it is helpful to step back and examine the reasons behind inflows and outflows of speculative investment in petroleum markets. These reasons fall into four categories:

1. news about market fundamentals that results in speculators wishing to increase or decrease their positions.

2. herding behavior, based on copying actions of those believed in possession of superior information, or widespread use of similar technical factors or advice from market forecasters.

3. entry of new speculators into the petroleum markets.

4. attempts by speculators to influence prices through exercise of market power, e.g., manipulation, cornering the market, etc.

The influence of speculative trading on market functioning depends on the forces behind the speculators' actions. Motivation 4 is outside the scope of this inquiry. Apart from occasional reporting of squeezes in the Brent cash market [see Møllgard 1997], or possible effects on heating oil and gasoline markets of Metallgesellschaft's large open positions in late 1993 [see Verleger 1994, Krapels 2001], claims that petroleum futures markets have been manipulated are scarce.

Motivation 1 implies that the presence of speculators tends to improve market functioning, or at worst, has no influence upon it, depending on how well informed they are. Speculators may have superior access to information (relative to commercial players in futures markets), either because they devote more resources to following and forecasting changes in market fundamentals than do commercials, or because they have lower costs than commercial participants in obtaining, interpreting, or acting on news.

Professionally-managed speculators (e.g., hedge funds and commodity pools) are often viewed this way, and sometimes referred to as "smart money," or "market leaders" among finance professionals. For example, Krapels [1997] claims that commercials are "reactive" to price changes, whereas non-commercials are "active" (p.24).

If speculators indeed tend to react more quickly than commercials, then their presence in the market will tend to speed price adjustment to supply and demand shocks, improving market functioning.[11] If news about fundamentals is itself changing rapidly, however, the improved market functioning could actually be associated with greater price volatility over short time periods. This is especially likely when political factors dominate market news, such as the attempted coup in the USSR in 1991, actions taken in the Gulf Crisis, political stability in major oil-exporting countries, etc.

Even if speculation exacerbates price volatility, however, it would be difficult to describe speculators as influencing the market (except in a very short-term sense), just because they react more rapidly to changes in fundamentals. For example, the title of one industry article, "Funds Vote Prices Lower" [Krapels

[11]Note that Dale and Zyren [1996] reach exactly the opposite conclusion, finding that speculators tend to follow, rather than lead the market.

1997b], is consistent with the view that speculators liquidated long positions in crude oil futures in early 1997 because they foresaw weakness in market fundamentals before other market participants.

It is also consistent, however, with the view that the funds staged a "bear attack" [Krapels 1997b: 23] in their attempt to influence the market. The term "attack" here is particularly unfortunate, because it echoes the speculative attacks regularly seen in foreign exchange markets, wherein some large market players (chiefly central banks) have attempted to maintain prices (in this case, exchange rates) at levels not supported by market fundamentals.

If instead of leading the market, speculators have similar access and reaction to news as commercials, than their reaction to changes in fundamentals has no effect on price levels or volatility. If speculators react more slowly than commercials, then their role is best understood under motivation 2, herding.

Herding, or copying the behavior of the "smart money," can be a profitable strategy for relatively-poorly-informed traders. When well-informed traders are running in the direction from which you are coming, it often makes sense to toss out your previous trading strategy, and run with them on the grounds that if you knew what they know, you would switch too, and finding out is too time-

consuming or expensive. It can also serve to exacerbate price volatility, as traders stampede first in one direction, then in the other.

Thus policymakers and market participants should be concerned with speculators as "dumb money," rather than as "smart money," just the opposite of the thrust of the industry literature. For example, PIW [1995] misses the point in characterizing Dale and Zyren's [1996] finding noted above as speculators being "sheep," rather than "shepherds." So too does Krapels' [1996] claim that the opposite is sometimes true, and therefore that speculators are better described as "wolves" (at least part of the time; perhaps werewolves would be more descriptive!). Here it is wolves that make the market work well, whereas sheep are potentially dangerous, as elaborated below in the section on herding.

As hedge-fund activity has increased in recent years, motivation 3, entry of new speculators into the oil futures market, has been a major concern of industry participants and policymakers, as well as an important factor behind the articles in the trade press. The concern is that even if individual speculators tend to act rationally, the market will suffer adverse effects, including increased volatility, if speculation comes to dominate trading activity.

Discussion of entry of new players into a futures market cannot ignore the liquidity issue. Except for the very largest contracts (e.g., eurocurrency), liquidity

in futures markets is limited. For example, the large oil-exporting countries have cited as a reason for not hedging their petroleum-price exposure market "thinness" (i.e., illiquidity) -- the inability to make large transactions in the oil futures markets without turning prices sharply against them. Entry of new players into the market helps provide additional liquidity, thereby making it more attractive to existing players and other potential entrants. It also limits the ability of any single large player to influence prices.

If the new entrants are noncommercials, then (aside from the increased liquidity they bring to the market) their effect on market functioning depends on whether they are well- or poorly-informed relative to existing players. Entry by sophisticated speculators tends to improve market performance, for the reasons discussed under motivation 1 above. In contrast, entry by relatively uninformed participants is likely to worsen functioning, as discussed under motivation 2 above. It should be emphasized that the mere influx of speculative capital into a market is not itself a cause for concern, and, all else equal, tends to improve market functioning through increasing liquidity.

Thus the concern over whether these funds have a positive or negative effect on market functioning comes down to whether the funds can be characterized as "smart money," – undertaking extensive analysis on possible changes in future industry, macroeconomic, political, etc. conditions and their likely consequences

for prices – or "dumb money" – noise traders chasing trends or herding sheep, buying and selling because others are doing so. As noted above for the case of herding, such behavior can be profitable, and hence would not necessarily be dissipated through exit of unsuccessful traders from the market. Similar arguments are made for the survival of noise traders in financial markets [Shleifer and Summers 1990].

Only if speculators are not reacting to expected changes in fundamentals can they meaningfully be said to be "causing" prices to rise or fall. As the result of the near bankruptcy (and bailout by some of its lenders) of the hedge fund Long-Term Capital Management in 1998, however, the funds are no longer just assumed to represent "smart money," raising the specter of a destabilizing influence in financial markets.

The answer cannot be determined without evidence, which does not prevent analysts from holding strong views on the subject. For example, according to Krapels [1999], "Of the hundreds of fund managers and commodity traders, the vast majority are 'systems traders,' relying upon the analysis of price trends for their trading decisions, and paying little if any attention to the fundamentals of the markets in which they are trading."

While Krapels's statement is consistent with his view (cited earlier) that speculators are a source of volatility, the same cannot be said about Dale and Zyren [1996], who claim that aggregate data show that funds are price followers (termed "sheep" by *PIW* [1995]) rather than an influence on prices. Even if their analysis showed such to be the case (which it does not, as pointed out by Krapels [1996], who notes "occasionally there is a wolf under that wool"), their reassuring interpretation is backwards, reflecting a complete misunderstanding of the discussion above. If these be sheep, then one is safer among wolves!

Unfortunately, in the absence of disaggregated data, the widely observed correlation between price fluctuations and changes in non-commercial positions implies little about the profitability of such positions, the effect of speculation on market efficiency and volatility, or whether this phenomenon is a cause for concern in the industry. Interpreting these relationships requires information on individual-trader behavior, to which we now turn.

Herding, Contagion, and Price Volatility

The emphasis in the recent trade literature on speculators as shepherds, sheep, market leaders, followers, etc., suggests that a focus on herding behavior will be worthwhile. While research on financial bubbles is longstanding, the topic of

herding behavior is a recent addition to work in the area of speculation and volatility in financial markets.

If speculators make trading decisions independently, there is no reason to believe that their behavior will amplify price fluctuations. If, however, speculators tend to react similarly, either because as poorly-informed market participants they trade by extrapolating past price changes ("technical analysis"), or because they watch and imitate each other's behavior, or because they follow the same expert advice, then such herding (or "stampeding") can exacerbate market volatility.

Empirical analysis of the extent of herding vs. independent behavior has been limited by data availability, and has focused on low-frequency (primarily quarterly) portfolio decisions by mutual-fund managers regarding stocks to add or drop. Likewise, the analysis of speculator influence in petroleum futures markets discussed above has been hampered by lack of access to either high frequency or disaggregated data. With only weekly information on the aggregate position of all speculators, it is not possible to determine if speculators act as a homogeneous group, or whether hedge funds (or other large speculators) tend to lead or follow the reactions of other traders to news regarding supply and demand shocks.

As part of its oversight and monitoring role as the regulator of futures markets in the United States, the U.S. Commodity Futures Trading Commission (CFTC) compiles position data for large commercial and noncommercial users of futures and options contracts (which under the U.S. Commodity Exchange Act are required to report their open interest each day they hold a large position), but ordinarily makes them public only in aggregate form, as part of its biweekly *COT* report (see Krapels [1999] for details).

As part of a U.S. Department of Energy project on the impact of speculation on heating oil prices and inventory levels (motivated in part by the claims noted above), however, data on individual trader positions in heating oil, crude oil, and gasoline were made available for the period 1993-1997 to the author, as well as to Ederington and Lee [1998], who provide a description and summary of the individual-trader data.

These data reveal positive, but weak evidence of herding behavior among commodity pool operators (CPOs - managers of funds that invest customer money in futures and options markets) with large positions in the heating-oil futures market (250 or more open contracts of 1000 barrels each). If CPOs tend to herd; i.e., to buy and sell at the same time, this should show up in high correlations among their daily changes in open position.

As can be seen in Table 1, the average correlation among position changes of the 80 CPOs large enough to be in the database (i.e., those holding a reportable position on at east one day during the 1993-97 period) was only about 11 percent. Most of these CPOs are relatively small, infrequent players in this market; the median number of days with a reportable position was only 92 out of 963 trading days during the period covered by the data. The infrequency of market activity, and the fact that many of the trading records are nonoverlapping, suggests that herding will not stand out in the data – traders cannot herd if they are not in the market at the same time.[12]

{insert Table 1 about here}

The nonoverlapping nature of much of the smaller traders' activity prevents calculation of many pairs of correlations, allowing but 1115 of the 3160 possible correlations.[13] Of these correlations, only about a tenth exceed 50%; the median correlation does not differ from zero significantly at conventional levels. Moreover, the few high correlations tend to be among the smaller players; when attention is restricted to the ten largest CPOs (measured by number of days with an open position of at least 250 contracts), the herding measures are still weaker.

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[12] I am grateful to the editor for this point.

[13] With n traders in the market, a maximum of n(n-1)/2 correlations can be calculated.

The median correlation is again close to zero; only one of the 45 exceeds 50% and only five exceed 30%.

The order statistics are however consistent with a weak tendency to trade in parallel. Three-quarters of the 45 correlations among the top 10 CPOs are positive; among the group of 80, 65 percent of the correlations are positive. The 90th percentile is 0.32, whereas the 10th percentile is –0.06. A similar asymmetry is evident in the order statistics for the entire group of 80 large CPOs. The median and mean correlations are positive for both groups, and significant at the 1 percent level, although small in size.

The results are similar to those found by Kodres and Pritsker [1996], the only other paper using high-frequency (daily) CFTC data on trader commitments to look at herding behavior. The authors applied correlation and probit analysis to individual trader positions in several financial futures contracts listed on the Chicago Mercantile Exchange and Chicago Board of Trade.[14] They found very limited evidence of herding among several categories of traders for the period they examined -- August 1992 to August 1994.

Conclusion

[14] The contracts examined were for interest rates (eurodollars, treasury bills, notes, and bonds), equity indices (S&P 500), and currencies (C$, DM, £, SF, ¥).

This paper has assessed the role of speculators in the volatile petroleum futures market. Much of what appears in the trade press on the subject is in error, and some of it is internally inconsistent. Examination of the behavior of an important subgroup of speculators – commodity-fund managers (CPOs) – reveals that the extent of parallel trading is weak economically, but statistically highly significant at conventional levels (p-values much less than 1 percent). In the absence of a dominant speculator, it is thus unlikely that "the funds" are the driving force behind the volatility so often observed in the crude oil market.

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Table 1 – CPO herding in heating-oil futures		
number of CPOs		80
maximum possible number of correlations		3160
	all 80	largest 10
median # of reportable days (out of 96;	92	536
number of correlations	1115	45
CORRELATION ORDER STATISTICS		
lowest	-100%	-16.9%
5%	-30.4%	-8.0%
10%	-17.4%	-6.4%
lower quartile	-3.5%	0.2%
median	4.7%*	2.2%*
upper quartile	24.9%	10.7%
90%	50.1%	32.2%
95%	76.2%	38.5%
highest	100%	51.3%
average	*10.9%**	*7.2%**

*Significantly different from zero at the .01 level