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ENERGY FUTURES MARKET TRADING VERSUS PHYSICAL COMMODITY USAGE: A PLAYGROUND FOR MANIPULATION OR A MISCALCULATION?

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ABSTRACT

The relationship between energy futures trading volume and physical commodity usage is evaluated with the aim of demonstrating the correct method of calculation. This relationship has been incorrectly calculated and the misleading results have been offered up as evidence of excessive speculator activity leading to higher and more volatile prices, on the one hand, and to support claims of high levels of market liquidity and transparency, on the other. It is shown that rather than constituting large multiples over physical usage the futures trading activity represents a *fraction* of usage. These fractions of physical usage represented by futures trading volume cannot support suggestions that futures markets are playgrounds for non-commercial market manipulators. Nevertheless, there is still strong evidence that the energy futures markets provide a valuable basis for price discovery and risk mitigation, since a significant share of physical usage is represented by futures market activity.

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Introduction

An unfortunate misunderstanding seems to permeate discussions of the size of energy futures trading activity relative to physical commodity usage. It is reputed that the daily trading volumes for natural gas futures exceed daily physical usage by anywhere from 12 times[1] to 20 times,[2] even 30 times;[3] similar claims are made regarding crude oil futures trading[4]. These large multiples ranges are presented by participants from both sides of the energy market manipulation debate. On the one hand, it is argued that these multiples indicate a high degree of liquidity that helps lower the costs faced by participants in the physical markets, who are interested in both risk mitigation and price discovery services. On the other hand, it is argued that these multiples[5] are indicative of the excessive amount of activity carried out in these markets by non-commercial parties (often referred to as speculators or, more recently, as a lump called hedge funds), which subjects these markets to manipulation. Each of these positions is wrong.

These large trading multiples are devoid of meaning and are the result of miscalculation. However, since these multiples have recently been introduced into the policy debate regarding

[1] See Cicio, 2006, p. 2. "Volumes traded each day are estimated to be over 12 times the actual physical volumes consumed." The statement is with reference to the natural gas futures and physical markets.
[2] See NYMEX, 2001, p. 20. "Average daily trading volume in 1997 was more than 47,000 contracts, the equivalent of almost 20 times U.S. gas consumption."
[3] See Cooper, 2006, pp. 21-22. "Natural gas may be traded over 30 times before it is consumed (i.e. the volume of trading exceeds the volume consumed by 30 times), fueling the suspicion that this trading drives up transactions costs and increases volatility." Cooper's report has been critiqued elsewhere (FERC, 2006, pp. 33-59), but not on the issue of this multiple.
[4] See NYMEX, 2006 (b). "The futures contract is the most liquid trading instrument for crude oil, with daily trading volume averaging the equivalent of 230 million barrels of crude, approximately three times physical daily output." The multiple of three times appears to refer to total *global* crude oil production, not just that for the U.S.
[5] These multiples have the appearance, or are given the appearance, of hedge ratios, and hedge ratios of these magnitudes are quite unlikely to be optimal. Optimal hedge ratios rarely exceed a value of one, so a multiple of, say, 12, assessed in terms of hedge ratios, would likely suggest excessive, non-optimal trading. These multiples are *not* hedge ratios and should *not* be interpreted as such.

the role of speculators, and the potential for increased price volatility, in these markets, the basis for the calculations should be analyzed and corrected where wrong. If observations regarding the relationship between futures trading and physical usage are to provide meaningful input into new policy development, they must be based on correct analysis.

The numbers

The multiples are typically calculated by taking the total volumes traded for the commodity of interest on a given day (or an average for some period of time) and converting the contracts traded into the units used to discuss consumption/usage of the underlying commodity. For example, natural gas is discussed in terms of cubic feet, and daily consumption is given in terms of billions of cubic feet, or Bcf. A single natural gas futures contract on the New York Mercantile Exchange (NYMEX) represents 10,000 million British thermal units (Btu). At roughly 1,000 Btus per cubic foot[6], a single contract accounts for 10 million cubic feet of gas, or 0.01 Bcf. Crude oil is discussed in terms of barrels (bbl), and each NYMEX crude oil contract represents 1,000 bbl.

Table 1: NYMEX trading volume summary for 2005 – numbers of contracts		
a)	**Crude oil**	**Natural gas**
Average daily total trading volume, all contracts-2005	237,600	76,300
Maximum daily total trading volume, all contracts-2005	406,300	149,400
b)		
Average daily trading volume for near-month contract-2005	93,500	31,130
Maximum daily trading volume for near-month contract-2005	178,300	70,950

[6] The actual Btu content may vary by location, but the average is about 1,030 Btus per cubic foot.

Table 1 provides a summary of the daily trading volumes for futures contracts on the NYMEX for 2005[7], for both natural gas and crude oil. Panel (a) provides the numbers of contracts traded for all open contracts, while panel (b) reports the same for the near-month contracts, only. The units of a commodity represented by each contract imply, for example, that the highest trading volume in any one day during 2005, for all contracts[8] open, for crude oil amounted to 406.3 million barrels. For natural gas, the highest daily futures trading volume for all contracts represents 1,494 Bcf.

Table 2 presents a set of calculations that represent the typical claims of the relationships between futures trading volumes and commodity consumption. The very large multiples that are claimed are based on the total trading for any given day, including all contracts trading for all maturities.

Table 2: *Typical* measurement of the trading multiple relative to daily consumption/usage, based on all open contracts

	Crude oil	**Natural gas**
Daily consumption/usage	18 mmbbl	63 Bcf
Average daily total trading volume-2005	238 mmbbl	763 Bcf
Maximum daily total trading volume-2005	406 mmbbl	1,494 Bcf
"Multiple" – average	13	12
"Multiple" – maximum	23	24

The multiples that eventuate from using total volumes for all contracts are 13 for crude oil and 12 for natural gas if the average daily total trading volume for 2005 is employed. This is based on an average daily U.S. usage of 18 million barrels (mmbbl) of crude oil and 63 Bcf of natural

[7] The trading volumes are sourced from NYMEX data and rounded.
[8] When this total trading volume number is used it includes contracts covering maturities five years into the future.

gas. If the maximum is employed the apparent multiple for crude oil trading is 23 times the daily usage for the US, and it is 24 times the daily U.S. usage of natural gas.

The results reported in Table 3 show the relationships between futures trading volume and usage when the focus is on the near-month contract. The multiples drop, as expected, but they are still substantial.

The focus on the near-month contract appears to be the most sensible approach[9], since including all contract maturities, extending far into the future, significantly muddies the waters with respect to any relationship between quantities of commodities represented by trading volumes and quantities associated with actual usage, typically presented in daily usage terms. The average daily futures trading volume for near-month crude oil for 2005 represents 93 million barrels of oil. This volume of trade certainly seems, on a rudimentary calculation, to provide substantial liquidity. The vast majority of all trading on the NYMEX occurs during open outcry floor trading between 10:05 am and 2:30 pm. This amounts to 265 minutes of trading time, and this allows for contracts representing over 350,000 barrels of crude oil for delivery in the near-month to be traded per minute, on average. This futures trading activity is also used to argue that about five times as many barrels of oil are traded on the futures market than are used each day.

[9] It is also worth noting that the near-month (spot) contract typically represents nearly 44 percent of trading in all maturities for crude oil and over 45 percent for natural gas. See NYMEX, 2005, pp. 7-8.

Table 3: *Typical* measurement of the trading multiple relative to daily consumption/usage, based on near-month contract		
	Crude oil	**Natural gas**
Daily consumption/usage	18 mmbbl	63 Bcf
Average near-month daily trading volume-2005	93 mmbbl	311 Bcf
Maximum near-month daily trading volume-2005	178 mmbbl	709 Bcf
"Multiple" – average	5	5
"Multiple" – maximum	10	11

For natural gas, Table 3 shows that contracts representing 311 Bcf for the near-month were traded on average during 2005. This represents futures trading at five times the daily usage. This activity also seems to provide substantial liquidity, since contracts representing roughly 1.2 Bcf were traded every minute, on average.

According to this method of calculating the relationships between futures trading and actual usage, the highest daily futures trading during 2005 implies a multiple of 10 for crude oil and 11 for natural gas.

Nevertheless, even though the analysis has been adjusted to account for only the near-month contract volumes, rather than incorrectly including all contract maturities, the analysis is still deeply flawed and provides misleading results. The next section will first briefly explain how these futures contracts operate and then provide an alternative calculation of the relationships between futures contract trading and physical commodity usage volumes.

Futures trading

The trading activity each day for natural gas and crude oil futures contracts (as well as that for gasoline and heating oil) is for delivery over an *entire month*, not any one specific day. For example, near-month futures contracts traded during any trading day in March (up to the last trading day, which differs across commodities)[10] are for quantities of the commodity to be delivered during (throughout) the month of April.

Therefore, to gain meaningful insight into the relative volumes traded under futures contracts compared to actual physical requirements/usage, the volumes of the commodity represented by the traded contracts must be divided by the number of days in the delivery month. That is, observing daily trading volume representing contracts that account for 12 times the daily usage, but for delivery into a month consisting of 30 days, actually implies trading activity that represents just 40 percent of the requirements for that month. Indeed, if a 30 times multiple were observed, it would represent daily futures trading activity that just covers the requirements for the delivery month.

As noted earlier, the analysis should be conducted on futures trading volume for the near month, or a specific month of interest, rather than the total of all contract maturities. As seen above, the large numbers, in the 12 to 30 range, are the result of aggregating the trading volume for all contracts traded on a given day, including those for many months and years into the future. The analysis of the near-month trading activity, the month that typically carries the largest trading

[10] The last trading day for the crude oil contract is the third business day prior to the 25 calendar day of the month prior to the delivery month. For natural gas, the last trading day is three business days prior to the first business day of the delivery month. For gasoline and heating oil the last trading day is the last business day of the month preceding the delivery month.

volume, results in much smaller multiples, as shown in Table 3. However, these values still require division by the number of days in the delivery month to provide a meaningful basis for comparison with reported average daily physical use of the commodity.

Table 4 reports values for near-month contracts for delivery into a 30-day month.

Table 4: Measurement of the trading multiple relative to daily consumption/usage, based on near month contract and adjusted for a 30-day delivery month

	Crude oil	**Natural gas**
Daily consumption/usage	18 mmbbl	63 Bcf
Average daily total trading volume, 30-day delivery month basis-2005	3 mmbbl	10 Bcf
Maximum daily total trading volume, 30-day delivery month basis-2005	6 mmbbl	24 Bcf
"Multiple" – average	0.167	0.159
"Multiple" – maximum	0.333	0.381

It is immediately obvious that large multiples of the physical commodity usage in the U.S. are *not* represented by the daily traded volumes on the futures exchange. Even if the highest futures trading day is evaluated for either commodity during 2005, the volumes of the underlying commodity accounted for by the traded contracts amount to just 33 percent of the daily usage for crude oil and 38 percent of the daily usage for natural gas. The average daily futures trading activity during 2005 represented volumes of roughly 16 percent of actual daily usage for both commodities.

Assessment

The results presented in Table 4 do not support the large multiples typically claimed, but they also do not suggest that the futures trading activity represents an insignificant share of the market. To assess the significance of futures trading activity it is also necessary to observe the open interest associated with the near-month contract. The open interest on futures contracts represents the number of contracts, and therefore the volumes of the underlying commodity, that are active and still constitute obligations[11] on the part of buyers and sellers. Trading volume, by itself, for futures contracts only provides a partial picture, since trading volume may add to, decrease, or leave unchanged the number of open contracts. Thus, a more complete picture is gained by examining the volumes of the commodity represented by the open interest positions in the futures market, in addition to trading volume.

Table 5 presents the average and maximum daily open interest for the two commodities for the 2005 trading year. When assessing the relationship between near-month contract open interest and daily usage of a commodity, it is reasonable to focus on the maximum, rather than the average. This is because open interest, by definition, rises and falls during the life of the contract, beginning at zero just before the contract is listed for trading and declining back to zero at the maturity of the contract. The maximum open interest typically occurs during the near-month (sometimes referred to as the spot month) trading period. The open interest for the near-month contract is also typically the largest for any traded contract maturity, just as is the case for futures contract trading volume.

[11] See NYMEX, 2006 (a), p. 2. "The Exchange's core energy contracts…stipulate physical delivery, although deliveries usually represent only a miniscule share of trading volume – less than 1% for energy – overall."

Table 5: Measurement of the open interest multiple relative to daily consumption/usage, based on near month contract and adjusted for a 30-day delivery month		
	Crude oil	**Natural gas**
Daily consumption/usage	18 mmbbl	63 Bcf
Average open interest, 2005 - contracts	155,000	52,560
Average daily open interest, 30-day delivery month basis-2005	5 mmbbl	17 Bcf
Maximum open interest, 2005 - contracts	284,100	100,300
Maximum daily open interest, 30-day delivery month basis-2005	9 mmbbl	33 Bcf
"Multiple" – average	0.278	0.270
"Multiple" – maximum	0.500	0.524

For crude oil, the maximum open interest for a near-month contract during 2005 was 284,100 contracts, and for natural gas it was 100,300 contracts. These maximum open interest positions accounted for 284.1 million barrels of crude oil and 1,003 Bcf of natural gas, respectively. Since these volumes were to be delivered over an entire month, on a 30-day month basis the crude oil maximum open interest represents average daily volumes of 9 mmbbl, and the natural gas maximum open interest represents average daily volumes of 33 Bcf. These open interest positions, therefore, represent roughly 50 percent of the average daily usage for both commodities. These clearly account for a substantial share of the physical commodity market of the U.S. that underlies the futures market.

Summary and conclusion

The very large multiples over actual commodity usage claimed for trading on the energy futures markets are the result of miscalculations and incorrect analyses, which do not properly allocate the trading volumes over the delivery month. The proper allocation of futures trading volume

over the delivery month demonstrates that this activity represents a *fraction* of the daily U.S. usage of both crude oil and natural gas, *not* a multiple.

Nevertheless, the apparent liquidity offered by the average number of trades per minute and the share of the average usage represented by the maximum open interest leads to the conclusion that the energy futures markets provide the basis for transparent price discovery and risk mitigation. Moreover, in the context of the current debate over speculators and volatility there is not the massive excess trading that suggests the futures markets are a playground for non-commercial market manipulators.

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