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The oil futures markets

Introduction and Mechanics

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New material …

I have set up a new web page linked off of our other class materials that will include new articles, typically in pdf format, that we will collectively uncover in class. Most of this material will be optional reading and will exist as a source for focused research.

The link will found under *reading material* for this class on my course description page
http://www2.hmc.edu/~evans/hmcgre.html

Of interest is a new article by Akbari, Menon, and Rosenfeld about Urban Albedo soon to be published in *Climate Change* (older version posted).

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What are futures contracts?

A futures contract allows a trader to undertake a contract to accept delivery of a commodity or some kind of financial asset in the future on a known date under specified conditions for a price contracted today.

The party to the contract who is agreeing to take delivery of the commodity is **long** in the position, whereas the party who is agreeing to deliver the commodity is **short** in the position.

Through submission of bids and asks, the exchange will match long orders with short orders, either with outside traders or with their own trades.

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Key terms

- Spot price: Today's cash price.
- Futures price: Today's price of a specified futures contract, like Dec 2008 NYMEX light sweet crude contract.
- Expected future spot price: Exactly what the name implies. There is a theory that says that this price will not be the same as the futures price (normal backwardation).
- Volume (futures): The number of contracts traded today (or in any period of time)
- Open interest (futures): The number of contracts that are "open," that exist right now, that have a long and short position.
- e-Mini contract: A smaller contract in some commodity, usually about half the size, electronically traded.

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Example: NYMEX light sweet crude contracts

Light Sweet Crude Oil

Physical | Financial | miNY™ Futures | Options | NYMEX ClearPort®

Market Data
Current Session Overview
Current Expanded Table
Previous Session Overview
Previous Expanded Table
Contract Detail
Description
Specifications

9/2/2008 Session Overview

	Last	Open High	Open Low	High	Low	Most Recent Settle	Change
Oct 2008	110.80	n/a	116.65	118.60	110.60	115.46	-4.66
Nov 2008	111.21	n/a	117.00	118.31	111.10	115.85	-4.64
Dec 2008	111.83	n/a	118.38	118.95	111.66	116.31	-4.48
Jan 2009	112.38	n/a	118.13	118.20	112.24	116.68	-4.30
Feb 2009	118.20	n/a	117.83	118.20	117.75	116.94	+1.26
Mar 2009	112.80	n/a	115.30	115.30	112.80	117.13	-4.33

Note: These prices were active just as Hurricane Gustov was striking the Gulf Coast.

Source: http://www.nymex.com

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Light Sweet Crude Oil

Physical | Financial | miNY™ Futures | Options | NYMEX ClearPort®

9/2/2008 Session Contract Detail for Oct 8

Last	110.83
Open High	
Open Low	116.65
High	118.60
Low	110.60
Settle	115.46
Change	-4.63
Open Interest	289212
Volume	51880
Last Updated	9/1/2008 11:14:59 AM

A single contract, the October 2008 NYMEX LSCO.

Spot price was about 115 on Friday, Aug 29.

Note:

This and the previous slide reflect a special Labor Day session because of Hurricane Gustov. The market opened on Sunday, Aug 30 at 2:30 PM EST, at 118.

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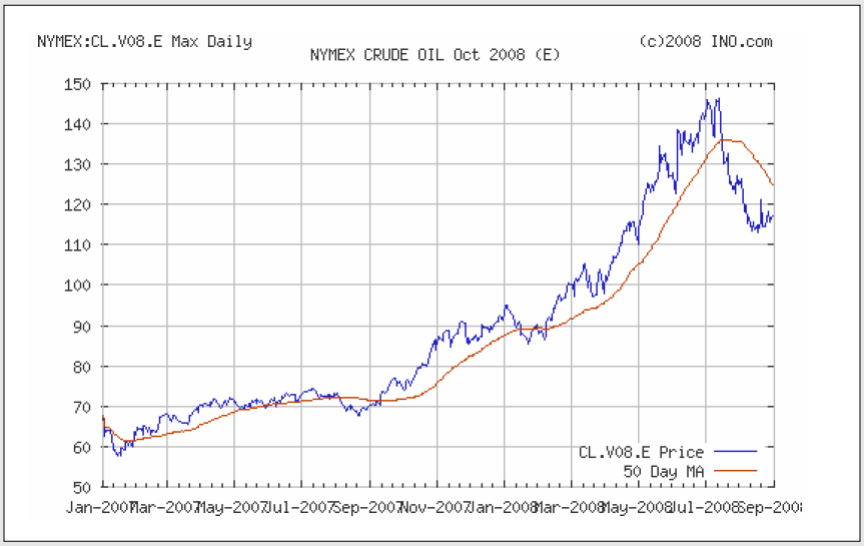
October 2008 NYMEX Crude



Source: http://www.ino.com

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An example of a futures contract

On September 1, 2008, you could have agreed to pay $110.83 per barrel (42 gallons) for 1,000 barrels of light sweet crude oil (with 0.42% sulfur or less) to be delivered at an agreed time during the month of October to a facility at Cushing, Oklahoma, F.O.B.

This contract was traded at the New York Mercantile Exchange, owned by the CMEGroup.

Like options, you can speculate or hedge in this contract without taking delivery - you simply reverse your position before the last trading day.

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What do we need to know (get from site)?

- Contract size
  - 1,000 bbls (42,000 gallons)
- Pricing of quote
  - $ per bbl ($110.83 [bb or ba])
- The exchange
  - New York Mercantile Exchange (CMEGroup)
- Initial margin requirement
  - $12,488 nm, $10,175 m

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need to know ... (cont).

- Maintenance (Day) Margin
  - $9,250
- Tick (minimum price fluctuation)
  - 1 cent per barrel or $10.00 per contract
- Last trading date
  - 3rd business day prior to the 25th day of the month in the preceding month of the contract.
  - 22 September for October Crude (see NYMEX chart)
- Delivery date or period
  - Any day in the contract month (October)
- Delivery location
  - Various named locations in Cushing, Oklahoma.

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Notes on these contracts

1. Short also
   - The previous example was for a long position (taking delivery or the equivalent). With futures, you are just as likely, and it is just as easy, to go short. With that position the trader *makes* delivery or the equivalent. In a spec position you benefit if the price goes down while you are in the contract.
2. Bid/Ask and limit orders
   - When you buy (long) or sell (short) a futures contract, you will pay close attention to the Bid/Ask queue, called the Depth of Market (DOM) queue, which is similar in structure to the NASDAQ Level II queue for stocks, and will likely use a limit order like you would do for stocks and options (see the OpenECry DOM for an example).
3. Implicit Leverage
   - Clearly with futures you have implicit leverage, which equals the *value of the position divided by the initial margin*. [Note the example in the second slide after this]. This leverage will clearly compound your gain or loss by the scale of the leverage.

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Settlement

Unlike options, futures are not paid for (which is to say, the commodity to be delivered is not paid for) until the delivery of the commodity.

The buyer of the future, however, is required to deposit funds in a special *margin account* which is, at the end of each day, adjusted to reflect the capital gain or loss. The starting required balance for this account is called the *initial margin*.

The seller is also required to maintain a margin account that is adjusted daily and if the seller does not own the commodity, may have to meet special requirements.

The account balance must always be kept above the *maintenance margin*, sometimes call the *day margin*.

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An example of margin account adjustment

October crude oil futures contract, long.

Date	Price	Position	Gain	Margin
0	110.83	110,830	0	12,488
1	109.72	109,720	-1110	11,378
2	108.65	108,650	-1070	10,308
3	106.89	106,890	-1760	8,548
4	107.44	107,440	550	9,098
5	109.12	109,120	1680	10,778
6	112.55	112,550	3430	14,208
				MC

Implicit leverage = 110,830/12,488 = 8.87 to 1

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How you pay for settlement

- If you go long (buy) on a futures contract for $110 (such as $110 per barrel of oil), and if you take delivery, you *will* end up paying $110 for the commodity.
- This payment, however, will consist of two components:
  - the price you pay at delivery, which is *spot* for that day, and
  - the results of the daily adjustment to your margin account, whether a capital gain or capital loss.

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Example

- In September, you buy an October Crude Oil future for $110.83 per barrel ($110,830). You are long. You want to take delivery.
- Spot price in September is $110.81 (not relevant to settlement).
- When October 22 arrives, spot price has risen to $112.55.
- Question: What are the settlement terms?
  - You take delivery of the oil at Oct spot ($112.55), *not* $110.83, so you pay $112,550.
  - You have gained $1,720 in your margin account.
  - The **total cost** of this contract to you is $110,830, exactly as contracted.

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Exiting the contract (offset)

Less than 1% of all futures contracts end with delivery of the commodity! Nearly all traders reverse their trades (called "offset") before the contract expiration date.

Remember that the futures price must converge to the spot price as the expiration date approaches. Open interest declines until it is zero.

Generally long positions exit at about the same pace as short positions, so open interest is gradually cleared off by the exchange.

Remember, you did not "buy" or pay for anything when you opened the contract. You agreed to daily settlement terms, which have been satisfied daily. When you offset you do not sell anything or get paid. You just inform your broker that you are closing out your trade and the exchange says goodbye.

Most ICE contracts allow either futures swaps (EFP) or cash settlement instead of delivery even if you do not offset.

Many non-commodity contracts do not have deliverables so offset is automatic.

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Questions and answers about pricing

Question: Spot and futures prices are sometimes very volatile. What, generally, is causing these price fluctuations.

Answer: These markets wouldn´t exist if prices weren´t volatile. There is no general answer about why prices rise and fall .. that depends upon the commodity. Coffee doesn´t follow the same cycle as crude oil (why would it)? Of course, at the root is basic supply and demand.

Generally, the many variables affecting production or supply on one side and the market for the product on the other will impact price, whether that is due to the weather, changes in consumer taste. Many commodity prices are affected by storage capacity, distribution capacity, interest rates, and other costs.

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Pricing fundamentals of tangible, storable commodities (like oil)

The prices of tangible, storable commodities like crude oil, natural gas, wheat, copper, and so forth are fundamentally determined by global trends in **supply** (production), **demand** (consumption), and stored **inventory**, which acts as a buffer between supply and demand. Often futures prices, which have a short-run orientation (although they are influenced by long-run expectations) are strongly affected by unexpected inventory fluctuations.

Energy Information Agency Data (weekly, monthly) on oil and nat gas influences prices greatly when expectations not met.

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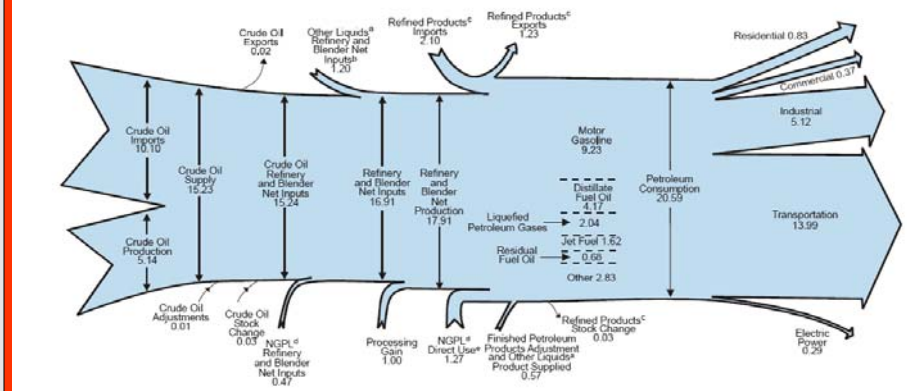
The U.S. Crude Oil Picture 2006



Quadrillion BTUs. Source: Energy Information Agency.

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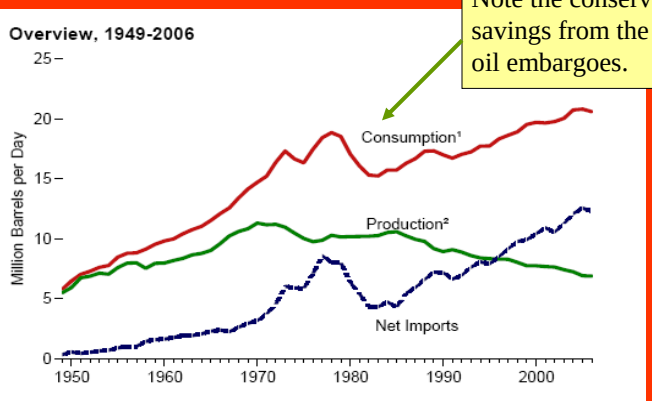
U.S. Petroleum Consumption, Production, Imports

Note the conservation savings from the OPEC oil embargoes.



In 2006, 20.59 million barrels per day used, 12.28 million imported (net).

Source: Energy Information Agency

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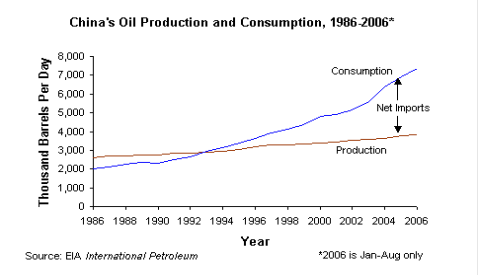
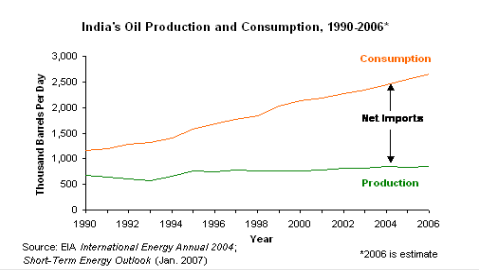
The impact of two new players on global demand



2nd largest consumer of petroleum products in 2004, passing Japan. Oil use is expected to grow at about 500 thousand barrels per day per year. Now responsible for 40% of growth in global oil demand.



India now uses 2.63 million barrels per day, 1.98 million imported. Oil use is expected to grow at about 100 thousand barrels per day per year.

Source: Energy Information Agency

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Supply and Demand Elasticity

a crash economics course

For either a supply or demand curve, ***elasticity*** defined to be the % change in quantity divided by the percentage change in price, mathematically

$$\frac{\Delta Q}{\Delta P} \times \frac{P}{Q} \quad \text{or} \quad \frac{\partial Q}{\partial P}\frac{P}{Q}$$

along a supply or demand curve. A supply curve is said to be ***inelastic*** when this value is less than zero, ***elastic*** greater than zero. For example, if the supply curve is inelastic at 0.25, a shift of demand along a supply curve of 1% will cause a 4% rise in price.

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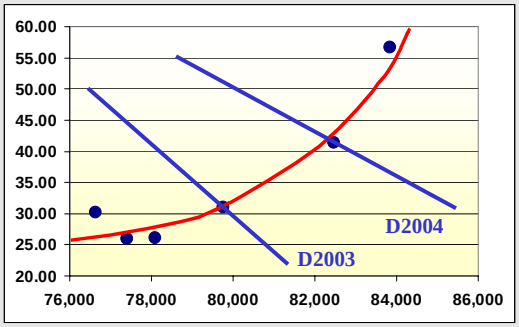
Severe Supply Inelasticity of Oil

Global Oil Market

	Demand	Price
2000	76,619	30.26
2001	77,406	25.95
2002	78,082	26.15
2003	79,742	30.99
2004	82,452	41.47
2005	83,837	56.70

Daily millions barrels

Source: EIA



WEFA study commissioned by the American Petroleum Institute in 1990 concluded that the supply elasticity of oil was only 0.13! (controversial)

Data source: Energy Information Agency.

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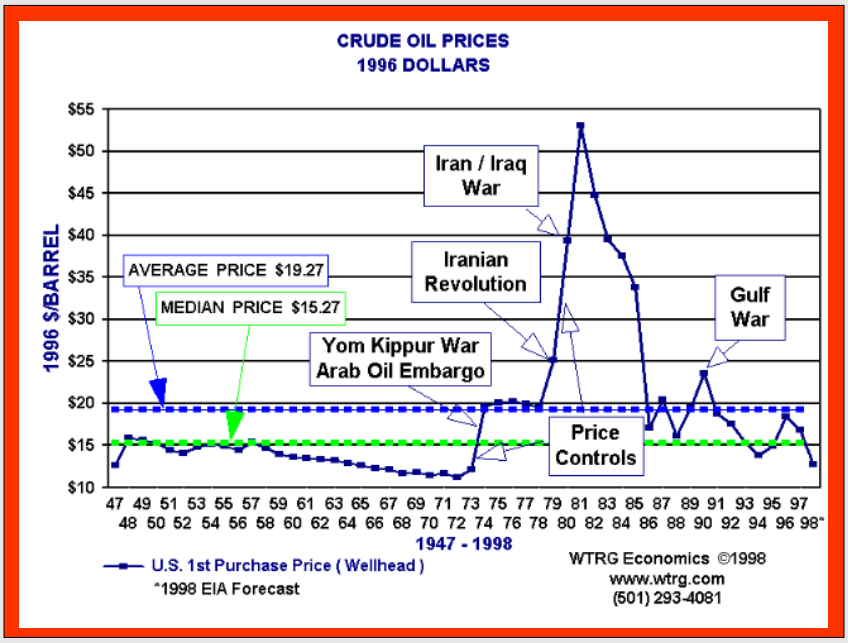

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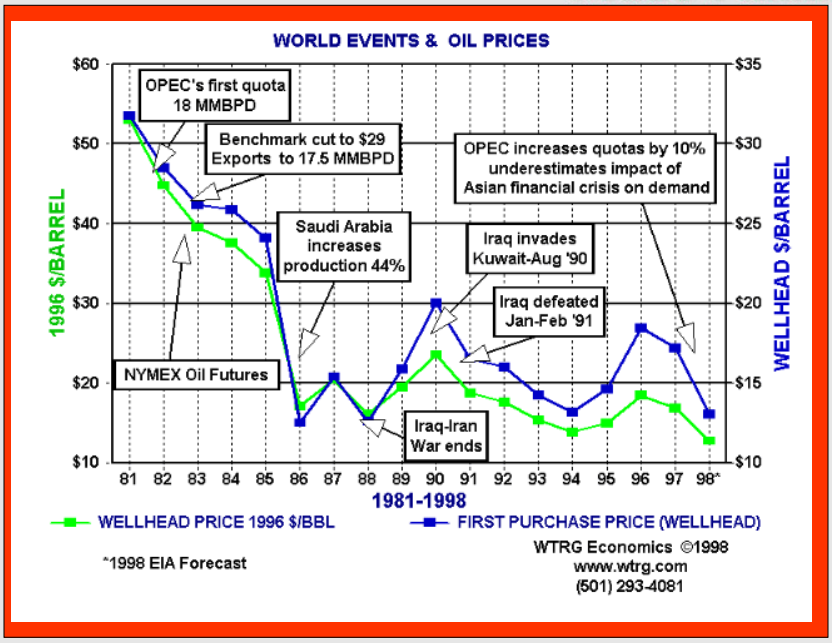

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Momentum markets

Substantial excess speculation can push financial asset prices up at exponential rates into ranges that economically make no sense. This can happen for an individual stock, an entire industry, or an entire market, for debt instruments and certainly real estate. For the stock market, such a cycle usually begins when stocks are truly undervalued, justifying a rapid rise, which begins to happen. Then heavy and immediate capital gains produces a market euphoria where speculative investments, in part from unsophisticated investors (even institutional investors) blows the market higher and higher. In the final phase of the market explosion, the only operative variable is ***momentum***. The clear, obvious, and well-publicized profits being made attracts more money which, results in more demand, which causes prices to accelerate. Sometimes the rise is exponential in the final phase before the *correction*, which is sometimes a collapse. Of course if the primary assets are accelerating, just imagine what the *derivatives* are doing. And just imagine what the derivatives do during the collapse if that happens.

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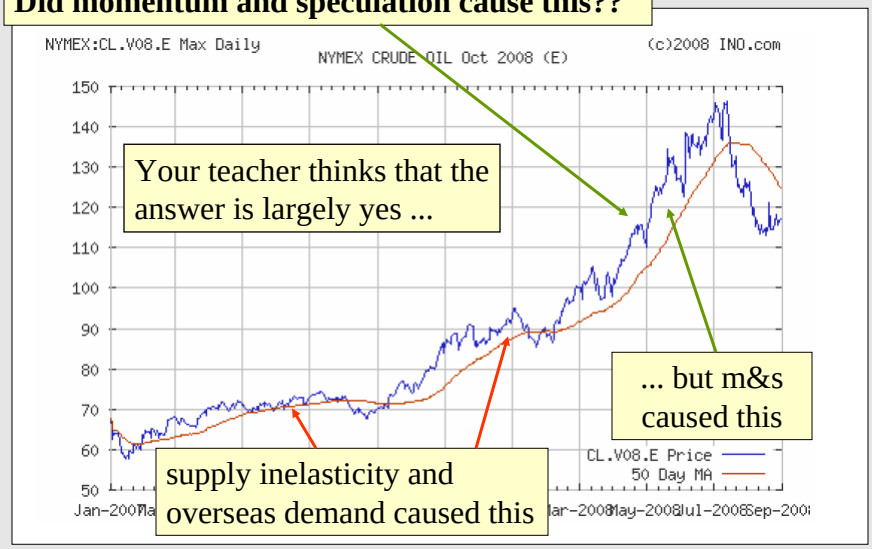
Did momentum and speculation cause this??



Your teacher thinks that the answer is largely yes ...

... but m&s caused this

supply inelasticity and overseas demand caused this

Source: http://www.ino.com

An example where inventory matters ...

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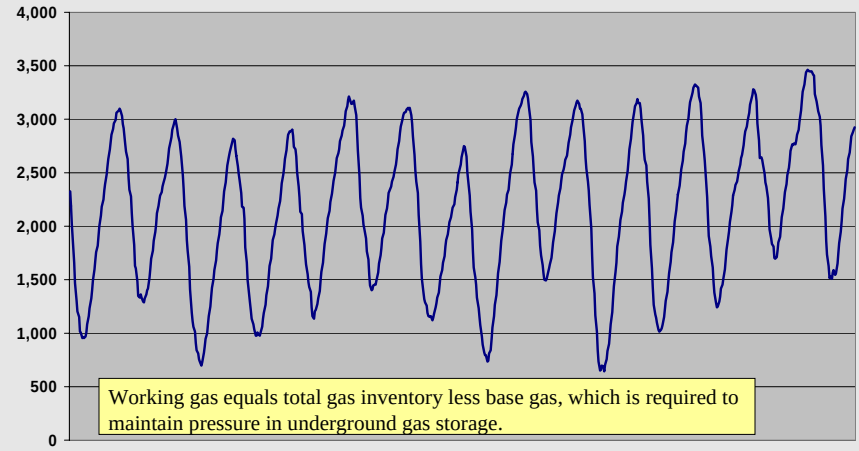
Natural Gas Underground Working Gas Inventories

Weekly data, December 1993 to August 2007

Billions of cubic feet



Working gas equals total gas inventory less base gas, which is required to maintain pressure in underground gas storage.

Source: Energy Information Administration

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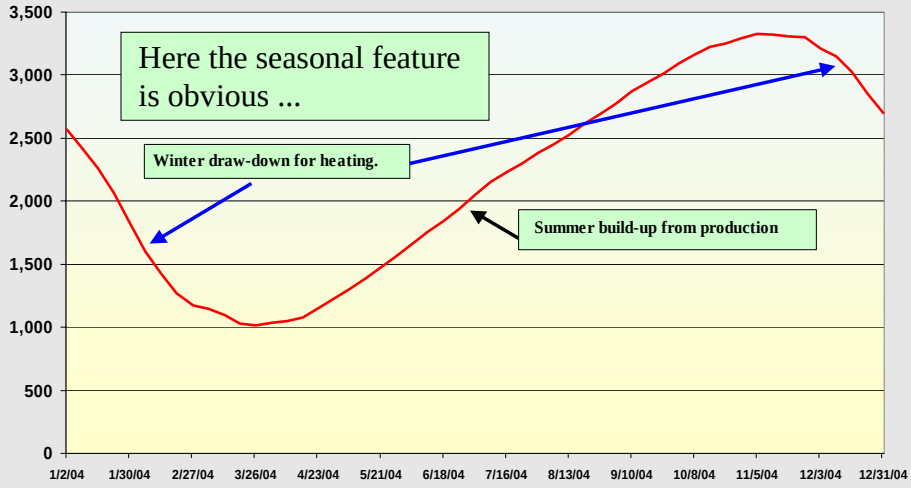
Working Underground Gas Inventories for a "Typical" Year: 2004



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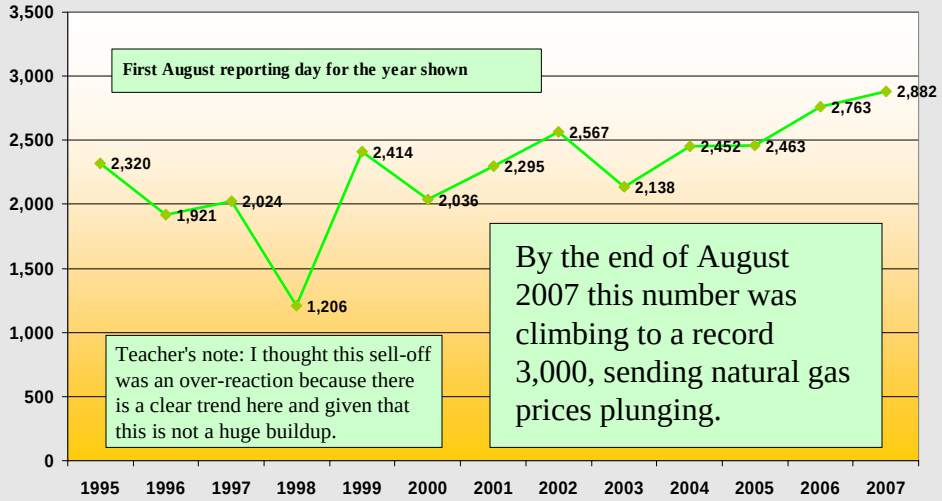
Comparing equivalent dates for different years: working gas Aug 1995- Aug 2007



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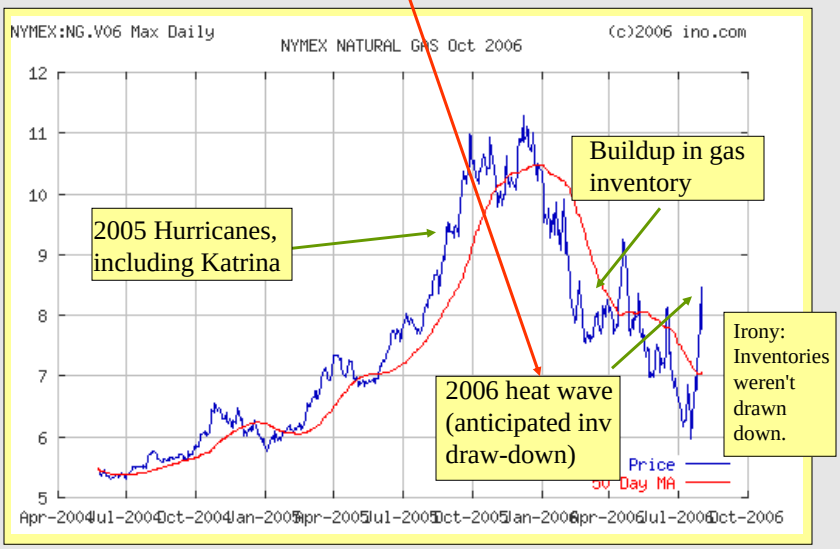
Mother Rock hedge fund forced to liquidate and shut down due to heat wave spike (they were short based on inventory data).

Price history of Oct 2006 NYMEX Natural Gas



Buildup in gas inventory

2005 Hurricanes, including Katrina

2006 heat wave (anticipated inv draw-down)

Irony: Inventories weren't drawn down.

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Amaranth's Collapse: Sep 2006

Not long after Mother Rock was liquidated because they were short in the natural gas spike of the July 2006 spike a much larger fund, Amaranth Advisors, revealed that they had lost $5 billion in a single week because of the trades of a single 32-year old trader, ultimately reducing the fund's value from $9 to $4.5 billion. This fund had a reputation of using "a world-class risk-management system." *This trader went long in natural gas contracts during the spike. Given that Mother Rock was short and Amaranth was long, and they both went broke, this shows the impact of leverage and margin requirements.*

According to the Wall Street Journal, "The risk models used by the hedge fund use historic data, but the natural gas markets have been more volatile this year than any year since 2001, making models less useful."

Both of these hedge funds were essentially destroyed by settlement. Remember, one was long and the other short during the same event.

For the account of Amaranth's collapse, see "What Went Wrong at Amaranth," *The Wall Street Journal*, page C1, September 20, 2006.