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Amaranth Lessons Thus Far

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Abstract

In September 2006, Amaranth Advisors, LLC collapsed under the weight of losses, which were reported as $6.6-billion. Unfortunately, this meant that the fund had become responsible for the largest hedge-fund debacle to have thus far occurred.

There were and are many surprising aspects of this debacle. How could a well-respected hedge fund implode so quickly? Could this multi-strategy hedge fund really have become one big bet on winter natural gas prices? How could Amaranth have amassed such huge derivatives positions in natural gas, comparable in size to nationwide residential natural gas consumption, without any regulators noticing? Given the scale of Amaranth's losses, why didn't this debacle lead to wider systematic distress in the financial markets?

This article will provide some answers to these questions by reviewing and analyzing the publicly available information that is known as of this point.

On September 18th, 2006, market participants were made aware of a large hedge fund's distress. On that date, the founder of Amaranth Advisors, LLC, had issued a letter to his investors, informing them that the fund had lost an estimated 50% of their assets month-to-date. By the end of September 2006, these losses amounted to $6.6-billion, making Amaranth's collapse the largest hedge-fund debacle to have thus far occurred.

There were (and are) many surprising aspects of this debacle. How could a well-respected hedge fund implode so quickly? Could this multi-strategy hedge fund really have become one big bet on winter natural gas prices? How could Amaranth have amassed such huge derivatives positions in natural gas, comparable in size to nationwide residential natural gas consumption, without any regulators noticing? Given the scale of Amaranth's losses, why didn't this debacle lead to wider systematic distress in the financial markets? That seemed to be a key worry following Long-Term Capital Management's (LTCM's) massive losses in 1998. Why didn't that worry apply with Amaranth's troubles?

This article will attempt to answer these questions by reviewing and analyzing the publicly available information that is known at this point. The paper will specifically discuss:

- Amaranth's energy trading strategies;
- The fundamental rationale for these strategies; and
- Basic risk analyses that would have provided red-flags before the fund's collapse.

We will also briefly cover:

- The U.S. government's response to this hedge fund's crisis; and
- Wider lessons for market participants.

One caveat regarding this paper's content is that it is necessarily incomplete because litigation against (and by) Amaranth is still ongoing.

Brief Background on Amaranth

Amaranth Advisors, LLC was a multi-strategy hedge fund, which was founded in 2000 and was headquartered in Greenwich, Connecticut. The founder's original expertise was in convertible bonds. The fund later became involved in merger arbitrage, long-short equity, leveraged loans, blank-check companies, and in energy trading. As of June 30th of 2006, energy trades accounted for about half of the fund's capital and generated about 75 percent of its profits, according to Burton and Leising (2006).

Davis (2006) has provided the best overview thus far on Amaranth's energy trading. The following account largely draws from her article.

Davis reported that Amaranth's head energy trader sometimes held "open positions to buy or sell tens of billions of dollars of commodities." Amaranth's energy trading operation was based in Calgary, Alberta.

"[Amaranth's head energy trader] saw that a surplus of [natural] gas this summer [in the U.S.] could lead to low prices, but he also made bets that would pay off if, say, a hurricane or cold winter sharply reduced supplies by the end of winter. He was also willing to buy gas in even further-away years, as part of complex strategies."

"Buying what is known as 'winter' gas years into the future is a risky proposition because that market has many fewer traders than do contracts for months close at hand."

"Unlike oil, [natural] gas can't readily be moved about the globe to fill local shortages or relieve local supplies."

"[Natural gas] traders … make complex wagers on gas at multiple points in the future, betting, say, that it will be cheap in the summer if there is a lot of supply, but expensive by a certain point in the winter. [Amaranth's head trader would] closely watch how weather affects prices and whether conditions will lead to more, or less, gas in a finite number of underground storage caverns."

Amaranth's structural position-taking may have assisted energy companies in their need to hedge their far-forward production, including through 2010.

"[Amaranth's energy book] was up for the year roughly $2 billion by April, scoring a return of 11% to 13% that month alone, say investors in the Amaranth fund. Then … [the energy strategies] … had a loss of nearly $1 billion in May when prices of gas for delivery far in the future suddenly collapsed, investors add. [The energy traders] won back the $1 billion over the summer …"

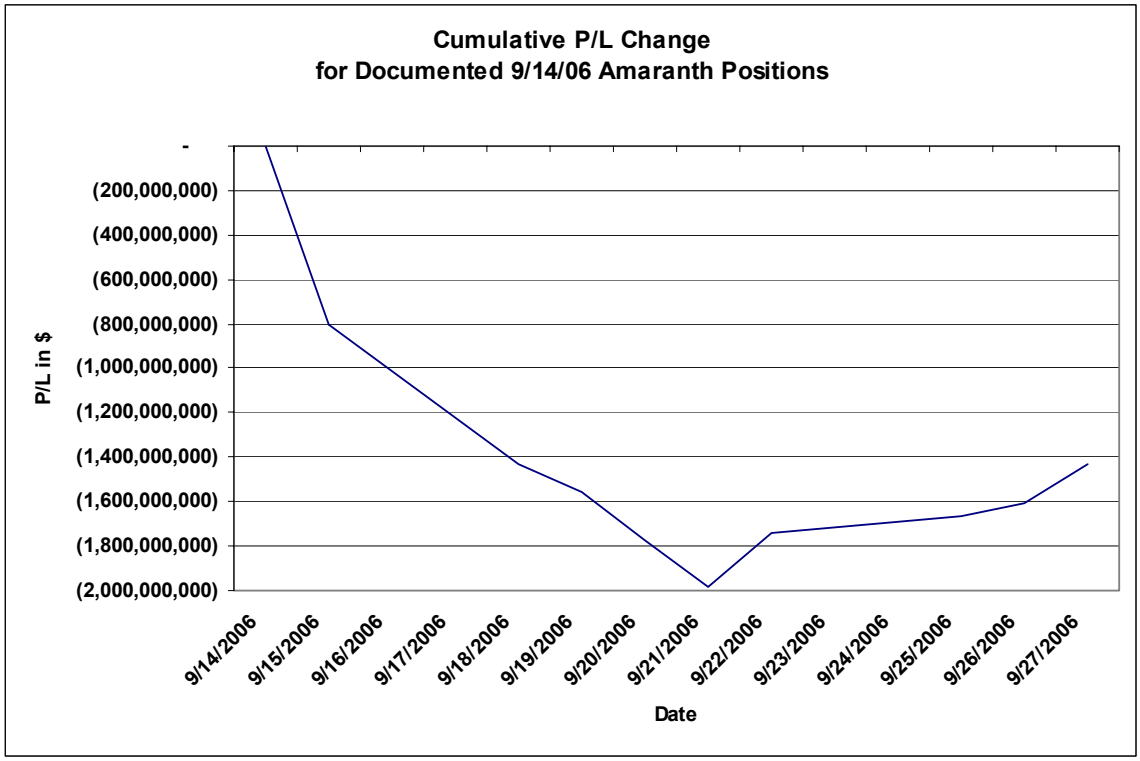
As of 8/31/06, the fund had about $9.2 billion in assets under management.

On Monday, September 18th, 2006, market participants were made aware of Amaranth's distress. The founder had issued a letter to investors, informing them that the fund had lost an estimated 50% of their assets since its end-August value. Additionally, the fund had lost -$560 million on Thursday, 9/14/06 alone, according to *Reuters* (2006).

According to Davis *et al.* (2007), the fund had scrambled to transfer its positions to third-party financial institutions during the weekend of 9/16 to 9/17. Merrill Lynch had agreed to take on 25% of the fund's natural gas positions for a payment of about $250 million. The fund then lost a further $800 million through Tuesday, 9/19/06, due to the natural gas market moving severely against its positions. On Wednesday, 9/20/06, the fund succeeded in transferring its remaining energy positions to Citadel Investment Group and to its clearing broker, JP Morgan Chase, at a -$2.15 billion discount to their 9/19/06 mark-to-market value. On Thursday, 9/21/06, the natural gas curve stabilized. Figure 1 shows the cumulative p/l for Amaranth's 9/14/06 positions, again showing that this p/l bottomed out on 9/21/06, one day after the fund's positions were transferred to two financial intermediaries.

The hedge-fund's losses ultimately totaled $6.6 billion, according to O'Reilly (2007).

Figure 1



Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

This graph is constructed from Amaranth's 9/14/06 positions, as graphically documented in "Excessive Speculation in the Natural Gas Market," Staff Report of the Permanent Subcommittee on Investigations (PSI), Committee on Homeland Security and Government Affairs, United States Senate, 6/25/07, Appendix IV, page 175; and from NYMEX natural gas futures prices downloaded from The Bloomberg.

Trading Strategies

As discussed in Till (2007b), Amaranth Advisors, LLC had employed a natural gas spread strategy that would have benefited under a number of different weather-shock scenarios, but did so on a scale that still surprises market participants.

On June 25th, 2007, the U.S. Senate Permanent Subcommittee on Investigations (PSI) released a report on the Amaranth debacle, entitled, "Excessive Speculation in the Natural Gas Market."

The 135-page report (and its further 345 pages of appendices) provided a wealth of detail on the Amaranth case. In carrying out their forensic analysis, the Senate subcommittee examined several million individual trades. The subcommittee obtained this information by subpoenaing records from the New York Mercantile Exchange (NYMEX), the Intercontinental Exchange (ICE), Amaranth, and other traders.

The PSI found that, for example, in late July 2006, Amaranth's natural-gas positions for delivery in January 2007 represented "*a volume of natural gas that equaled the entire amount of natural gas eventually used in that month by U.S. residential consumers nationwide*." [Italics added.]

Drawing from the U.S. Senate's report, Figure 2 summarizes the scale of Amaranth's natural gas trading activity. Figure 3 draws from the report's appendix to show the positioning of the fund through May 2009, as of the end of August 2006. The U.S. Senate report does not include similar charts for the fund's positions past the May 2009 maturity date. The report also does not explicitly include the fund's other miscellaneous commodity investments.

Amaranth's core energy trading strategies were constructed through calendar spreads, which were executed on both the New York Mercantile Exchange (NYMEX) and the Intercontinental Exchange (ICE).

A calendar spread is the difference in price between two different delivery months for a futures contract. As discussed in Till (2007a), there are reasonably *short-horizon* price-pressure effects on futures calendar spreads that are due to the seasonal hedging of commodity inventories, including in the natural gas markets.

Amaranth's spread trading strategy involved taking long positions in winter contract deliveries and short positions in non-winter contract deliveries. These positions would have benefited from potential weather events such as hurricanes and cold-shocks from 2006 through 2010.

Figure 2

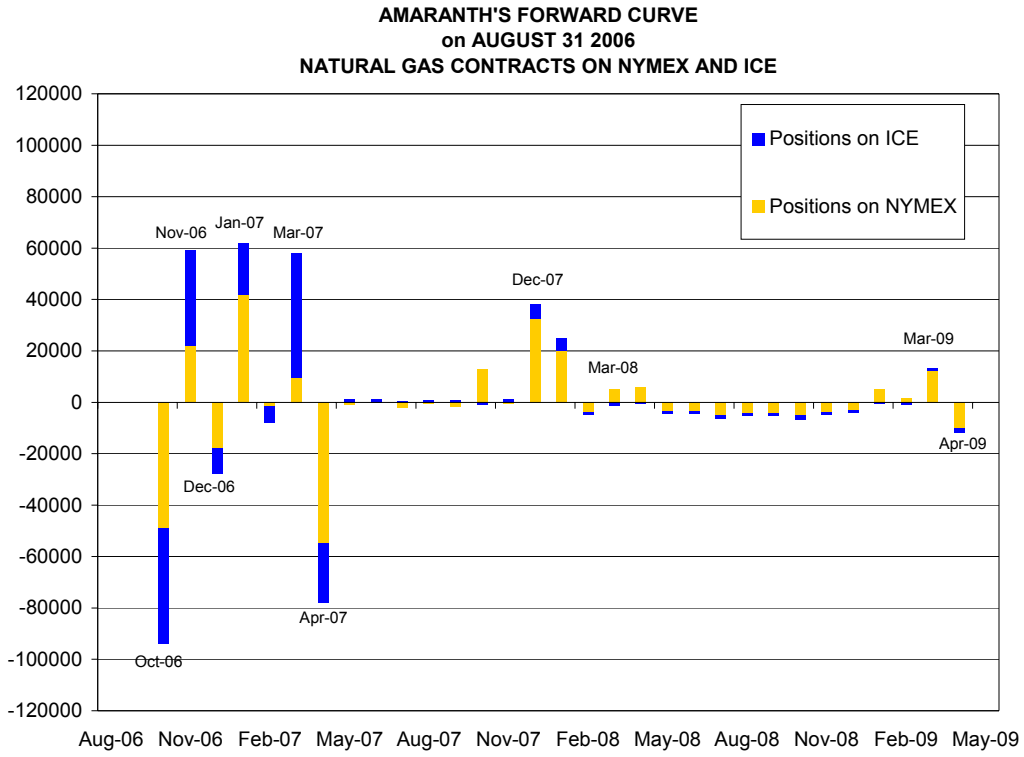
Scale of Amaranth's Natural Gas Trading

At times Amaranth controlled up to 40% of all the open interest on NYMEX for the winter months (October 2006 through March 2007).	pp. 51-52
In late July 2006, Amaranth held a total of more than 80,000 NYMEX and ICE contracts for January 2007, representing a volume of natural gas that equaled the entire amount of natural gas eventually used in that month by U.S. residential consumers nationwide.	p. 52
On July 31st, 2006, Amaranth's trading in the March and April 2007 contracts represented almost 70% of the total NYMEX trading volume in each of these contracts on that date.	p. 52
Amaranth held large positions in winter and summer months spanning the five-year period from 2006-2010.	p. 52
For example, Amaranth held 60% of the outstanding contracts (open interest) in all NYMEX natural gas futures contracts for 2010.	p. 52
On 7/24/06, Amaranth's futures position as a % of NYMEX futures open interest in the December 2007 contract was 81%.	p. 94
On 8/28/06, Amaranth accounted for over 40% of the total volume on the ICE, and over 25% of the entire volume of exchange-traded futures and swaps on NYMEX and on ICE on that date.	p. 101

NYMEX: New York Mercantile Exchange
ICE: Intercontinental Exchange

Source: "Excessive Speculation in the Natural Gas Market," Staff Report of the Permanent Subcommittee on Investigations, Committee on Homeland Security and Government Affairs, United States Senate, 6/25/07, as summarized in Till, Hilary, "A Brief Review of the U.S. Senate Report on the Amaranth Debacle," *EDHEC-Risk Industry Analysis*, 7/6/07.

Figure 3



Source: "Excessive Speculation in the Natural Gas Market," Staff Report of the Permanent Subcommittee on Investigations, Committee on Homeland Security and Government Affairs, United States Senate, 6/25/07, Appendix V, p. 38.

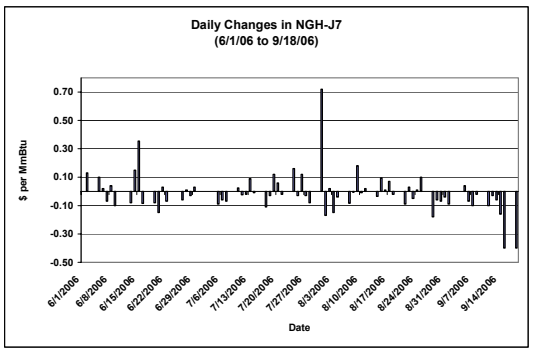
Returns-Based Analysis

Market participants did not have to wait for the June 2007 Senate report to draw early lessons from the Amaranth crisis. Soon after the debacle, several authors, including Till (2006), McCullough (2006), Petzel (2006), and Chincarini (2007), were able to infer the types and magnitudes of the fund's positions. Participants were able to do so from examining dislocations in the natural-gas futures curve.

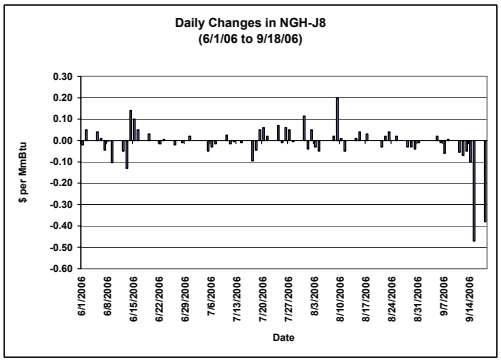
Figures 4 and 5 show how large the changes for various spread relationships were across the natural gas curve on 9/15/06 and 9/18/06, which at the time indicated to market participants that a distressed liquidation was taking place, given that these moves were very large standard-deviation moves compared to recent history.

Figure 4

Daily Changes in March-April Natural Gas Spreads
2007 through 2011 Deliveries
6/1/06 to 9/18/06



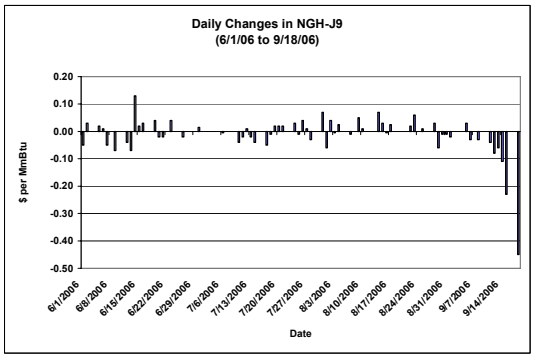
Using data from 5/31/06 to 8/31/06, the change in the NGH-J7 (Natural Gas March-April 2007) spread on 9/15/06 was -3.1 standard deviations.



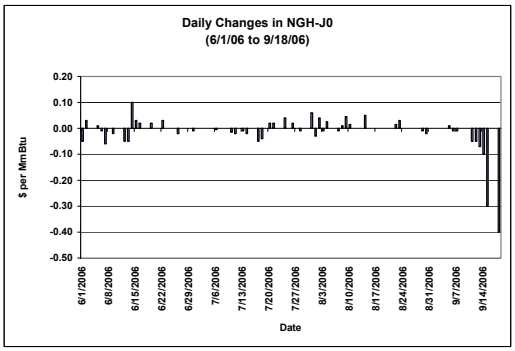
Using data from 5/31/06 to 8/31/06, the change in the NGH-J8 (Natural Gas March-April 2008) spread on 9/15/06 was -9.0 standard deviations.

H is the futures symbol for the March contract; J is the symbol for the April contract.

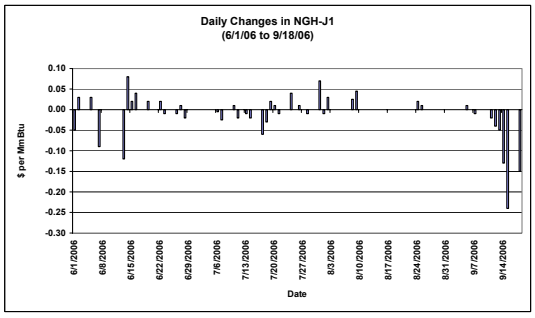
Data source: The Bloomberg



Using data from 5/31/06 to 8/31/06, the change in the NGH-J9 (Natural Gas March-April 2009) spread on 9/15/06 was -6.5 standard deviations.



Using data from 5/31/06 to 8/31/06, the change in the NGH-J0 (Natural Gas March-April 2010) spread on 9/15/06 was -11.1 standard deviations.

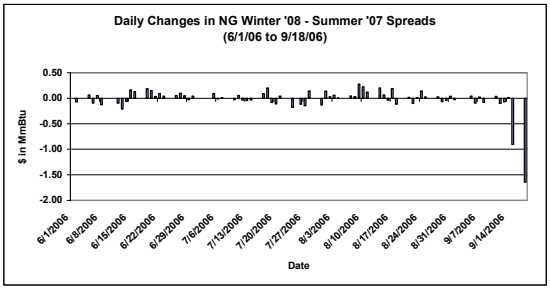


Using data from 5/31/06 to 8/31/06, the change in the NGH-J1 (Natural Gas March-April 2010) spread on 9/15/06 was -8.2 standard deviations.

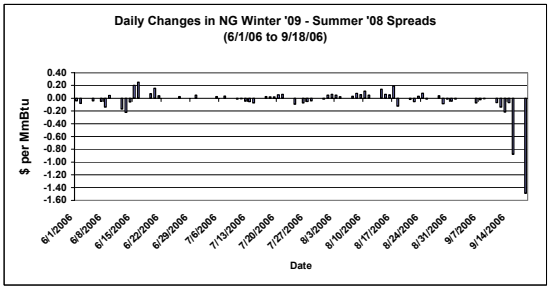
Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

Figure 5

Daily Changes in Winter-Summer Natural Gas Spreads
2007 through 2011 Deliveries
6/1/06 to 9/18/06

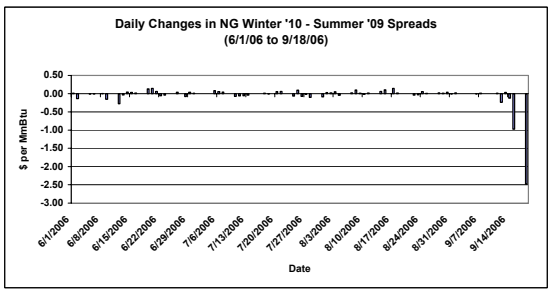


Using data from 5/31/06 to 8/31/06, the change in the Natural Gas Winter '08 - Summer '07 spread on 9/15/06 was -8.7 standard deviations.

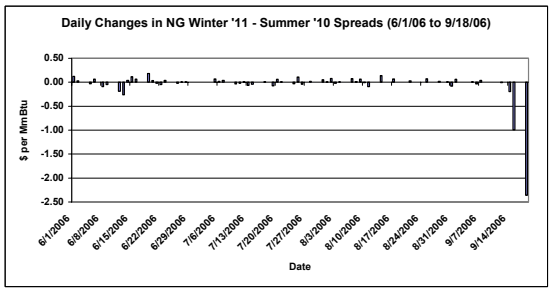


Using data from 5/31/06 to 8/31/06, the change in the Natural Gas Winter '09 - Summer '08 spread on 9/15/06 was -10.9 standard deviations.

Data source: The Bloomberg



Using data from 5/31/06 to 8/31/06, the change in the Natural Gas Winter '10 - Summer '09 spread on 9/15/06 was -13.9 standard deviations.



Using data from 5/31/06 to 8/31/06, the change in the Natural Gas Winter '11 - Summer '10 spread on 9/15/06 was -14.7 standard deviations.

Note: The definition of Winter vs. Summer natural gas spreads is long the December, January, February, and March forward maturities, and short the June, July, August, and September maturities.

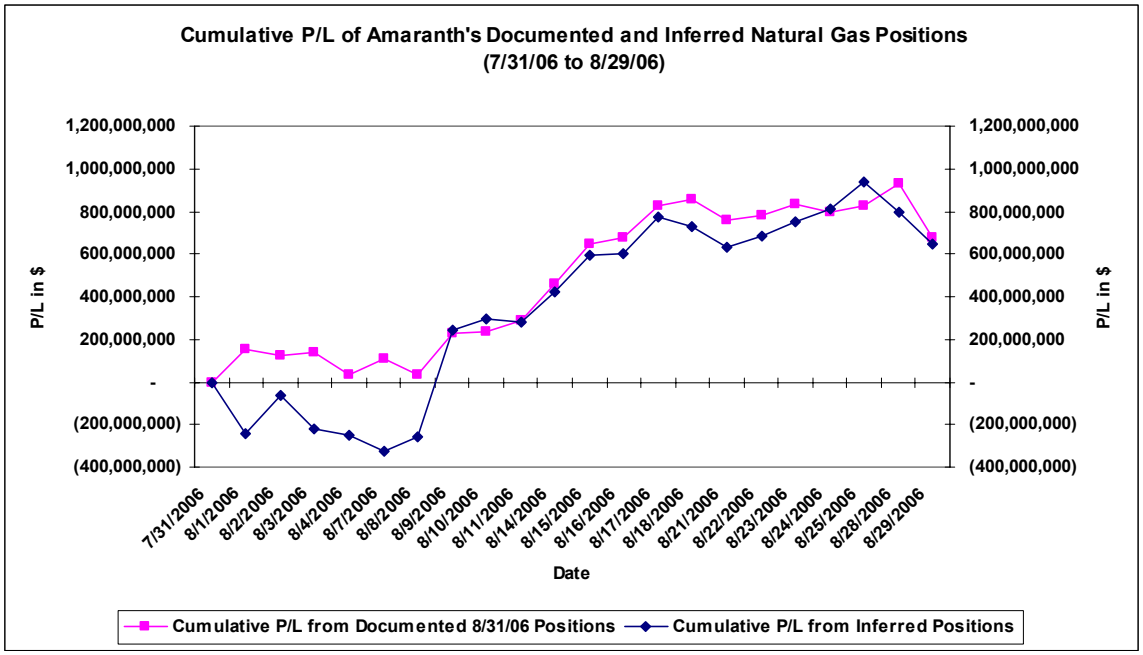
Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

As seen in Figures 4 and 5, the winter-month contracts collapsed with respect to the non-winter-month contracts in the near-month-through-2011 forward-maturities for natural gas.

One of the key insights in the Weisman and Abernathy (2000) approach to returns-based analysis is to use inflection points in a fund's profits and losses (p/l) to infer a fund's underlying exposures. It is mainly when there are inflection points in a fund's p/l, which coincide with large market moves, that a fund's exposures reveal themselves. This is precisely what happened with Amaranth in mid-September 2006: given that there were very large standard-deviation moves in the natural gas curve, which were coincident with public reports of extremely large losses on the part of Amaranth, a number of market participants, including this author, inferred the key risk exposures of the fund in late September.

Figure 6 shows how closely correlated a 9/26/06 analysis of Amaranth's inferred exposures was to the fund's actual positions. We reconstructed Amaranth's actual positions from the Senate report's graphical representation of the fund's positions, which were shown in Figure 3.

Figure 6



Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

Source of Documented 8/31/06 Positions: "Excessive Speculation in the Natural Gas Market," Staff Report of the Permanent Subcommittee on Investigations, Committee on Homeland Security and Government Affairs, United States Senate, 6/25/07, Appendix V, p. 38.

Source of Inferred Exposures: Till, Hilary, "EDHEC Comments on the Amaranth Case: Early Lessons from the Debacle," *EDHEC-Risk Publication*, 10/2/06.

Fundamental Rationale for Strategies

What was the fundamental rationale for Amaranth's positioning in being long winter vs. non-winter natural-gas contracts?

In order to answer this question, one needs to provide some background on the U.S. natural gas market.

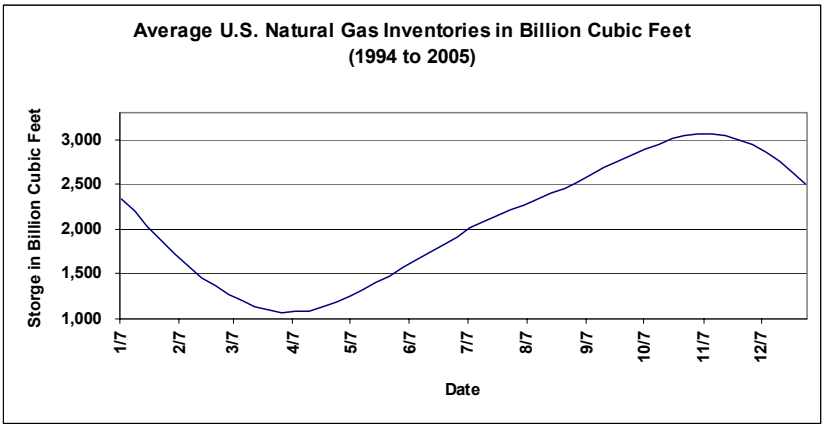
Natural gas derivatives trading has offered hedge funds a potentially alluring combination of scalability and volatility, and also at times, pockets of predictability. Traders have been able to access these markets through the NYMEX for exchange-traded exposure or through the ICE for over-the-counter exposure.

The key economic function for natural gas is to provide for heating demand during the winter in the northern states of the United States. Natural gas is also a key energy source for air-conditioning demand during the summer.

There is a long "injection season" from the spring-through-the-fall in which natural gas is injected and stored in caverns for later use during the long winter season.

Figure 7 illustrates the normal seasonal pattern of builds and draws in natural gas throughout the year.

Figure 7



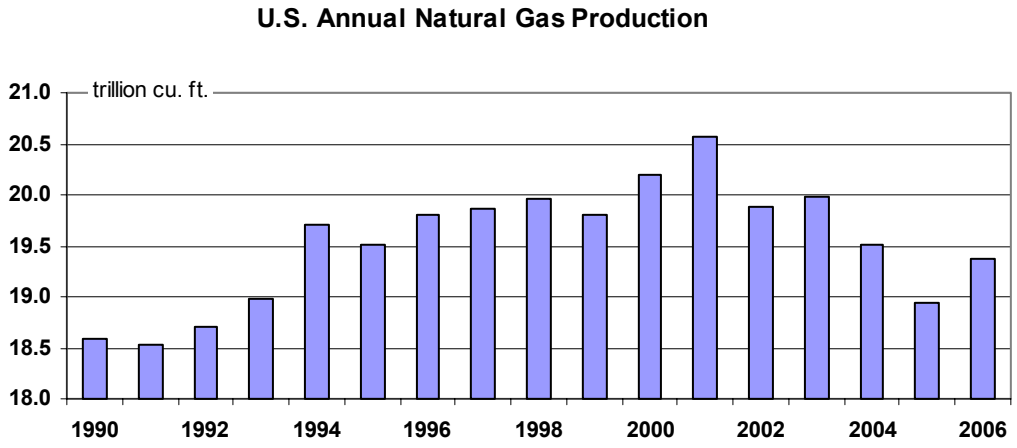
Note: This graph specifically shows the U.S. Department of Energy's total estimated storage data for working natural gas inventories averaged over the period, 1994 to 2005.

Data Source: The Bloomberg.

Several technical points make natural gas an especially volatile commodity market:

- Domestic natural gas production has not kept pace with increasing demand for this commodity; this point is illustrated in Figures 8 and 9;
- The U.S. natural gas markets are largely insulated, at least in the short-term, from global energy factors, since only a small amount of U.S. natural gas needs are met through imports of Liquid Natural Gas (LNG);
- There is arguably insufficient storage capacity of natural gas to meet demand if there was a particularly severe winter; and
- At the end of winter, inventories at some facilities have to be cycled out of storage, regardless of price, in order to maintain the integrity of storage facilities.

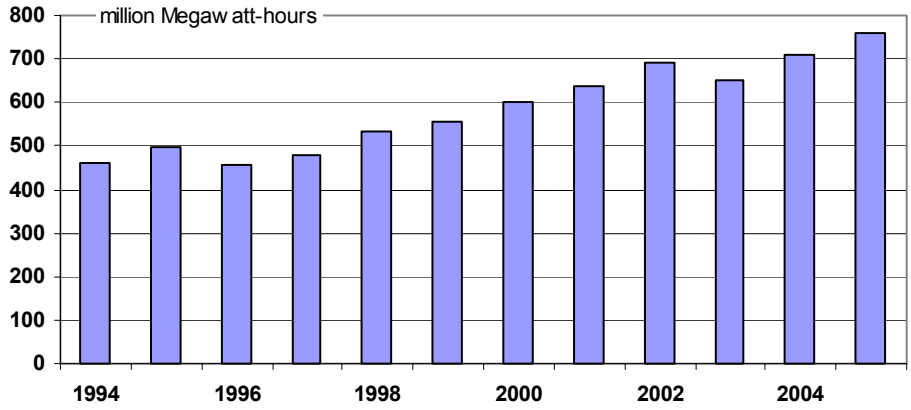
Figure 8



Source: This chart is based on Figure 10 of "Excessive Speculation in the Natural Gas Market," Staff Report of the Permanent Subcommittee on Investigations, Committee on Homeland Security and Government Affairs, United States Senate, 6/25/07, page 19.

Figure 9

Electricity Generated by Natural Gas



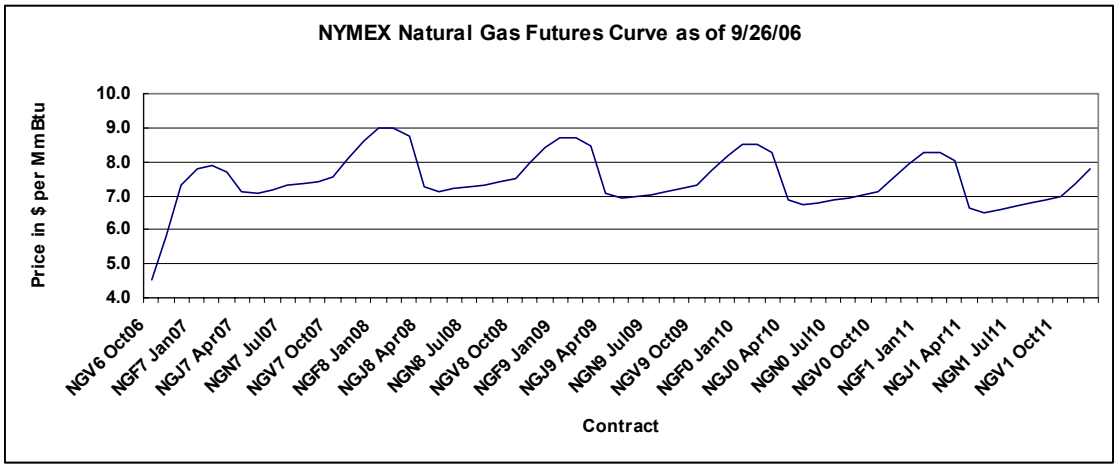
Source: This chart is based on Figure 11 of "Excessive Speculation in the Natural Gas Market," Staff Report of the Permanent Subcommittee on Investigations, Committee on Homeland Security and Government Affairs, United States Senate, 6/25/07, page 20.

In essence, the technical issues with natural gas mean that it is (arguably) a quasi-storable commodity. This has a direct impact on the pricing relationships between different delivery months for natural gas.

In all commodity futures markets, there is a different price for a commodity, depending on when the commodity is to be delivered. For example, with natural gas, a futures contract whose delivery is in October will have a different price than a contract whose delivery is in December. Commodity traders will frequently specialize in understanding the factors that impact the spread between two delivery months; this is known as *calendar-spread* trading, as noted previously. In our example, a futures trader may trade the spread between the October vs. December futures contracts.

Figure 10 shows the futures curve for natural gas of 9/26/06. We refer to the term structure of a commodity futures market as a curve since each delivery-month contract is plotted on the x-axis with their respective prices on the y-axis; thus, a curve is traced out.

Figure 10



Data source: The Bloomberg.

When the near-month futures contracts trade at a discount to further-delivery contracts, one says that the futures curve is in *contango*. When the near-month futures contracts instead trade at a premium to further-delivery contracts, one says the futures curve is in *backwardation*.

One can note that the yearly futures curves for natural gas in Figure 10 mirror the average inventory build-and-draw pattern of Figure 7. The prices of summer and fall futures contracts typically trade at a discount to the winter contracts. The markets thus provide a return for storing natural gas. An owner of a storage facility can buy summer natural gas and simultaneously sell winter natural gas via the futures markets. This difference will be the storage operator's return for storage. When the summer futures contract matures, the storage operator can take delivery of the physical natural gas, and inject this natural gas into storage. Later when the operator's winter futures contract matures, the operator can make delivery of the physical natural gas by drawing physical natural gas out of storage for this purpose. As long as the operator's financing and physical outlay costs are under the spread locked in through the futures market, then this operation will be profitable.

The example provided above is actually a highly simplified version of how storage operators can choose to monetize the value of their physical assets. Sophisticated (unregulated) storage operators can *potentially* value their storage facilities as complex options on calendar-spreads. Storage is worth more if the calendar spreads in natural gas are volatile. As a calendar spread trades in steep contango, storage operators can buy the near-month contracts and sell the further-out month contracts, knowing that they can ultimately realize the value of this spread through storage. But a preferable scenario would be for the spread to then tighten, which means that they can trade out of the spread as a profit. Later if the spread trades in wide contango again, they can reinitiate a purchase of the near-month versus far-month spread. As long as the spread is volatile, the operator/trader can continually lock in profits, and if they cannot trade out of the spread at a profit, they can then take physical delivery and realize the value of their storage facility that way. Again, admittedly, this explanation is also quite simplified, but does convey the essence of the process.

It is our expectation that both storage operators and natural gas producers were the ultimate counterparties to Amaranth's sizeable spread trading.

Why are natural gas spreads so volatile? It is only when a commodity is fully storable, that commodity spreads can be predictably stable. In that case, the determining factor between the value of one contract versus a later-month contract is the cost of storing and financing the commodity from one period to the next.

With U.S. natural gas, storage capacity has actually declined since 1989. Further, domestic production has not kept pace with demand. These factors have caused massive volatility in the outright price of natural gas and in the price relationships between different sectors of the natural gas curve. To give one an idea of natural gas' volatility, on 9/26/06, the implied volatility of one-month, at-the-money natural gas options was 92.5%. This was the case even though there were no hurricanes, heat-waves, or cold-shocks presently confronting this market at the time.

The outright price of natural gas as well as the spread relationships in this market are highly sensitive to the prevailing storage situation for the commodity.

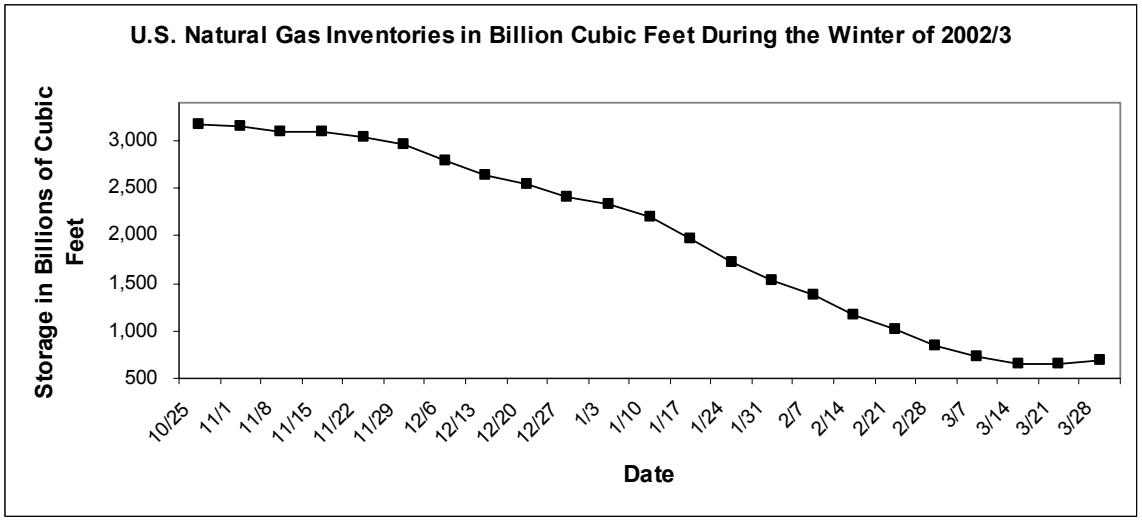
During the summer if there are hurricanes in the U.S., concerns emerge that not enough natural gas will be produced and stored for winter needs. In that scenario, the front-month contract's price has exploded to discourage current demand, and the futures curve has traded in steeper contango to provide a further enhanced return for storage. This eventually occurred in the aftermath of Hurricane Katrina in 2005.

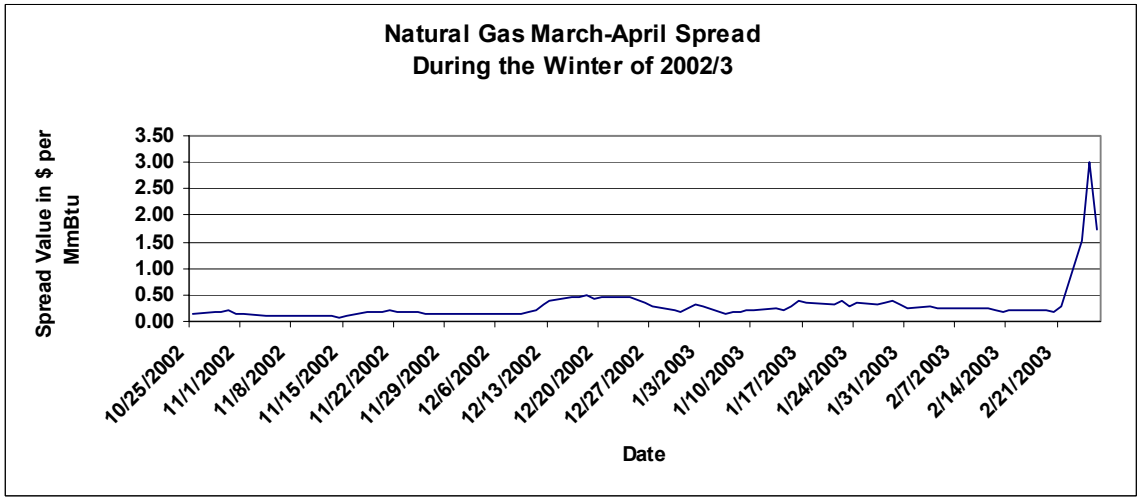
At the start of the winter, if there are predictions of an exceptionally cold winter, the winter contracts trade at a large premium to spring contracts in order to encourage supplies to be brought out of storage immediately, and to discourage any non-essential use of natural gas. This occurred in December of 2005, even though storage at the start of the season was quite high.

At the end of the winter, if there is a cold shock and inventories are at their seasonal low, the end-of-winter contracts can also explode relative to later-month contracts in order to limit current use of natural gas to absolutely essential activities. This scenario occurred in the winter of 2002/3 and is illustrated in Figure 11.

Figure 11

February 2003's Near-Stock-Out Scenario





Source: Till, Hilary, "EDHEC Comments on the Amaranth Case: Early Lessons from the Debacle," *EDHEC-Risk Publication,* 10/2/06. Data source: The Bloomberg.

Instead, if the winter is unexpectedly mild, and there are still massive amounts of natural gas in storage, then the near-month price of natural gas plummets to encourage its current use and the curve trades in contango in order to provide a return to any storage operator who can still store gas. This occurred during the end of the winter in early 2006.

As one may surmise for the above scenarios, the U.S. natural gas markets provide many spreading opportunities around seasonal inflection points for natural gas use. The summer/fall injection season creates opportunities in the summer/fall versus winter natural gas spread relationship. The end-of-winter period creates opportunities in the March-versus-April natural gas spread. As documented in the U.S. Senate report, Amaranth was precisely involved in these sorts of opportunities on a massive scale.

Risk Analysis

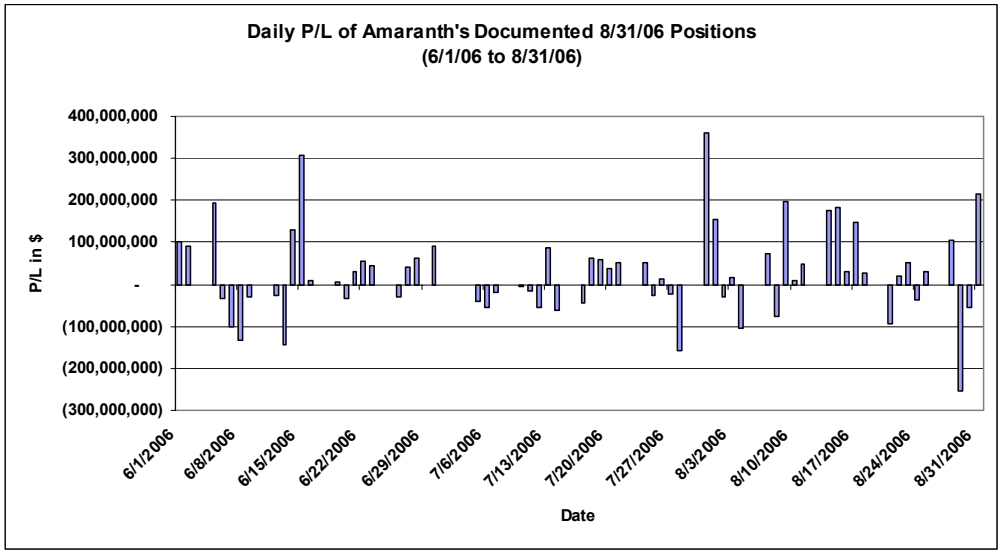
Recent Volatility

How could Amaranth's risk managers have gotten caught so wrong-footed?

One explanation might be that risk metrics using recent historical data would have vastly underestimated the magnitude of moves that can occur during an extreme liquidation pressure event.

Figure 12 shows the daily p/l of Amaranth's 8/31/06 positions. These positions were documented in the U. S. Senate report and were, in turn, illustrated in Figure 3.

Figure 12



Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

Now, Amaranth's positions did change over the summer of 2006, so the intention of Figure 12 is not to show the fund's actual p/l over this period. Instead, the gist of Figure 12 is to show what the typical volatility that Amaranth's risk managers might have expected from the portfolio, going into September 2006.

The daily standard deviation of the 8/31/06 positions, based on three months of data, was about $105-million.

Scenario Analysis

If the fund's risk managers had employed scenario analyses that evaluated the range of natural-gas-spread relationships that had occurred in the not-too-distant past, they would have seen how massively risky the fund's structural position was in its magnitude.

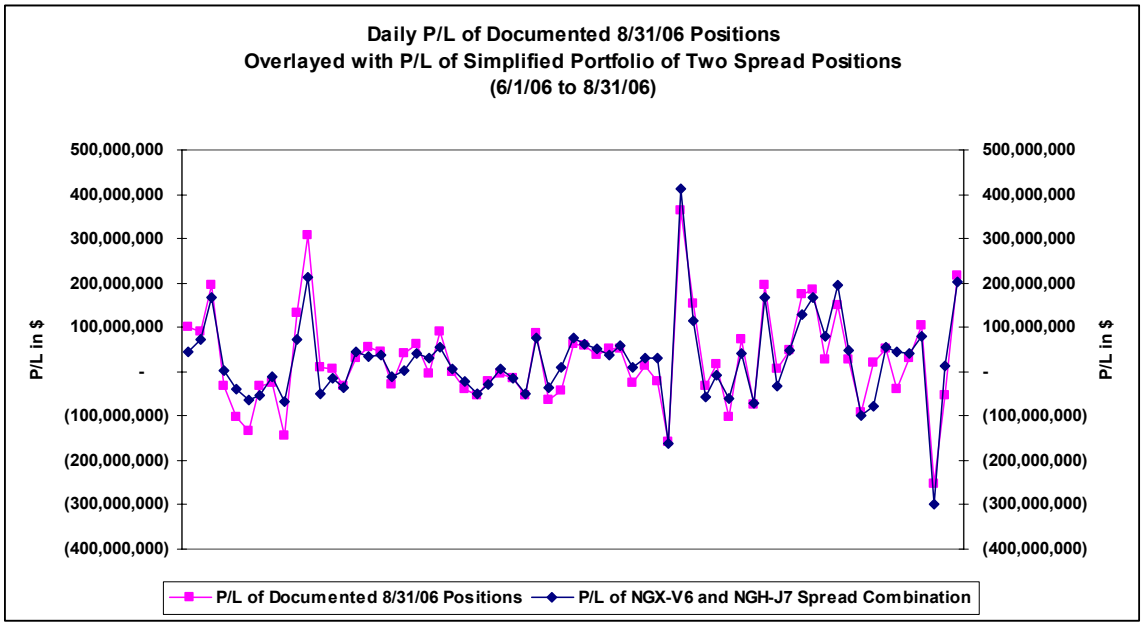
As of 8/31/06, winter natural gas futures prices were trading at an extreme relative to non-winter-month contracts. A simple scenario analysis of the time would have been to examine over say, the previous six years, what the level of the fund's spreads had been. One could have then quickly evaluated what the potential losses could be if a normal state-of-the-world reappeared.

Again, using the Senate report's documented positions for Amaranth as of 8/31/06, we find that two spreads were 93% correlated to Amaranth's natural-gas book:

The November 2006 vs. October 2006 (NGX-V6) spread; and the
The March 2007 vs. April 2007 (NGH-J7) spread.

Figure 13 illustrates how closely a simplified portfolio of NGX-V6 and NGH-J7 spreads match the p/l of Amaranth's documented 8/31/06 positions.

Figure 13



Note: NGX-V6 refers to the short October 2006 versus the long November 2006 natural gas spread. NGH-J7 refers to the long March 2007 versus short April 2007 natural gas spread.

Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

In our scenario analysis, we will examine the past spread values for the NGX-V6 spread and the NGH-J7 spread in order to understand the riskiness of Amaranth's documented 8/31/06 portfolio. If these two spreads had reverted to levels that had prevailed at the end of August during the previous six years, one could have seen that up to -36% could have been lost under normal conditions. This is illustrated in Figure 14.

Figure 14

Scenario Analysis if Winter vs. Non-Winter Spreads Reverted to Past Spread Relationships

Number of Contracts	Spread Symbol	Natural Gas Spread	8/31/06 Level
(105,620)	NGV-X	October-November	-2.18
59,543	NGH-J	March-April	2.14

Date	NGV-X	NGH-J	Losses due to V-X	Losses due to H-J	Total Losses	Portfolio Loss
8/31/2000	-0.058	0.26	$ (2,241,256,400)	$ (1,119,408,400)	$ (3,360,664,800)	*-36.5%*
8/31/2001	-0.33	0.09	$ (1,953,970,000)	$ (1,220,631,500)	$ (3,174,601,500)	*-34.5%*
8/31/2002	-0.33	0.113	$ (1,953,970,000)	$ (1,206,936,610)	$ (3,160,906,610)	*-34.4%*
8/31/2003	-0.25	0.44	$ (2,038,466,000)	$ (1,012,231,000)	$ (3,050,697,000)	*-33.2%*
8/30/2004	-0.643	0.57	$ (1,623,379,400)	$ (934,825,100)	$ (2,558,204,500)	*-27.8%*
8/31/2005	-0.185	2.24	$ (2,107,119,000)	$ 59,543,000	$ (2,047,576,000)	*-22.3%*

Source: EDHEC Risk and Asset Management Research Center; and Premia Capital Management, LLC.

One caveat with this analysis is that it is based solely on the positions that were documented in the June 25th U.S. Senate report's graphical appendix. This analysis may therefore be incomplete, to the extent that Amaranth held other sizeable positions *not* documented in the Senate report, *or* if the Senate report oversimplified Amaranth's natural-gas position-taking, which included options. (Chincarini (2008) noted that the Senate subcommittee had converted option positions into NYMEX-futures-equivalent positions using each option position's delta.)

Structural Position-Taking

Under at least one measure of risk, the fund's structural position-taking was effectively increased from 5/31/06 to 8/31/06, which (arguably) should have been a red flag for its risk managers after the fund's documented $1-billion-loss in May 2006.

Drawing from the U.S. Senate report, we can examine what the fund's positions were on 5/31/06. These positions had a daily standard deviation in p/l of about $96-million (based on the previous three months of history), so the fund had increased its risk by the end of August by 9%. The 8/31/06 positions were about 81% correlated with the 5/31/06 positions, so one could argue that similar views on the natural-gas market were expressed across these dates.

That said, we need to caveat this analysis again to note that we are relying on the Senate report in drawing these conclusions. If the report did not include other material positions, then this analysis would be incomplete.

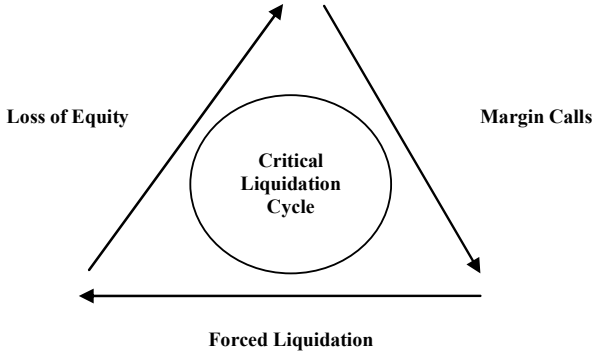
Critical Liquidation Cycle

By the end of Friday, 9/15/06, the fund had lost more than $2-billion month-to-date. According to Davis *et al.* (2007), at this point the fund was "bleeding cash and facing a Monday demand for money [from its clearing broker] for money that it didn't have."

It was at this point that the critical liquidation cycle was initiated. Once a fund crosses a threshold of losses, a cycle of investor redemptions occur and/or the fund's prime brokers demand the reduction of leverage, and the fund's net asset value thereby declines precipitously as the fund sells off holdings in a distressed fashion. This cycle has been modeled in De Souza and Smirnov (2004) as being a kind of barrier-put option, which is illustrated in Figure 15.

Figure 15

The Critical Liquidation Cycle



Source: De Souza, Clifford and Mikhail Smirnov, "Dynamic Leverage," *Journal of Portfolio Management*, Fall 2004, pp. 25-39.

By Wednesday, September 20th, the fund locked in a further $3.2 billion in losses, including the $2.15 billion concessionary payment to two financial institutions who, in turn, took on Amaranth's remaining energy positions.

Nodal Liquidity

This $2.15-billion payment was obviously quite massive when viewed as a multiple of the fund's daily volatility that prevailed as of the end of August.

Another key lesson from the Amaranth debacle is that the commodity markets do not have natural two-sided flow. For experienced traders in the fixed income, equity, and currency markets, this point may not be obvious.

The commodity markets have "nodal liquidity." If a commercial market participant needs to initiate or lift hedges, there will be flow, but such transactions do not occur on demand.

For experienced commodity traders, a key part of one's strategy development is a plan for how to exit a strategy. What flow or catalyst will allow the trader out of a position? In the case of Amaranth, there was no natural (financial) counterparty who could entirely take on their positions in under a week (or specifically during the weekend of 9/16 and 9/17/06 when the fund initially tried to transfer positions to a third party.) The natural counterparties to Amaranth's trades are the physical-market participants who had either locked in the value of forward production or storage. The physical-market participants would likely have had physical assets against their derivatives positions so would have had little economic need to unwind these trades at Amaranth's convenience.

Red Flag for Investors

Since April 2006, investors had known that Amaranth's energy portfolio could have up or down months of about 11% to 13%. The monthly volatility of the energy strategies therefore would have potentially been at least 12%. As a consequence, it would not have been unusual for the fund's energy trades to lose -24% in a single month, corresponding to a two-standard-deviation event.

The significance of a -24% loss is that this is the approximate month-to-date loss in mid-September 2006, which sent the fund into a critical liquidation cycle.

Official Response

The Amaranth debacle raised a number of troubling questions, which were preliminarily addressed during the summer of 2007 by the U.S. Senate's Subcommittee on Permanent Investigations, the House of Representative's Subcommittee on General Farm Commodities and Risk Management, the Commodity Futures Trading Commission (CFTC), and by the Federal Energy Regulatory Commission (FERC).

U.S. Senate

On June 25th and July 9th, 2007, the U.S. Senate's Subcommittee on Permanent Investigations held hearings on Amaranth's massive natural gas positions, which, as noted previously, were rigorously documented in the subcommittee's staff report.

The report links the extreme values of various calendar spreads with Amaranth's trading activity during several months of 2006. Specifically, the report shows how correlated Amaranth's positions were with various spread values, which traded to historically extreme levels.

Both economists and statisticians would *normally* not like to see correlation and causality as being confounded. Also, prior econometric work has generally shown that it is commercial hedging activity that leads to changes in speculative positions.

But given the extreme magnitude of Amaranth's positions, one may agree with the Senate committee's report that *normal* considerations regarding the impact of speculative positions on futures price relationships may not have applied in this case.

The Senate report also notes how Amaranth was able to shift a substantial fraction of its NYMEX natural gas futures positions to equivalent over-the-counter (OTC) positions on ICE in order to avoid position limits, which were eventually imposed on Amaranth by the NYMEX. The report refers to ICE as "a virtually unregulated exchange that operate[s] largely outside CFTC oversight …."

The June 25th report concludes that the CFTC needs to have enhanced oversight of energy derivatives trading. This would be achieved in three ways:

- By providing greater funding for the CFTC through user fees;
- By requiring over-the-counter, electronic trading to be subject to the same regulatory requirements as regulated exchanges such as the NYMEX; and
- By essentially establishing speculative position limits in the deferred-delivery months of natural gas futures contracts.

Just as supply in the physical natural gas markets has declined while demand has increased, the U.S. Senate hearings of July 9th revealed a similar issue with the current U.S. regulatory infrastructure, which oversees futures trading.

According to the July 9th, 2007 written testimony from the Acting Chairman of the U.S. Commodity Futures Trading Commission, Walter Lukken, "…. the number of actively traded [futures] contracts trading on U.S. exchanges has more than quintupled in the last decade, with most of that growth seen in the last five years. [CFTC] Staff devoted to surveillance today is 46; ten years ago, it was 58. As for [CFTC] Enforcement, staff has fallen from 154 to 110 during the same ten-year period."

The CFTC's acting chairman also noted that the commission's budget for the current fiscal year is $98-million.

The CFTC "operates with a staff of 436 – a historic low at a time when the [futures] industry … is at an all-time by almost any measure: more volume, more trading platforms, more products, more complexity and a more global marketplace."

The CFTC chairman's testimony highlighted the need for additional funding if more oversight responsibilities are to be granted to the commission.

U.S. House of Representatives Hearings

The U.S. House of Representative's Subcommittee on General Farm Commodities and Risk Management also held hearings on July 12th, 2007 on energy derivatives trading. At the same time a bill was introduced into the House to enhance the transparency of trading in over-the-counter derivatives in natural gas.

The bill would formally bring over-the-counter derivatives trading in natural gas under the CFTC's oversight, including transactions that are accessed through "a foreign board of trade." Market participants would have to report on large transactions to the CFTC.

Commodity Futures Trading Commission and Federal Energy Regulatory Commission (FERC)

The U.S. Senate report documented how massive Amaranth's natural gas trading was, both as a fraction of prevailing trading activity and as a fraction of U.S. residential natural gas consumption.

Based on the Senate's report, one would agree that the Amaranth case brought up public-policy issues that needed to be addressed. But did Amaranth do anything that violated current laws or regulations?

This question was preliminarily answered on July 25th and July 26th, 2007. Both the CFTC and the FERC answered in the affirmative on these respective dates. That said, as of the writing of this article, Amaranth's current and former principals were vigorously countering the regulatory actions against the firm and its former traders.

While the Senate report focused on whether Amaranth's position-taking pushed up the price of forward winter natural gas prices, the CFTC and FERC's (publicly known) investigations were much more narrowly focused on Amaranth's trading activities on several days of 2006.

The CFTC's regulatory authority mainly covers the exchange-traded futures markets, so their investigation narrowly focused on the fund's documented activities on the NYMEX.

Correspondingly, the FERC is responsible for overseeing the wholesale natural gas and electricity markets in the U.S. The monthly settlement price for the expiring NYMEX natural gas futures contract is frequently used in pricing physical natural gas transactions, so the FERC *may* have oversight jurisdiction if there is an attempted (or actual) manipulation of the NYMEX settlement price for expiring contracts.

Essentially, both the CFTC complaint of 7/25/07 and the FERC preliminary findings of 7/26/07 allege that Amaranth and its energy traders attempted to manipulate the settlement price of the expiring NYMEX futures contract *downwards* on several occasions in order to benefit very large over-the-counter ICE swaps that were positioned short.[1] The fund's ICE swaps cash-settled against the NYMEX settlement price and so would benefit from a decline in the NYMEX price.

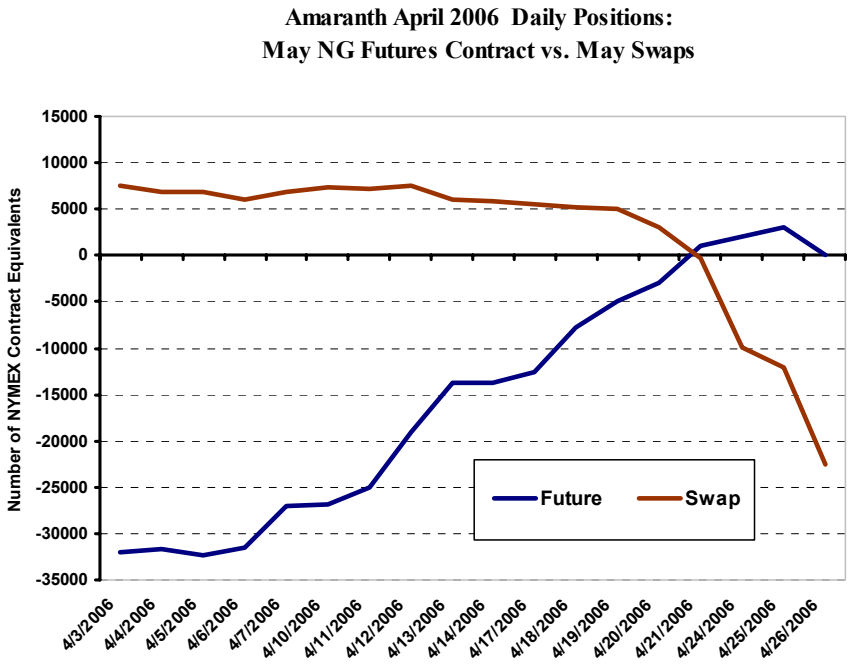
Figure 16, for example, shows the relative positioning of Amaranth's futures and swaps positions going into the April 26th expiry of the May 2006 natural gas futures contract. This figure illustrates how the ICE short position became much larger than the NYMEX long position as of the late-April expiry. The CFTC and FERC cite numerous trading records, showing how the fund concentrated its sales of its long position in NYMEX futures until the very end of the trading day. This strategy may have had a large impact in driving down the price of the expiring contract.

In addition to trading records, both the CFTC and FERC cite voluminous e-mail exchanges, instant messages, and recorded phone conversations in bolstering their allegations of an attempted (or actual) price manipulation.

The CFTC also alleged that Amaranth made false statements to the NYMEX when the exchange formally asked the fund about the justification and commercial purpose of its May-contract expiry trading.

[1] To be more precise, the CFTC complaint alleges *attempted manipulation*, while the FERC order alleges *actual manipulation*.

Figure 16



This graph is based on Figure 10 of Federal Energy Regulatory Commission, *Amaranth et al*., Docket No. IN07-26-000, "Order to Show Cause and Notice of Proposed Penalties," 7/26/07, p. 57.

The CFTC complaint requests that the U.S. District Court (Southern District of New York) enter an order prohibiting Amaranth and its former head trader from "engaging in any business activities related to commodity interest trading" amongst other prohibitions.

The FERC was granted anti-manipulation authority in the physical natural gas markets by the Congress in 2005, and the Amaranth case is the first such exercise of this authority.

Procedurally, the FERC issued a "show cause order" on 7/26/07 "after making a preliminary finding of serious manipulation in the natural gas markets." The FERC is "proposing to order disgorgement of unjust profits and civil penalties totaling nearly $300 million," including a penalty of $30 million for Amaranth's former head trader.

The FERC order explains why the commission was calling for very large monetary penalties for Amaranth and two of its natural gas traders:

"There are strong enforcement and deterrence policy bases for setting the civil penalties for individual traders at a high level. The traders in this industry have historically been capable of easily recovering from disastrous performance or misconduct by simply moving to, or starting up, another trading operation. Even after spectacular failures, a trader can attract capital to start new trading activities or a new fund. … Under the circumstances, the Commission sends here a clear message that manipulation will have severe personal consequences for individual traders in order to deter them and others from violative behavior."

According to an energy-trading industry journal, *The Desk* (2007), additional charges may be filed against Amaranth and its former energy traders, so any conclusions or lessons to be drawn on the regulatory front are necessarily incomplete.

Wider Lessons

When the history books finally close on this case, we predict that there will be four major lessons from the Amaranth debacle:

[1] *One would expect there to be increased care by financial institutions in participating in the commodity derivatives markets.*

According to a California Public Employees' Retirement System (2006) report, the size of the commodity derivatives markets is less than 2% of global asset values. This means that the commodity derivatives markets are relatively small for sophisticated financial-market participants. The Amaranth case shows how just *one* large hedge fund can effectively overwhelm an entire commodity futures market, the U.S. natural gas market.

Given the size of penalties envisioned in the FERC order for "gaming of the energy markets," one might expect increased vigilance by global trading entities in evaluating the impact of their activities on these relatively small markets.

[2] *There has been an obvious regulatory gap in covering over-the-counter energy derivatives trading.*

There had been an explicit body-of-law in the U.S. covering futures trading and physical energy transactions, but clearly not for over-the-counter energy derivatives trading.

This meant that effectively it was only Amaranth's credit providers and investors who could constrain Amaranth's natural-gas trading activities. In retrospect, neither set of participants had been effective in this regard.

Unlike post-mortems after the Long-Term Capital Management debacle, there has not yet been an official examination of the role of Amaranth's credit providers in allowing their client to amass such hugely concentrated positions in natural gas across both exchange-traded and over-the-counter platforms. We would expect this to happen before the complete history of and lessons from the Amaranth debacle can be written.

[3] *Even though the Amaranth collapse did not lead to wider problems in the financial markets, one should still be cautious about concluding that the alternative investment industry has the wherewithal to absorb major hedge fund failures.*

In the Long-Term Capital Management crisis, the hedge-fund-in-distress had positions that were highly correlated or identical to the core positions held by leveraged, money-center banks.

In the Amaranth crisis, the fund's key risk positions were calendar spreads in the U.S. natural gas derivatives markets; these are not positions that are central to the risk-taking activities of the main international banks. Therefore, the impact of Amaranth's losses was (arguably) largely confined to its investors.[2]

Also, it is likely that physical natural-gas market participants were the ultimate risk takers on the other side of Amaranth's trades, and so benefited from the temporary dislocations that ensued from the fund's distress. In other words, it does not appear that the commercial natural-gas industry was damaged by this financial crisis; in fact, commercial suppliers of natural gas likely benefited.

Natural gas commercial hedgers would have earned substantial profits had they elected to realize their hedging windfall during the three months that followed the Amaranth debacle, as discussed in Till (2007c).

A true test of the alternative investment industry's robustness would have to be one where a large hedge fund not only became distressed, but also held substantial positions that were highly correlated to those held by the major international banks.

[2] The Senate subcommittee report, though, noted that large-scale consumers of natural gas, who had bought winter natural-gas contracts forward, would have done so at disadvantageously elevated levels prior to Amaranth's collapse.

[4] *The Amaranth debacle will eventually be seen as one of the consequences of the massive liquidity that had severely mispriced all manner of risky assets.*

Ultimately one would hope that the market-place would provide a sufficient disciplining mechanism in preventing future Amaranths. After all, no hedge-fund investor would want to see a swift 70% decline in the value of their investments. Perhaps the lesson for global investors in 2006 and 2007 will be that value matters: one should not pay extreme prices for forward U.S. winter natural-gas prices relative to non-winter months; just like one should not invest in the U.S. sub-prime mortgage market without adequate compensation for default risk, as explained by Tavakoli (2007).

Endnotes

Much of the work in this article was drawn from research that the author carried out on behalf of the EDHEC Risk and Asset Management Research Centre, including in Till (2006a), Till (2006b), Till (2007b), and Till (2007d).

This article benefited from assistance from Katherine Farren, CAIA, of Premia Capital Management, LLC.

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