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# MAKING SENSE OF THE NEGATIVE ROLL YIELD:
## Some Guidance for Commodities Investors

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# C O N T E N T S

# MAKING SENSE OF THE NEGATIVE ROLL YIELD:
## Some Guidance for Commodities Investors

From August 2004 through September 2006, the roll yield of the Goldman Sachs Commodity Index (GSCI) returned -28.3%. However, the GSCI Total Return Index (TR index) managed to return 7.8% over this period, thanks to the Spot Index's 39.4% return. Several commentators have argued that the negative roll yield is a result of the wall of money that has poured into long-only passive commodities futures products, fundamentally altering the nature of the investment opportunity. Some, therefore, conclude that investors should avoid the doomed asset class altogether. While the character of commodities investing may be changing, we disagree with the assessment that investors should run for the hills, and offer several implementation options.

### Background—Sources of Return

There are three potential sources of return for commodities futures contracts: the change in spot prices, the collateral yield, and the roll yield.

Spot return is the price appreciation or depreciation of the futures contracts for underlying commodities, and is driven by imbalances between commodity supply and demand. Collateral yield is the interest earned on the cash that fully collateralizes the futures, which is typically invested in three-month Treasury bills, though some managers may invest collateral actively to provide value added. Since 1970, spot return has contributed 4.0 points and collateral, 6.4 points, to the TR index's 11.7% average annual compound return (AACR) (Exhibits 1 and 2).

The roll yield is derived from the difference between the spot price of a commodity and the price of its futures contract (or from the price difference between two futures contracts with different expiration dates). Roll yield can either be positive (backwardation) or negative (contango). Positive roll yield exists if the spot price is higher than that of the futures contract—the futures price will converge, or roll up to the spot price as the futures contract nears expiration. Conversely, negative roll yield exists if the futures contract price is higher than the spot price and the futures contract falls in price as the two converge. The roll yield has contributed 0.9 percentage points to the GSCI's AACR since 1970.[1]

In constructing our long-term performance expectations for commodities, we relied on these historical patterns, while also acknowledging that they have been highly volatile and that the character of the GSCI has changed considerably over time, with weightings tied to the global production quantities of major exchange-traded futures. For example, energy futures, which now account for 74% of the index, were not included in the GSCI until 1982. Finally, history has repeatedly demonstrated that the characteristics of all asset classes and investment strategies evolve as they become more established. The commodities market should not be an exception. Considering these factors, we assume commodity futures will return an average of 5% annually after inflation, with a 19% standard deviation, which implies a real compound return of about

[1] Returns on these components do not add to the TR index's AACR because of compounding.

3%. By comparison, the total return of the GSCI from 1970 through June 30, 2006, was 7.3% in real terms, with a standard deviation of 19.3. We also assume commodities have slightly negative correlations with stocks and bonds, which has generally been the case historically.

With these long-term assumptions, asset allocation modeling reveals that commodities are an attractive addition to most portfolios. There are several key questions going forward: Should return expectations be ratcheted down, based on expectations that the roll yield may persistently detract from returns? If so, at what point will commodities, with their diversification and inflation-hedging characteristics, become unattractive? Finally, what options are available for investors who want to mitigate the effects of the negative roll yield, should it persist?

**The Rise and Fall of the Roll Yield**

Energy and industrial metals sub-indices have been the main, though inconsistent, generators of positive roll yield of the GSCI. Agricultural products have rarely generated positive roll yield, and precious metals never have, though some individual commodities—live cattle, feeder cattle, and live hogs, for example—within these sub-indices have been consistent providers of positive roll yield.

The term structure of the futures curve is unstable, and investors should expect continued volatility (Exhibit 3). There have been periods in the history of the GSCI when the term structure was in backwardation and periods when it was in contango. Since 1970, the GSCI's roll yield often has been negative: 53.2% of the time on a monthly basis, 47.2% on a rolling three-month basis, and 40.0% on a rolling 12-month basis.

In addition, negative roll yield can persist. Although investors may be frustrated with the length of the current period of negative roll yield—26 months so far—it is only the third longest period in the history of the GSCI. The longest period of negative roll returns occurred during the 112 months between July 1976 and October 1985. That was the only notable period other than the current time when the TR index posted a positive AACR (7.8%) while the roll yield was negative (Exhibit 4).

While the roll yield has fluctuated over the long term, over the shorter term it has been, variously, the primary contributor on the positive and negative side to the TR index (Exhibit 5). Over the life of the GSCI, there have been four periods when the 12-month return was greater than 10% and five periods when it was less than -10%, ranging from 20.6% (January 1997) to -19.2% (January 1999).

Returns of the TR index have generally been stronger when the roll yield was positive, but correlations have been relatively low. In fact, since 1970, correlations between the roll yield and the TR index have been 0.08 based on monthly returns, and somewhat higher (0.44) based on annual returns rolled monthly. While correlations have been relatively low, for most years, when the total return has been positive, the roll yield has tended to be positive, and vice versa. In the 36 years for which we have data, there have been only ten years in which the TR index was positive while roll yield was negative (including the recent

period beginning in 2002), and two years in which the TR index registered negative returns while the roll yield was positive.

The TR index suffers the most when both the spot and roll yield post negative returns, though such episodes have been relatively rare. Since 1970, there have only been two cases when both sources of return were negative, and, while neither lasted more than 12 months, the double-whammy inflicted a heavy toll. During the ten months from November 1997 through August 1998, the TR index posted an AACR of -46.3%, while during the 11-month period from February 1981 through December 1981, the TR index registered a -19.2% AACR. Worrisomely, both indices turned negative in third quarter 2006; for that quarter alone, the TR index returned -15.5%, spot, -12.0%, and roll, -5.2%.

The unstable nature of the roll yield underscores a more fundamental question: what drives the futures curve's term structure? If investor flows are the primary determinant of the curve's shape, the recent inflows to long-only passive commodities products may represent a structural change in the asset class. If the term structure is determined primarily by a different set of activities, a cyclical and self-correcting dynamic may be at work.

**How Much is Invested in Passive Commodities Indices?**

Common estimates place investment in the $80 billion to $120 billion range, and most industry experts believe about $90 billion is the accurate figure. Of this amount, about $50 billion to $60 billion is estimated to follow the GSCI, $20 billion to $30 billion, the Dow Jones-AIG Commodity Index (DJ-AIG), and the rest, the Deutsche Bank Liquid Commodities, Reuter/Jeffries CRB, and Rogers Commodity Indices. These considerable sums reflect the rapid growth of assets invested in such products, which totaled only about $10 billion as recently as five years ago.

These totals appear less impressive, however, in the context of the size of the entire commodities futures market. Open interest in the commodities futures market is estimated to total $384 billion. Daily trading volume, which some observers believe is a more accurate measure of liquidity, is believed to total $95.2 billion for the GSCI and DJ-AIG constituents. The presence of indexers is most apparent during the roll period (five to nine days for the GSCI) when spreads become less backwardated (and more contangoed) than before or after the roll period. However, after the ninth day, prices tend to fall back to their pre-roll levels. In sum, the effect of indexers on the curve seems localized to the five- to nine-day roll convention period.

While passive buyers may have some impact on near-term price levels, they cannot explain the fundamental shift in long-term oil prices because they do not take delivery and cannot have an impact on long-term supply and demand curves.

**So What Drives the Term Structure?**

Another piece of evidence that underscores the limited impact of passive buyers on the term structure is the fact that several commodities remain in, or have become more, backwardated. For example, nickel, lead, and zinc are currently in backwardation. Over last ten years, the average contango between the first and second month contracts for zinc has been $-4.60 per metric ton on average, compared to its current backwardation level of $15.00 per metric ton.

Many industry observers believe inventories—not investor flows—are the primary determinant of the shape of the futures curve. There tends to be a negative relationship between the two; that is, the front end of commodity price curves moves from contango into backwardation when inventories are sufficiently low. Relatively high spot prices motivate producers to sell excess supplies quickly in order to take advantage of higher prices, while consumers are willing to pay a premium for promptly delivered materials (the spot) compared to those delivered in future months.

Conversely, the term structure moves from backwardation to contango when inventory levels rise, either because producers have an incentive to hold onto inventories at current price levels with the expectation that prices will rise in the future and/or because consumers are willing to pay a premium for future deliveries.

This pattern is evident in the specific case of crude oil where inventory levels have recently reached highs last seen in mid-1998. In fact, stocks started rising in third quarter 2004, just around the time the West Texas Intermediate curve went into contango. Exhibit 6 illustrates the relationship between time spreads and inventory growth, indicating that as U.S. inventory growth rises, the term structure, as measured by spot price minus the 12-month contract, tends to go into contango.

This cyclical dynamic suggests that strong demand for crude oil will eventually reduce the relatively high level of inventories, which should lessen the contango in the crude oil forward curve and eventually shift the curve toward backwardation.

Philip Verleger, a well-known oil market observer, has argued that passive investors can increase futures prices if their purchases encourage active participants to put crude oil or petroleum products into storage rather than selling them immediately. High demand for oil to be delivered in the future may encourage active participants to withhold some portion of current supply from the current market in order to offer it in a later period. In fact, he argues that inventories have become profit centers instead of expenses.

While this argument seems reasonable, it is suspect on several fronts. First, quantifying the inducement to hold inventories is not as simple as the difference between spot and futures prices. The cost of production and carry for crude oil, which includes interest expense, warehouse fees, and insurance fees, can be prohibitive factors in holding inventories. Verleger notes these influences but downplays their impact, while other market participants believe these costs are significant.

Second, and more importantly, it is not clear that this dynamic is actually being played out. According to several commodities traders, it does not appear that producers are selling at the top of the curve where prices are the highest (currently, months 17 through 19) (Exhibit 7), and calendar spreads remain relatively constant. In addition, if the curve were driven by indexers, who stay in near-dated contracts, it should be in sharp contango in the first months, then drop into sharp backwardation immediately afterwards. This is not happening.

**Investment Conclusions**

Although long periods of contango have been rare, they are not a new phenomenon, and should be expected to occur periodically. While the popularity of passive commodities indexing may have contributed to lower roll yield returns, and may do so going forward, there is no evidence to suggest that investor flows will cause roll yields to be negative in perpetuity. Nonetheless, regardless of its cause, the current period of contango has been difficult for investors and there remains uncertainty about how long it might persist.

When determining whether to invest (or continue investing) in commodities, prospective investors should first examine their rationale for holding commodities. Commodities provide diversification and a hedge against unexpected inflation, and historically have generated returns comparable to those of equities (Exhibit 8). The economic basis of returns is fundamentally different from those of financial assets, suggesting that commodities should provide strong diversification to portfolios. However, should investor flows begin to dominate supply/demand and inventory fundamentals, correlations to financial assets could rise. Commodities are also a logical inflation hedge since commodity prices are a leading, rather than coincident, indicator of inflation, with sharp changes flowing through to the Consumer Price Index only after a considerable lag. It should be noted that commodities returns have a stronger relationship with the rate of *increase* in inflation than with the rate of inflation itself.

Even if we were to assume passive indexers have altogether eliminated the roll yield's potential—not our base case—commodities would still be attractive to some investors. Use of efficient frontier analysis to evaluate asset allocation options, selecting from a wide range of traditional and alternative asset classes with no allocation constraints, suggests an 11% allocation to commodities, assuming a total portfolio return objective of roughly 5% in real terms using our current arithmetic return assumption of 5% real. If we reduce our commodities return assumption to 4%, leaving the standard deviation and correlations unchanged, the model suggests a 9% allocation. However, if returns drop to 3%, the model suggests only a 3% allocation, and no allocation at all if expected real returns are 2% or below. Even with a 0% return assumption, the model would suggest at least some allocation to commodities for investors with very low risk/low return portfolio objectives. However, it is important to recognize that any prospective risk, return, and correlation assumptions for commodities investing are subject to a relatively high degree of specification error. While we have a long history of commodity spot returns, the performance history of a diversified commodities futures index is relatively sparse. In other words, there is a reasonably high probability that the performance of commodities will fall outside expected bounds. This is particularly true given that investor interest is relatively nascent and markets tend to change character as they mature. Therefore, commodities allocations should be sized accordingly.

While we continue to regard passive investment in long-only commodities futures a reasonable investment strategy, it is important to recognize that contango could continue to be a drag on performance for some time. Consequently, we encourage investors to explore the growing selection of both passive and active managers that have developed strategies designed to minimize the impact of contango on returns. Furthermore, we maintain our view that the energy complex remains particularly overvalued, and continue to prefer passive strategies and benchmarks that underweight energy exposure, such as the DJ-AIG Index and GSCI-Lite. This also serves to reduce the impact of contango, as oil futures have been most significantly affected.

Some managers of passive products already employ contango-reducing strategies to some degree. For example, PIMCO's Commodity Real Return currently rolls a portion of the fund outside the five- to nine-day convention. State Street Global Advisors and WAMCO have also invited clients to discuss with them the option of altering roll periods. Similarly, some custom indices or swaps may provide commodities exposure that differs significantly from those of the major indices. Examples include the DJ-AIG ex Energy or an equal-weighted GSCI. In the coming months, we expect to see a proliferation of custom indices and swaps that offer varied roll dates, term structure positioning, and sector exposure. While some of these products may be attractive, we are skeptical about approaches whose promise is predicated on back-tested data, because the changing nature of commodities investing will certainly erode these advantages or eliminate them altogether. New strategies must be carefully evaluated with a goal of assessing the degree to which they are expected to prove advantageous, net of fees, over time.

Investors should also consider the growing array of active commodities products, though the menu of attractive offerings is thin and their track record relatively short. The possibilities within this option vary considerably, ranging from altering roll conventions, investing farther out the futures curve, changing the specific weight of commodity exposure, and making active long-only bets. It is important to note that these strategies are not mutually exclusive and that some products may utilize them in combination. For example, some strategies may avoid commodities that are in contango, while buying those that are in backwardation. Others may buy commodities that are in contango, but take positions farther out the curve where the term structure is less steep. The main disadvantages of going beyond the front month are higher tracking error, more expensive swap costs, and reduced liquidity.

Additional examples of active commodity management include dynamic strategies that under/overweight sectors or individual commodities relative to exposure of the GSCI or DJ-AIG. These are usually guided by fundamental and/or technical analysis; for example, temporarily underweighting the entire energy complex or natural gas only. Other managers may go beyond the reach of traditional indices to invest in sunflowers, lumber, potatoes, rubber, and ethanol, for example.

Another active option employed by some managers is to short some of the near months where contango is most pronounced. If their entire exposure is net long, investors should maintain at least some of the inherent returns of the asset class. Although a long-short commodity futures strategy may seem appealing, it incurs different types of risk—tracking error, spot price risk, and potentially leverage, for example—and may not actually dampen volatility if the manager makes wrong bets or is concentrated among

few commodities. In short, investors in long/short commodities futures funds should make sure they understand exactly what types of risk they are assuming.

Investors may also determine that they wish to avoid commodities futures entirely and choose to seek their commodities exposure via equities. While this alternative may appeal to investors who cannot tolerate commodity-level volatility and who want equity-like returns, they should realize it will dilute the purpose of long-only passive commodities since the returns of commodities-rich equities may be influenced by movements in commodities markets, but are dominated by their characteristics as common stocks. Many companies hedge at least a portion of their exposure to commodity price volatility by selling their production forward with futures. In addition, equity prices reflect the firm's financial structure, management quality, product line diversity, as well as the overall sentiment toward equities in general. Exhibit 9 shows that correlations of the GSCI and DJ-AIG with the S&P 500 Energy Index have been quite low historically, though they have climbed in recent months. In general, we would expect commodities-rich equities to perform reasonably well during periods of unexpected inflation, but with less impact than commodities futures.

Although each investor's objectives and risk tolerance should dictate the appropriate choice among these options, we continue to regard investments in long-only passive commodities as reasonable, but recommend investors select indices with relatively diversified commodities exposure that diminishes the impact of overvalued energy spot prices, as well as the contango. We also recommend considering managers (both active and passive) that seek to minimize the impact of contango on performance, but given the relatively short track records of most of these products, investors must be particularly critical in evaluating their staying power and the degree to which active managers are likely to maintain an advantage over passive alternatives net of fees.

**EXHIBITS**

**Exhibit 1**

## GOLDMAN SACHS COMMODITY INDEX AND DOW JONES-AIG COMMODITY INDEX COMPONENT RETURNS (%)

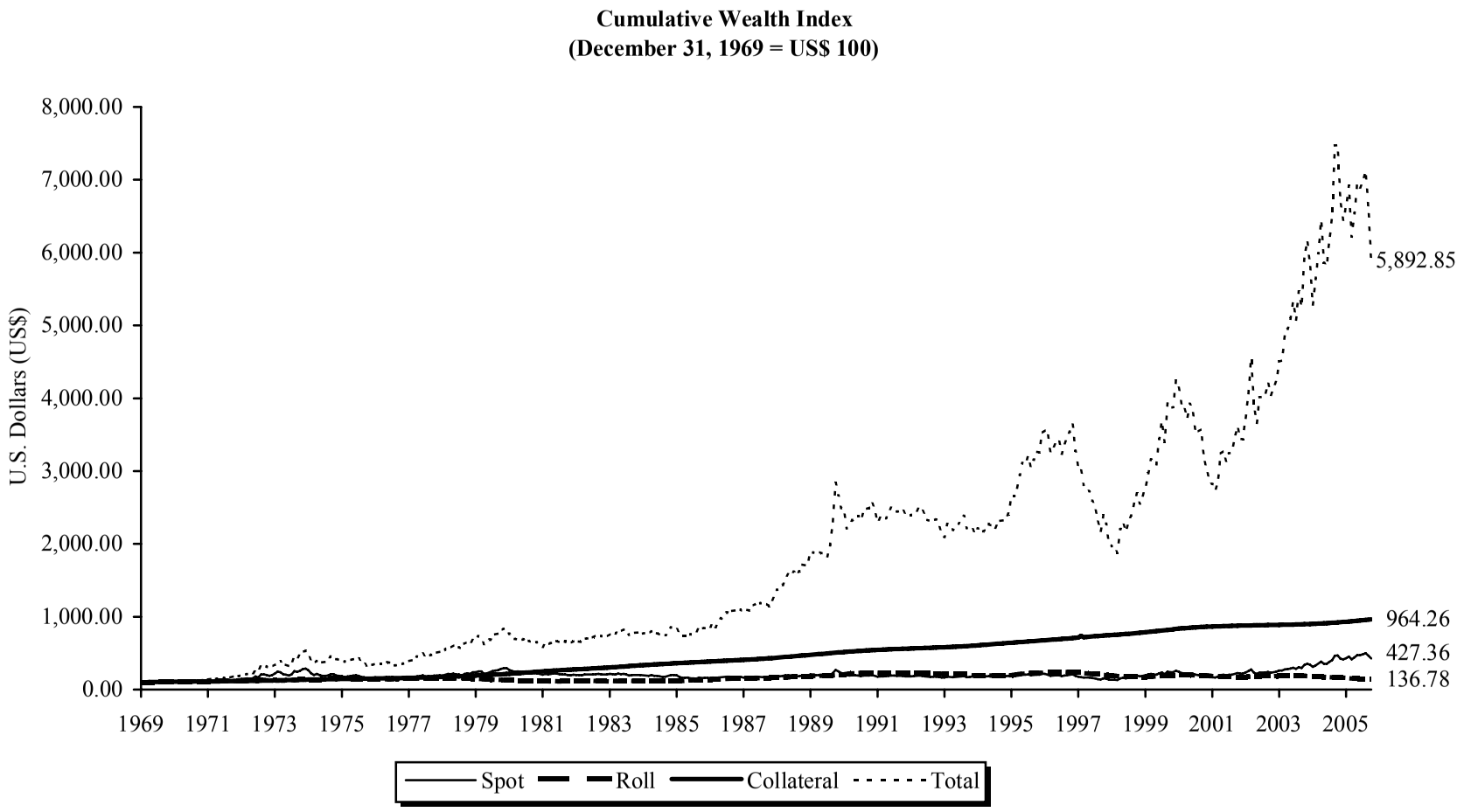
| | GSCI | | | | DJ-AIGCI | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Spot | Collateral | Roll | Total | Spot | Collateral | Roll |
| 1970 | 15.1 | 4.9 | 6.8 | 2.6 | --- | --- | --- | --- |
| 1971 | 21.1 | 6.7 | 4.6 | 8.5 | --- | --- | --- | --- |
| 1972 | 42.4 | 31.5 | 4.4 | 3.4 | --- | --- | --- | --- |
| 1973 | 75.0 | 48.7 | 7.8 | 8.8 | --- | --- | --- | --- |
| 1974 | 39.5 | 20.7 | 8.6 | 7.1 | --- | --- | --- | --- |
| 1975 | -17.2 | -30.5 | 6.0 | 11.9 | --- | --- | --- | --- |
| 1976 | -11.9 | -13.8 | 5.1 | -3.2 | --- | --- | --- | --- |
| 1977 | 10.4 | 0.8 | 5.5 | 2.9 | --- | --- | --- | --- |
| 1978 | 31.6 | 21.2 | 7.8 | 0.6 | --- | --- | --- | --- |
| 1979 | 33.8 | 23.2 | 11.1 | -2.7 | --- | --- | --- | --- |
| 1980 | 11.1 | 13.0 | 12.5 | -12.8 | --- | --- | --- | --- |
| 1981 | -23.0 | -25.0 | 15.1 | -11.0 | --- | --- | --- | --- |
| 1982 | 11.6 | -0.1 | 11.7 | -0.1 | --- | --- | --- | --- |
| 1983 | 16.3 | 7.3 | 9.3 | -0.8 | --- | --- | --- | --- |
| 1984 | 1.1 | -9.5 | 10.3 | 1.0 | --- | --- | --- | --- |
| 1985 | 10.0 | 0.3 | 8.0 | 1.2 | --- | --- | --- | --- |
| 1986 | 2.0 | -18.8 | 6.3 | 17.5 | --- | --- | --- | --- |
| 1987 | 23.8 | 3.2 | 6.2 | 13.2 | --- | --- | --- | --- |
| 1988 | 27.9 | 12.2 | 7.2 | 6.6 | --- | --- | --- | --- |
| 1989 | 38.3 | 12.4 | 8.8 | 13.1 | --- | --- | --- | --- |
| 1990 | 29.1 | 6.1 | 8.2 | 12.7 | --- | --- | --- | --- |
| 1991 | -6.1 | -19.6 | 5.6 | 10.2 | -0.7 | -5.2 | 5.1 | -0.4 |
| 1992 | 4.4 | 2.3 | 3.6 | -1.5 | 3.7 | 1.0 | 3.6 | -0.9 |
| 1993 | -12.3 | -9.6 | 3.1 | -5.9 | -1.1 | 2.5 | 3.1 | -6.5 |
| 1994 | 5.3 | 10.5 | 4.4 | -9.0 | 16.6 | 16.5 | 4.4 | -4.2 |
| 1995 | 20.3 | 12.6 | 5.8 | 1.1 | 15.2 | 8.3 | 5.8 | 0.6 |
| 1996 | 33.9 | 5.8 | 5.4 | 20.3 | 23.2 | 3.8 | 5.4 | 12.5 |
| 1997 | -14.1 | -18.4 | 5.2 | -0.2 | -3.4 | -9.8 | 5.3 | 1.6 |
| 1998 | -35.7 | -24.3 | 5.0 | -18.9 | -27.0 | -19.8 | 4.9 | -13.2 |
| 1999 | 40.9 | 46.2 | 5.0 | -8.4 | 24.3 | 27.2 | 4.9 | -7.0 |
| 2000 | 49.7 | 26.9 | 6.3 | 11.1 | 31.8 | 21.2 | 6.3 | 2.4 |
| 2001 | -31.9 | -31.5 | 3.5 | -4.1 | -19.5 | -18.2 | 3.5 | -5.0 |
| 2002 | 32.1 | 39.0 | 1.7 | -6.8 | 25.9 | 33.3 | 1.7 | -7.3 |
| 2003 | 20.7 | 10.8 | 1.0 | 7.6 | 23.9 | 19.0 | 1.1 | 3.1 |
| 2004 | 17.3 | 19.2 | 1.4 | -3.0 | 9.1 | 12.4 | 1.4 | -4.4 |
| 2005 | 25.6 | 39.1 | 3.3 | -12.7 | 21.4 | 30.2 | 3.3 | -9.9 |
| 2006 (9 mos) | -11.1 | -0.8 | 3.6 | -13.3 | -3.2 | 4.4 | 3.6 | -10.6 |
| Since Inception: | | | | | | | | |
| AACR | 11.7 | 4.0 | 6.4 | 0.9 | 7.5 | 6.9 | 4.0 | -3.3 |
| Standard Deviation | 23.9 | 20.7 | 3.1 | 9.3 | 17.0 | 16.2 | 1.6 | 6.4 |
| High Inflation 1973-81: | | | | | | | | |
| AACR | 12.8 | 3.6 | 8.8 | -0.1 | --- | --- | --- | --- |
| Standard Deviation | 31.7 | 25.8 | 3.4 | 8.5 | --- | --- | --- | --- |
| Low Inflation 1982-2006: | | | | | | | | |
| AACR | 9.8 | 3.1 | 5.6 | 0.8 | --- | --- | --- | --- |
| Standard Deviation | 21.9 | 19.7 | 2.7 | 10.2 | --- | --- | --- | --- |
| Common Period 1991-2006: | | | | | | | | |
| AACR | 5.8 | 4.3 | 4.1 | -2.6 | 7.5 | 6.9 | 4.0 | -3.3 |
| Standard Deviation | 25.5 | 23.6 | 1.6 | 10.3 | 17.0 | 16.2 | 1.6 | 6.4 |

Sources: The Bloomberg, Dow Jones & Company, Inc., Goldman Sachs & Co., and Thomson Datastream.
Notes: Data for DJ-AIG for 1991 represents a cumulative return from February 1 to December 31. Collateral returns are constructed based on the difference between total and excess monthly returns. Roll returns are constructed based on the difference between excess and spot monthly returns.

**Exhibit 2**

**CUMULATIVE WEALTH OF GOLDMAN SACHS COMMODITY INDEX COMPONENT RETURNS**

**January 1, 1970 - September 30, 2006**

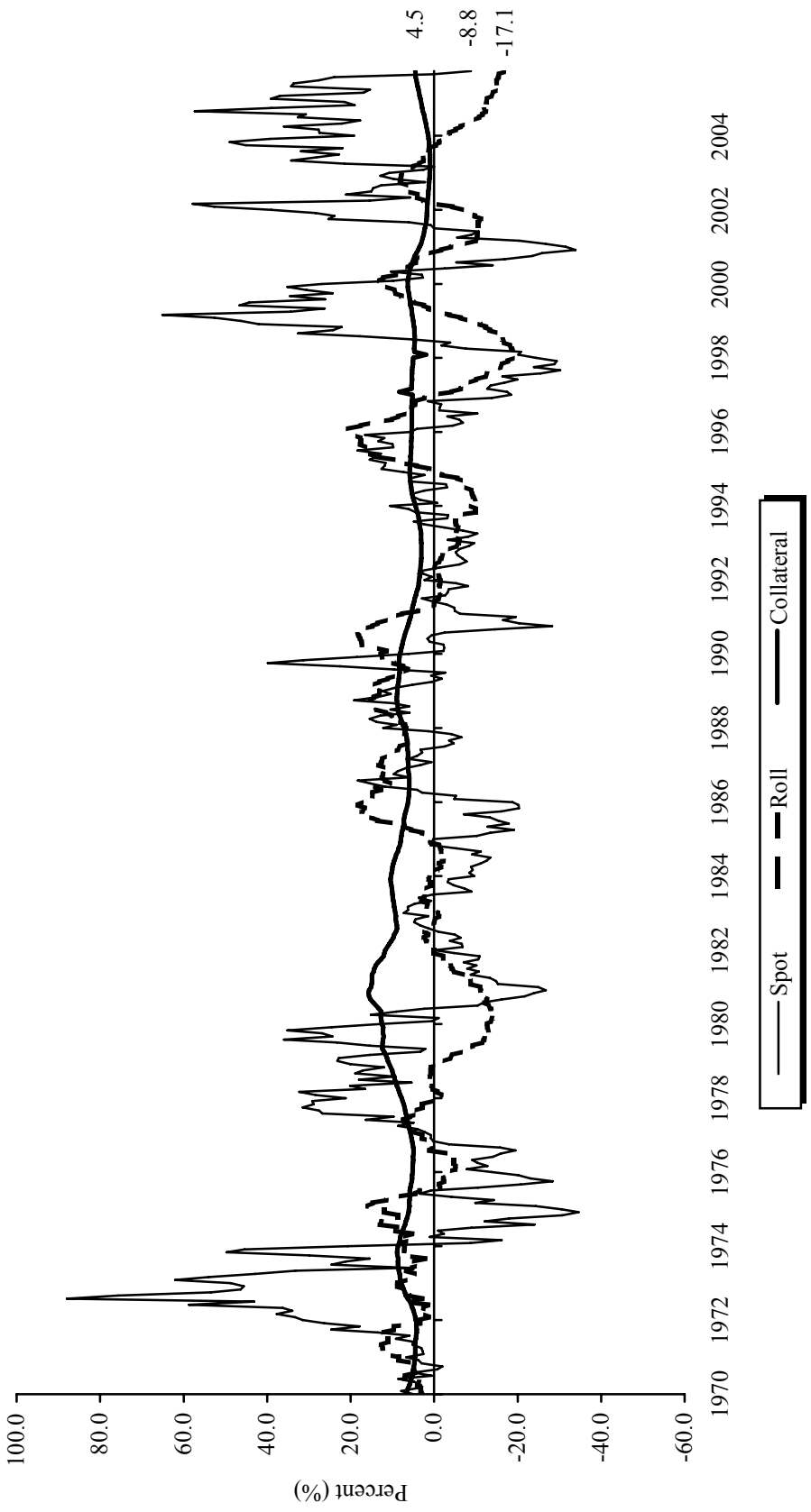



Sources: Goldman Sachs & Co. and Thomson Datastream.

**Exhibit 3**

**GOLDMAN SACHS COMMODITY INDEX: ROLLING 12-MONTH RETURNS**

**January 1, 1970 - September 30, 2006**




Sources: Goldman Sachs & Co. and Thomson Datastream.

## Exhibit 4

## PERIODS OF POSITIVE AND NEGATIVE ROLL YIELD FOR THE GSCI

**Periods Longer Than Six Consecutive Months**

| Period of Positive Roll Return | No. Months | AACR of Total Return Index (%) |
|---|---|---|
| Feb 1971 - June 1976 | 65 | 25.9 |
| Nov 1985 - Oct 1991 | 72 | 20.3 |
| Dec 1995 - Aug 1997 | 21 | 22.8 |
| Dec 1999 - Aug 2001 | 21 | 18.5 |
| Dec 2002 - July 2004 | 20 | 32.1 |

| Period of Negative Roll Return | No. Months | AACR of Total Return Index (%) |
|---|---|---|
| July 1976 - Oct 1985 | 112 | 7.8 |
| Nov 1991 - April 1992 | 6 | -10.9 |
| June 1993 - Nov 1995 | 30 | 0.1 |
| Sept 1997 - Nov 1999 | 27 | -11.0 |
| Sept 2001 - Nov 2002 | 15 | -3.2 |
| Aug 2004 - Sept 2006 | 26 | 3.5 |

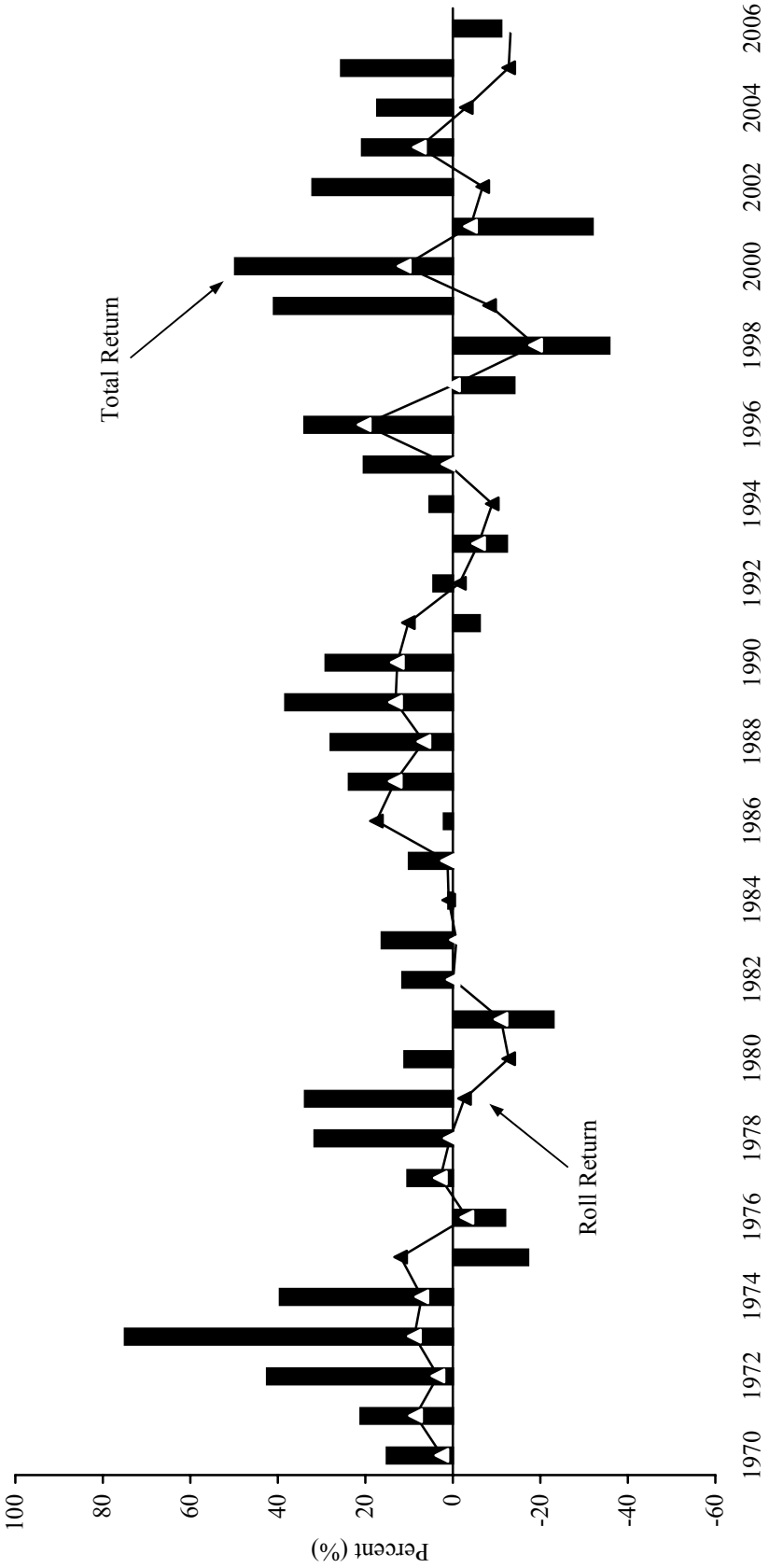
Sources: Goldman, Sachs & Co. and Thomson Datastream.

Notes: All returns over one year represent average annual compound returns (AACR). The AACR for the Goldman Sachs Commodity Index from January 1, 1970 to September 30, 2006 is 11.7%. Beginning and end periods are marked by a minimum six consecutive positive (or negative) months.

**Exhibit 5**

**GOLDMAN SACHS COMMODITY INDEX TOTAL AND ROLL RETURNS**

**1970-2006**



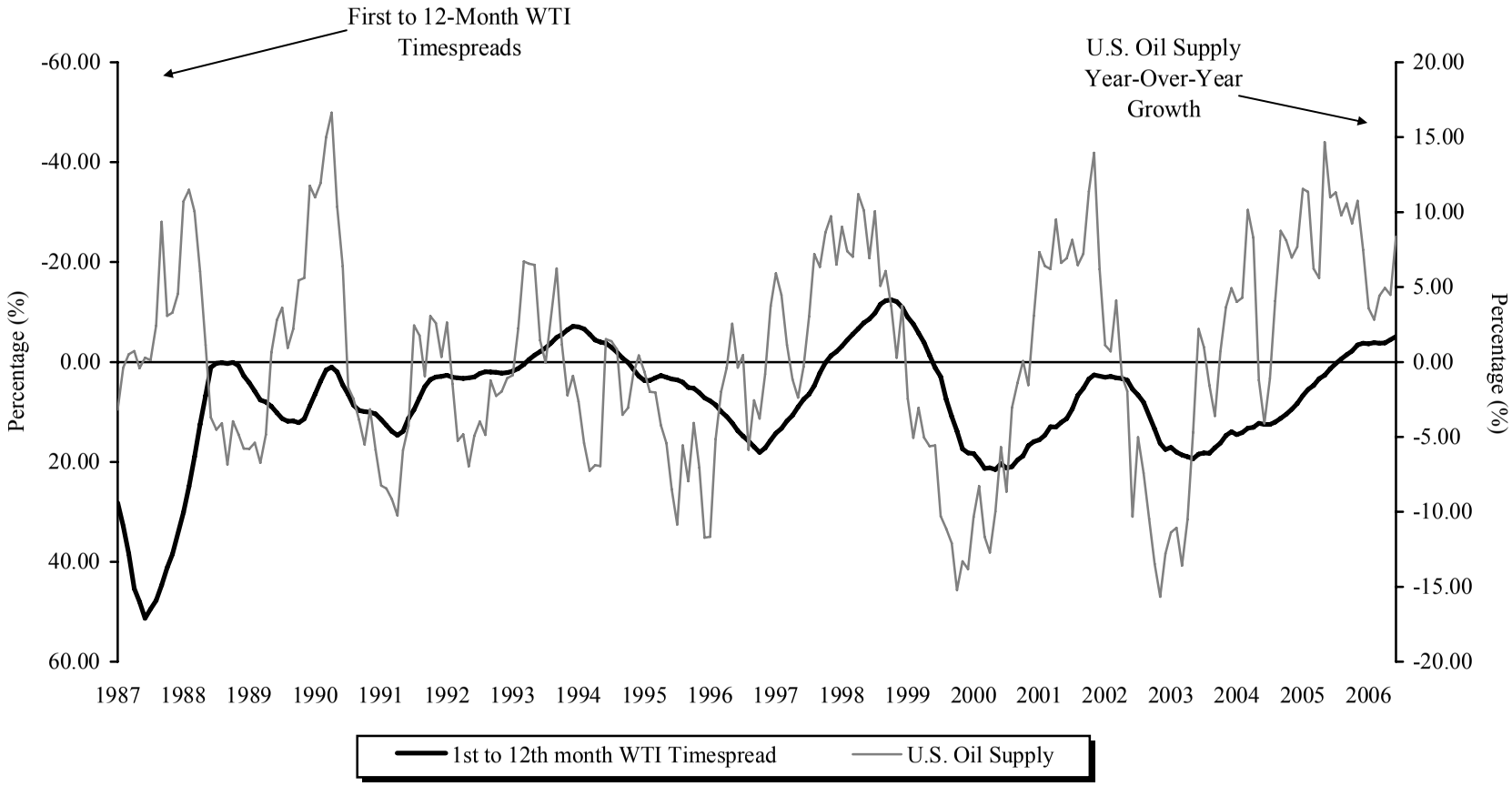

Sources: Goldman Sachs & Co. and Thomson Datastream.

Notes: Roll return was derived by subtracting the spot return from the capital gains/excess return. Data for 2006 are year-to-date as of September 30.

**Exhibit 6**

**U.S. OIL SUPPLY: GROWTH AND TIMESPREADS**

**April 30, 1986 - September 30, 2006**



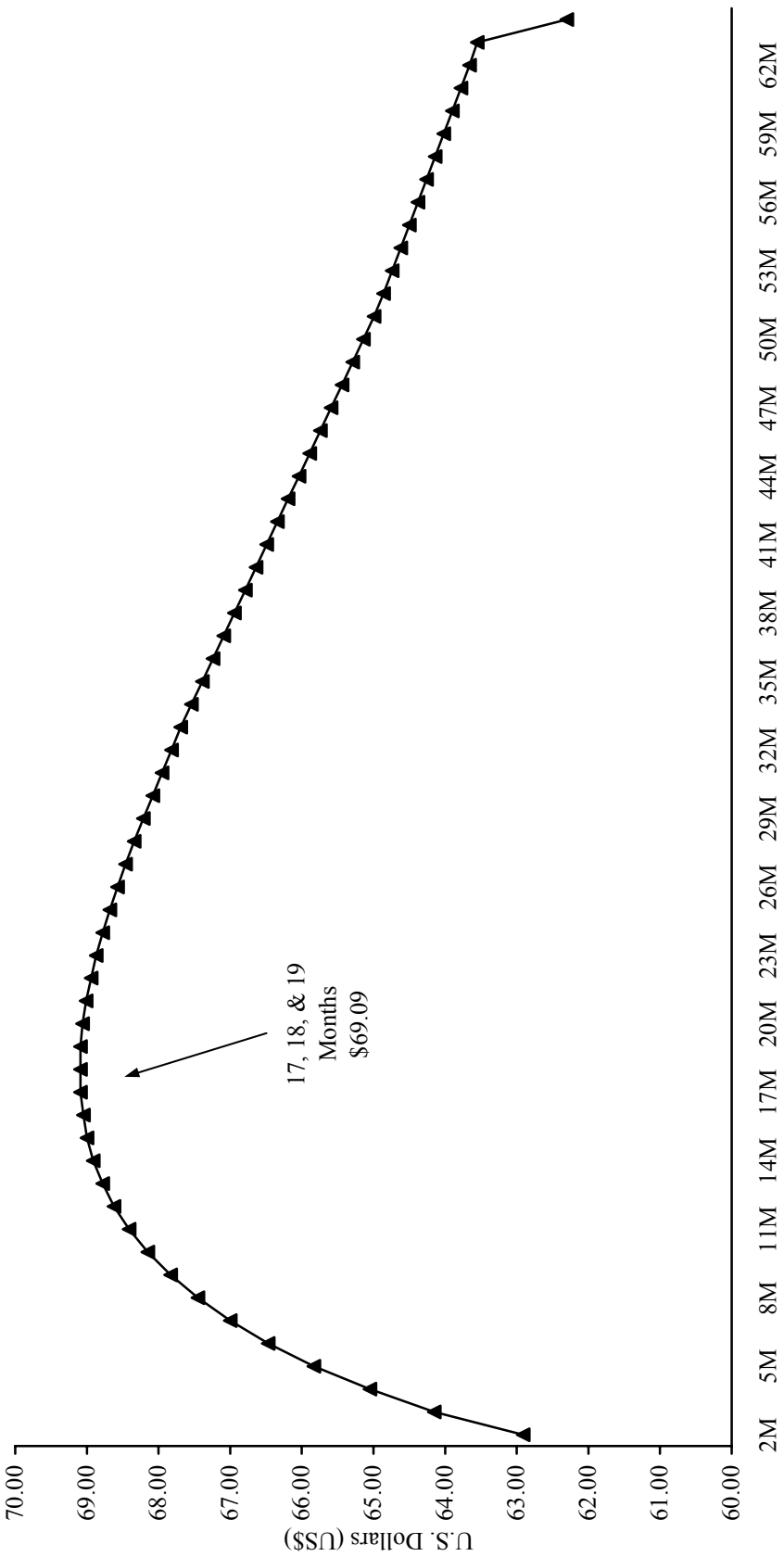

Source: The Bloomberg.

Notes: U.S. oil supply growth represents the year-over-year percentage change and is in the right axis. First to 12th month WTI timespread is the average of the percentage change between the spot price and the 12-month future price and is in the left axis.

**Exhibit 7**

**WTI CRUDE OIL PRICE CURVE**

**As of September 30, 2006**




Source: The Bloomberg.

## Exhibit 8

## CORRELATION MATRIX:
## COMMODITY INDICES, CAPITAL MARKET INDICES, INFLATION AND COMMODITIES

### January 1, 1973 - September 30, 2006

| | GSCI | S&P 500 | MSCI EAFE | LB Govt/ Credit | ML 91-Day T-Bills | U.S. CPI-U | 12-Month Lagged CPI-U | G7 CPI | U.S. PPI | S&P Energy | MSCI World Energy | Oil | Gas | Gold |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GSCI | 1.00 | | | | | | | | | | | | | |
| S&P 500 | -0.30 | 1.00 | | | | | | | | | | | | |
| MSCI EAFE | -0.20 | 0.70 | 1.00 | | | | | | | | | | | |
| LB Govt/Credit | -0.15 | 0.25 | 0.20 | 1.00 | | | | | | | | | | |
| ML 91-Day T-Bills | 0.00 | -0.02 | -0.09 | 0.23 | 1.00 | | | | | | | | | |
| U.S. CPI-U | 0.25 | -0.22 | -0.24 | -0.24 | 0.47 | 1.00 | | | | | | | | |
| 12-Mo. Lagged CPI-U | 0.10 | -0.08 | -0.11 | -0.10 | 0.63 | 0.80 | 1.00 | | | | | | | |
| G7 CPI | 0.16 | -0.14 | -0.17 | -0.15 | 0.53 | 0.92 | 0.86 | 1.00 | | | | | | |
| U.S. PPI | 0.36 | -0.22 | -0.22 | -0.26 | 0.28 | 0.76 | 0.69 | 0.76 | 1.00 | | | | | |
| S&P Energy | 0.16 | 0.61 | 0.46 | 0.08 | -0.08 | 0.05 | 0.00 | 0.02 | 0.00 | 1.00 | | | | |
| MSCI World Energy | 0.43 | 0.57 | 0.61 | -0.37 | -0.11 | 0.14 | 0.21 | 0.20 | 0.14 | 0.95 | 1.00 | | | |
| Oil | 0.59 | -0.27 | -0.30 | -0.18 | 0.00 | 0.28 | 0.13 | 0.22 | 0.26 | 0.20 | 0.35 | 1.00 | | |
| Gas | 0.21 | -0.01 | 0.05 | 0.07 | -0.03 | 0.02 | 0.06 | 0.03 | 0.16 | 0.16 | 0.38 | 0.07 | 1.00 | |
| Gold | 0.20 | -0.07 | 0.17 | 0.03 | 0.00 | 0.25 | 0.21 | 0.28 | 0.35 | 0.09 | 0.15 | 0.20 | 0.05 | 1.00 |

Sources: Bureau of Labor Statistics, Goldman Sachs & Co., Lehman Brothers, Inc., Merrill Lynch & Company, Morgan Stanley Capital International, Oil & Gas Journal Energy Database, Standard & Poor's, Standard & Poor's Compustat, Thomson Datastream, and *The Wall Street Journal*. MSCI data are provided "as is" without any expressed or implied warranties.

Notes: GSCI represents Goldman Sachs Commodity Index. The 91-Day Treasury Bill Index represents returns calculated using yield data from the Federal Reserve from 1970 to 1977 and the Merrill Lynch 91-Day Treasury Bill Index from 1978 to present. MSCI World Energy Index data start in first quarter 1995. Total returns for MSCI developed markets indices are net of dividend taxes.

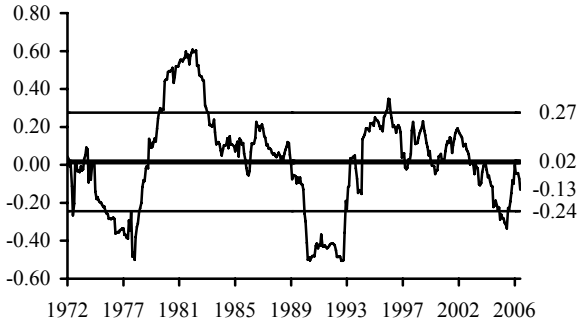
480q mod

## Exhibit 9

## 36-MONTH ROLLING CORRELATIONS

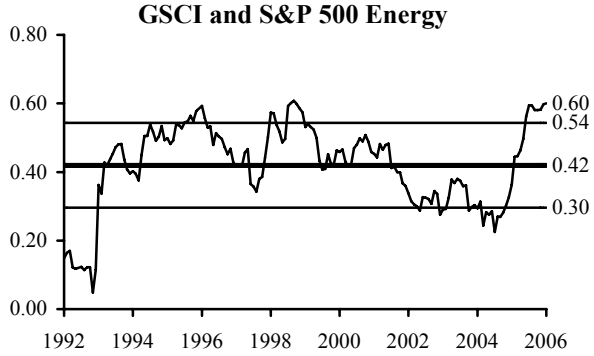
**January 1, 1970 - September 30, 2006**

**GSCI and S&P 500**



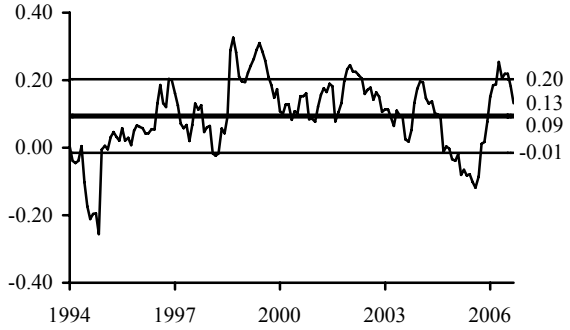

**October 1, 1989 - September 30, 2006**

**GSCI and S&P 500 Energy**

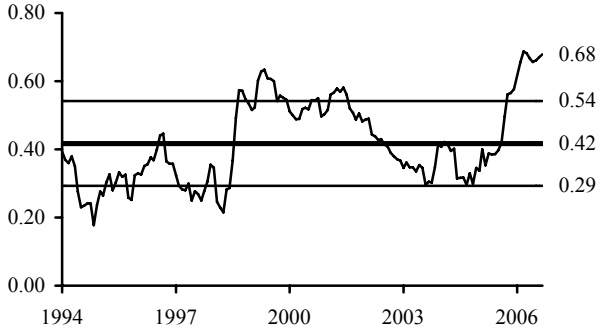



**February 1, 1991 - September 30, 2006**

**DJ-AIGCI and S&P 500**

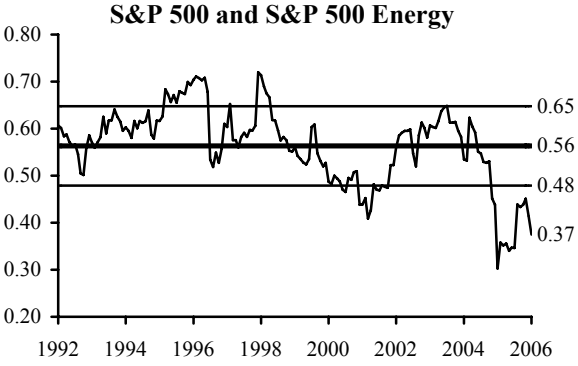


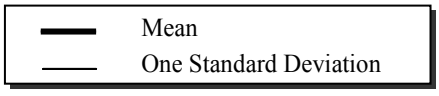

**DJ-AIGCI and S&P 500 Energy**




**October 1, 1989 - September 30, 2006**

**S&P 500 and S&P 500 Energy**




Sources: Dow Jones & Company, Inc., Goldman Sachs & Co., and Standard & Poor's.

Notes: All returns represent total returns denominated in U.S. dollars. GSCI represents the Goldman Sachs Commodity Index and DJ-AIGCI represents the Dow Jones-AIG Commodity Index.