Commodities Position Paper

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Abstract

Skyrocketing commodity prices combined with the poor performance of equities have led to an increased interest in commodity allocations. Commodities have not historically been part of an institutional investor's asset allocation, and some even question whether commodities are an asset class. This paper will explore commodities as an investment, focusing on investment vehicles, the sources and attributes of historical risk and return, and commodities' place in an investment portfolio. Commodities as an investment are introduced and then the mechanics of long-only futures positions are explained. Next, the drivers of individual commodity returns and portfolios of commodity positions are examined. Finally, commodities are analyzed in the context of a balanced portfolio.

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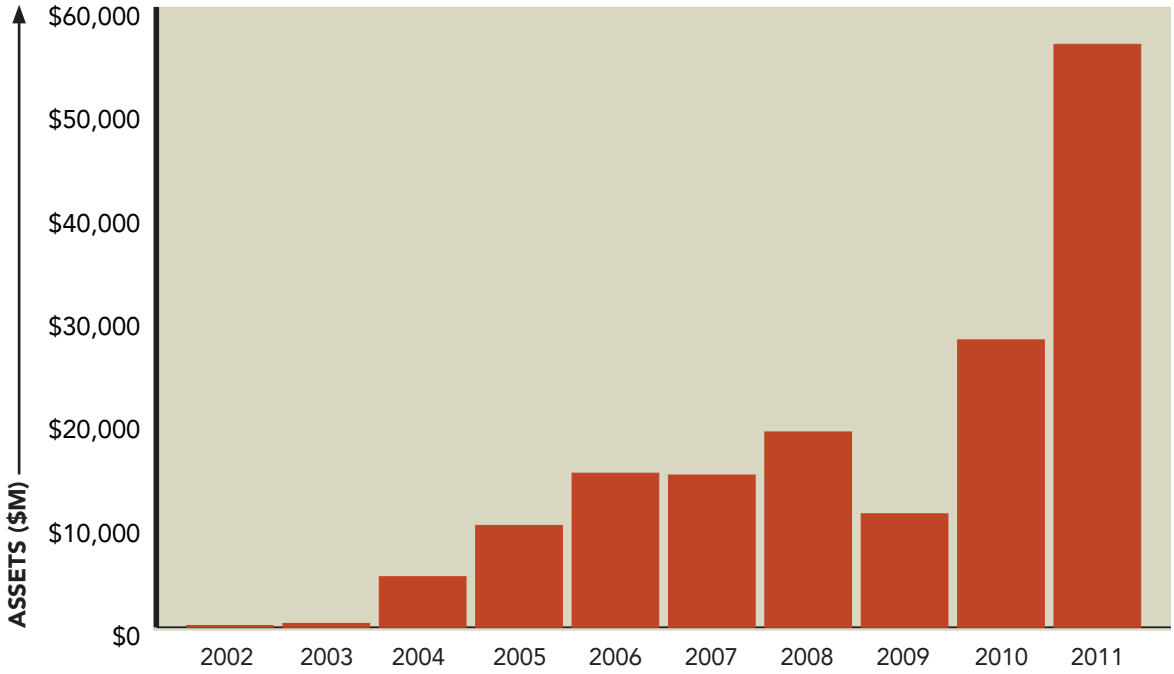
Introduction

Skyrocketing commodity prices combined with the poor performance of equities have increased interest in commodity allocations in recent years. Commodities have not historically been part of an institutional investor's asset allocation, and some even question whether commodities are an asset class. However, over the past decade, investments in commodity funds have increased dramatically (shown in Exhibit 1), though commodity funds still represent less than 1% of mutual fund assets.

This paper will explore commodities as an investment, focusing on investment vehicles, the sources and attributes of historical risk and return, and commodities' place in an investment portfolio. Commodities as an investment are introduced and then the mechanics of long-only futures positions are explained. Next, the drivers of individual commodity returns and portfolios of commodity positions are examined. Finally, commodities are analyzed in the context of a balanced portfolio.

Exhibit 1: Net Assets of Commodities Mutual Funds by Year



Source: Morningstar Direct

What are Commodities?

Commodities are raw materials that are the physical inputs of production. Gasoline that powers cars and wheat that feeds families are examples of commodities. Commodities are fungible: cotton from Kansas is interchangeable with cotton from Missouri. Unlike financial assets, commodities have no cash flows. Thus, while over the long-term, the prices of stocks and bonds are determined by discounted cash flows, the prices of commodities are determined by global supply and demand.

Commodities are traded in the spot and futures market. In the spot market, buyers and sellers exchange physical commodities for cash. In the futures market, buyers and sellers trade futures contracts. These contracts are agreements to buy or sell a precise quantity of a specific commodity, at a set date in the future. For more details on the mechanics of futures contracts, see Marquette Associates' white paper, *Introduction to Futures Contracts*. Broadly speaking, commodities traded in spot and futures markets can be divided into five categories: energy,

industrial metals, precious metals, agriculture, and livestock. Examples of each category include:

- **Energy** – Crude Oil, Natural Gas
- **Industrial Metals** – Aluminum, Copper
- **Precious Metals** – Gold, Silver
- **Agriculture** – Wheat, Cotton
- **Livestock** – Live Cattle, Lean Hogs

There are three primary ways investors can access commodities: by investing in commodity related stocks, by purchasing commodities in the spot market, or by purchasing commodities in the futures market. While commodity related stocks do provide some exposure to commodities, the primary driver of returns is still equity risk. Holders of physical commodities are faced with additional costs, such as storage. Therefore, commodities exposure through futures contracts is cheaper. The main exception to this rule is precious metals. Based on the structure of the gold and silver futures markets, it is cheaper to gain exposure in the spot market. For most other commodities, investing in spot commodities offers direct commodity exposure, but it can be difficult or impossible to invest in the spot market. On the other hand, investors in commodity futures are able to obtain exposure through a liquid investment. Therefore, this paper focuses on gaining commodities exposure through futures contracts. The costs and benefits of different investment options are shown in Exhibit 2 below.

Exhibit 2: Benefits and Drawbacks of Commodities Investment Vehicles

INVESTMENT VEHICLE	Benefits	Sources of Risk	Drawbacks vs. Futures
Commodity Stocks	Liquidity, Cash flows	Commodity Risk, Equity Risk	Major source of risk and return is equity market risk
Spot Commodities	Direct Commodity Exposure	Commodity Related Risk	Can be difficult and expensive to directly invest in spot commodities
Commodity Futures	Liquidity, Indirect Commodity Exposure	Commodity Related Risk	N/A

Futures Exchanges

Commodity futures are traded on futures exchanges. Futures exchanges were initially created to allow end users to hedge their underlying commodity exposures. A corn farmer, for example, may plant crops in April to sell in October. Effectively, the farmer is long corn. Based on the volatility of the price of corn shown in Exhibit 3, this long position may create business risk for the corn farmer. If prices drop unexpectedly before corn is harvested in October, the farmer would experience substantial losses. To hedge the price volatility of corn, the farmer could enter into a futures contract to deliver corn in October for a set price. Thus, the farmer can hedge his inherent long position in corn with an off-setting short futures position.

In this scenario, the farmer's counterparty may himself be a *hedger*. A food manufacturer such as General Mills, for example, has an underlying short position to corn. In order to hedge this position and guarantee a price for future inputs, the manufacturer may enter into a long futures position.

The farmer's counterparty could also be a *speculator*. In this scenario, a speculator is defined as a trader of commodities futures contracts with no underlying economic interest in the commodity. Participants in commodities markets can be defined as either hedgers or speculators. Investors in commodities act as speculators, providing liquidity to futures exchanges and acting as counterparties to hedgers. While the farmer is accessing the futures

markets in this example to manage risk, the speculator is attempting to profit from an increase in the futures price. The interaction between the two types of commodity futures market participants, speculators and hedgers, underpins many theories that attempt to explain commodity future returns.

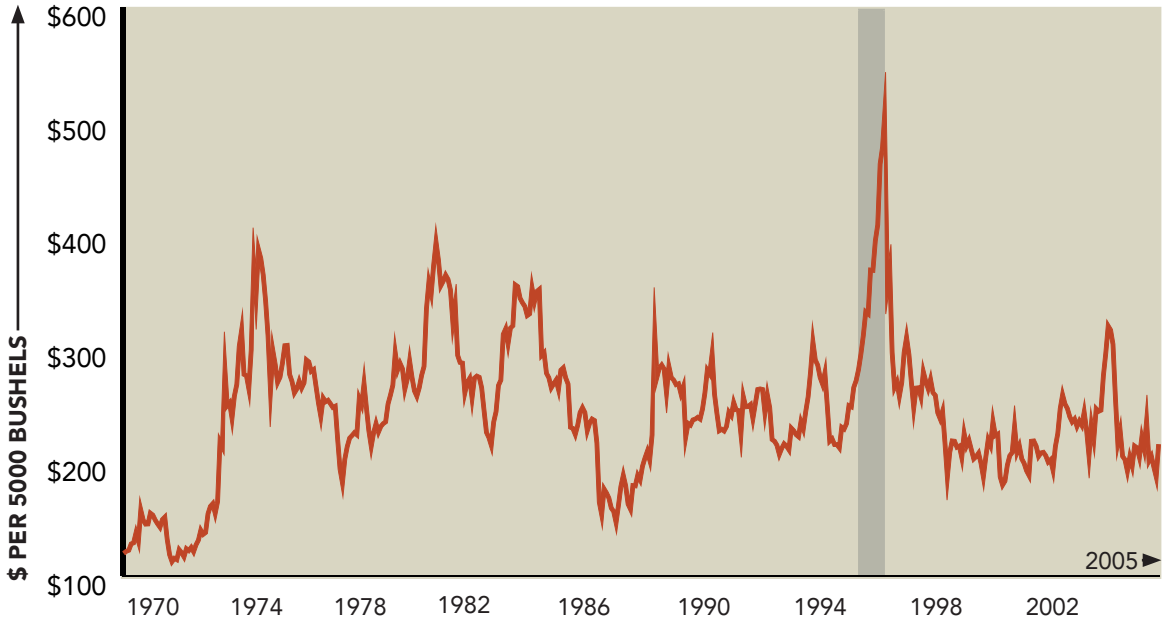
The Chicago Mercantile Exchange (CME), Chicago Board of Trade (CBOT), and the New York Mercantile Exchange (NYMEX), all owned by the CME Group, are the primary futures exchanges where commodities contracts are traded in the United States.

Investing in Commodities

Investors are typically drawn to commodity futures investments for two reasons. First, they believe that commodities prices rise over time. Second, they believe that because commodity prices are rising, they will earn a positive return. It turns out that neither of these assumptions is necessarily true.

In the long-term, commodity prices reflect the cost of commodity production. Thus, over the long term, most commodity prices are mean reverting;[1] they do not necessarily increase. In the short-term, commodity prices can experience shocks due to shortages, but as markets normalize commodity prices return to equilibrium. While many believe commodity prices rise over time due to recent price spikes, if anything, over the past 30 years the reverse has been true. As many commodities' prices are mean reverting in nominal terms, in real terms commodity prices have actually fallen. This is illustrated in the historical price of corn, shown in Exhibit 3.

Exhibit 3: Corn Spot 1970 - 2005[2]



Source: Bloomberg

From 1970-2005, corn prices fluctuated around $250, but with substantial volatility.[3] Notably, prices increased in the first half of 1996 over 40% due to drought. However, within a few years prices had again returned to the $250 mark. Commodity price shocks may partially explain why commodity investments are uncorrelated to equity investments. While positive shocks are beneficial events for long commodity investors, they are negative events for

[1] Andersson, Henrik. "Are Commodity Prices Mean Reverting" Applied Financial Economics: Vol. 17, Issue 10. 2007.

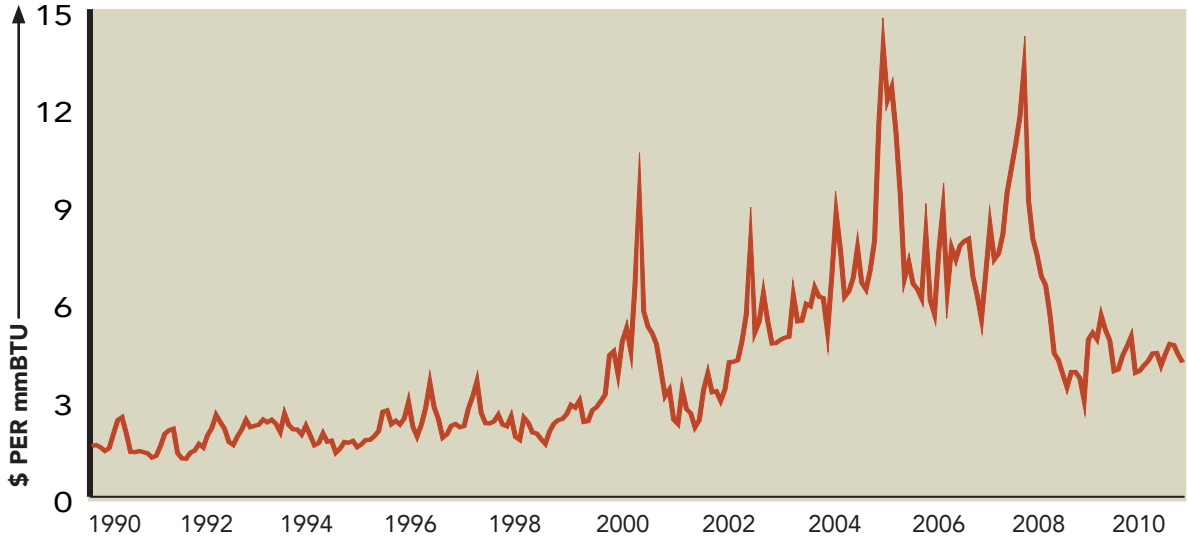
[2] Graph is shortened to better show mean reversion. Recent prices of corn have spiked over $700, fallen, and spiked again.

[3] The standard deviation of the change in corn prices during this time was 25.7%, greater than stocks.

equity investors in companies with commodity inputs. For example, over the first six months of 1996, the stock of General Mills was down 7.4%, even as the overall stock market was up 21.3%. The effect of commodity shocks on equities may help explain why commodities have historically been good diversifiers in portfolios of stocks and bonds.

As another example of mean reversion, Exhibit 4 shows the price of natural gas since 1990. Natural gas prices have experienced more extreme upward price shocks than corn, causing the price change of natural gas to be more than twice as volatile. Still, the price of natural gas seems to fluctuate around the $4 mark.

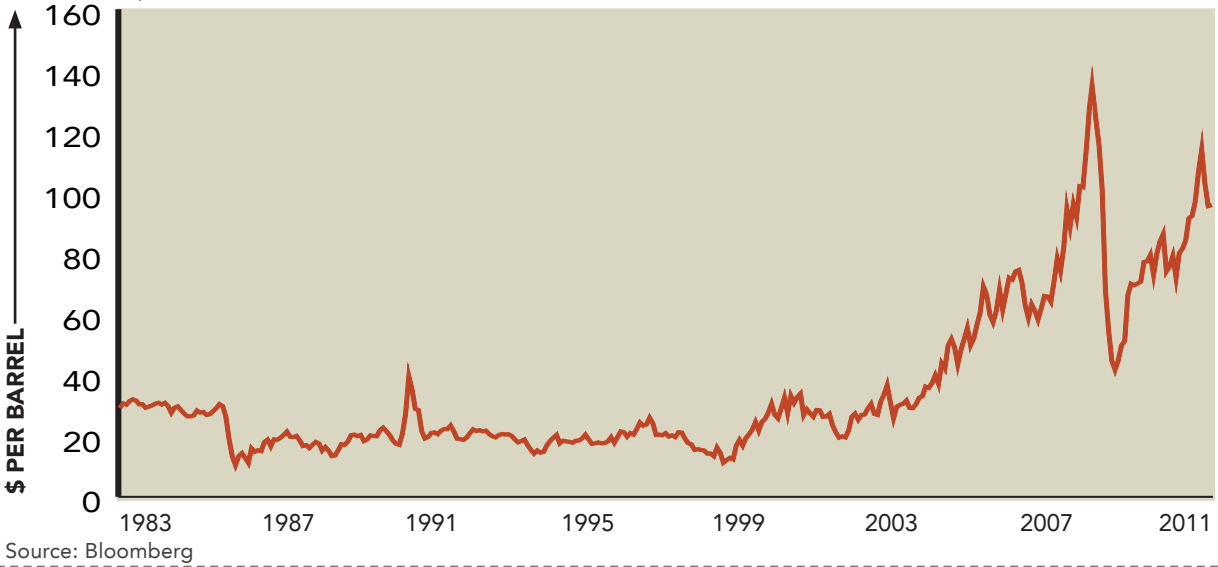
Exhibit 4: Natural Gas Spot Price



Source: Bloomberg

Finally, Exhibit 5 shows the spot price of oil since 1983. While like most other commodities the price of oil was mean reverting for much of the last century, during the previous decade the price of oil has been characterized by an upward trend as increases in oil demand have not been met with new supply. Even with a rapid price increase over the past five years, the annual price increase of oil in real terms since the 1970's is 1.5%.[4]

Exhibit 5: Oil Spot Price



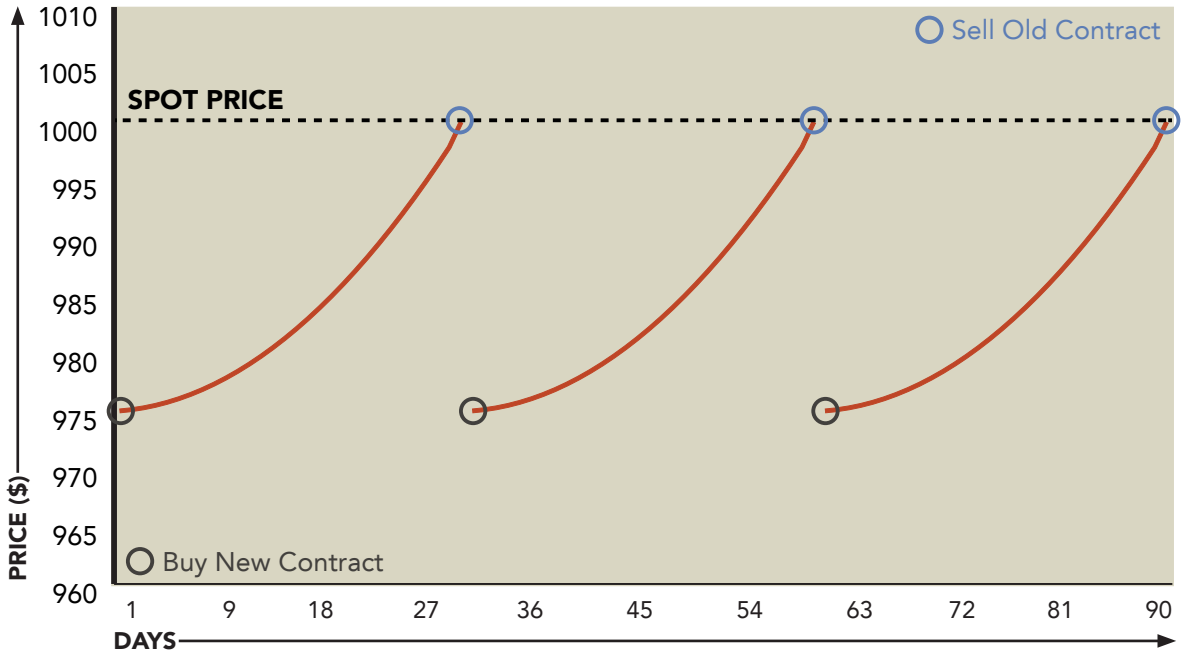
Source: Bloomberg

[4] Source: St. Louis Fed

If most commodities have not historically risen over the long-term, does this mean that investors in commodities futures can expect zero returns? The answer is no. Indeed, investors in commodities futures over the past twenty years would have achieved returns well above zero. The reason lies in the mechanics of futures investing.

Unlike stocks, which represent perpetual ownership stakes in corporations, futures contracts are derivatives with defined expiration dates. To maintain consistent equity exposure, investors merely buy and hold stocks. Investors who buy and hold futures contracts however, would be forced to take delivery. In order to maintain a consistent exposure to the underlying commodity by owning futures contracts, investors must continuously buy contracts, sell them before expiration, and then repurchase longer dated contracts. The process of selling existing contracts to buy longer dated contracts in order to maintain a consistent exposure is known as *rolling* futures contracts. Exhibit 6 shows an example of rolling a futures contract.

Exhibit 6: Rolling Futures Contracts



Source: Marquette Associates

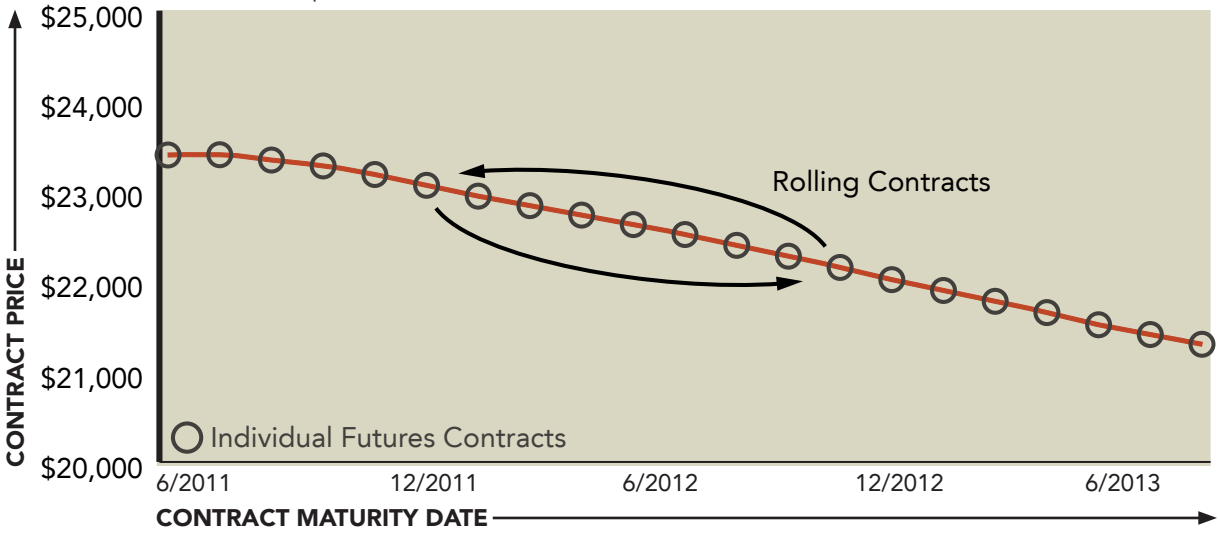
The example in Exhibit 6 shows the performance of rolling a hypothetical futures contract three times over the course of 90 days. The spot price of the underlying commodity is constant at $1,000 over the 90-day investment period. The investor purchases a futures contract on day 1 for $975. As the contract matures, it increases in value, approaching the spot price of $1,000. The investor then sells this contract and repurchases a longer dated contract, again for $975. The process then repeats itself. Thus, in our hypothetical example, even though the spot price has not moved, the investor has earned 2.56% on each contract, for a cumulative return of 7.89%.[5]

Exhibit 6 illustrates an important concept of futures investing. Of course, the price of a futures contract depends on the current spot price. However, the long-term *return* of an individual futures investment may or may not depend on the spot price. When futures prices are lower than the spot price, holders of long futures positions can earn a positive return with no move in the spot price. When the price of a futures contract is below the spot price, this is known as *backwardation*. Conversely, when the price of a futures contract is above the current spot price, this is known as *contango*.

[5] For the sake of simplicity, this calculation assumes infinitely divisible contracts.

Futures prices of different maturities can be charted over time on a futures curve. When the futures market is in backwardation, the futures curve is downward sloping. Exhibit 7 shows an example of a downward sloping futures curve.

Exhibit 7: Backwardation Example, Nickel Futures Curve[6]

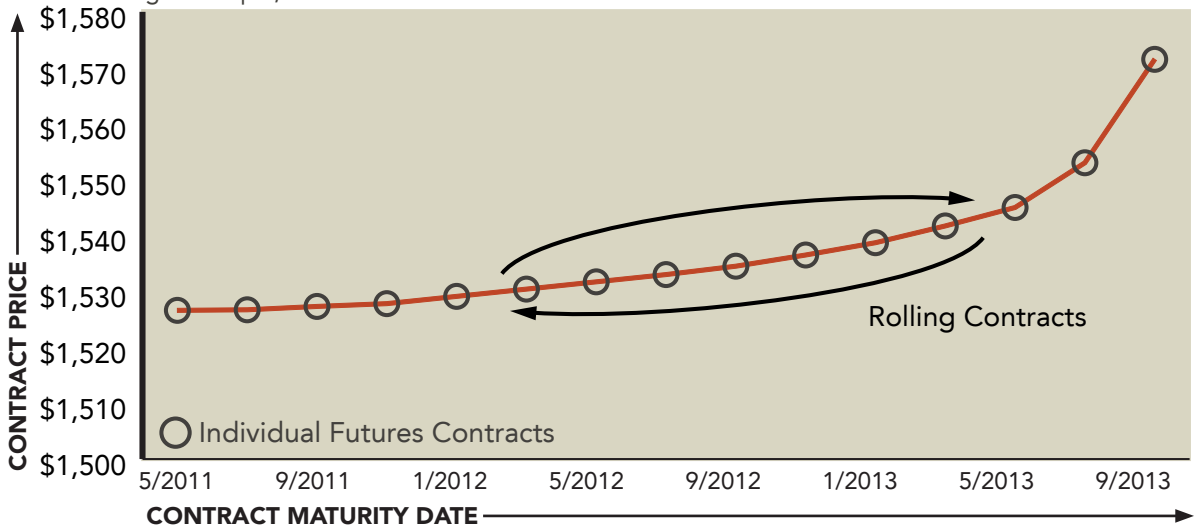


Source: Bloomberg

Note that while Exhibit 6 shows one futures position over time, Exhibit 7 depicts several contracts at one point in time. An investor rolling one position would move from left to right on the x-axis in Exhibit 6, but right to left on the axis in Exhibit 7 as the contract approached maturity.

The converse of a backwardated market, in which the futures price is lower than the spot price, is a contango market, where the futures price is higher than the spot price. A market in contango is characterized by an upward sloping futures curve. While long investors in backwardated markets can earn a positive return with no move in spot prices, long investors in contago markets will experience a loss with no move in spot prices. An example of a market in contango is shown in Exhibit 8.

Exhibit 8: Contango Example, Gold Futures Curve[7]



Source: Bloomberg

[6] As of 5/25/2011

[7] As of 5/25/2011

Theories of Commodities Speculation

Despite increased interest in commodities investment in recent years, academics have long debated whether or not commodities speculators should earn positive returns. Futures investing is a zero sum game: there are two sides to every contract, so if one side profits, the other side loses. While the details of this debate may not be important to investors in commodities, the substance is. As all investors know, past returns are not a guarantee of future returns. Even though commodities investments have been profitable in the past, what is important for investors today is whether commodity investments will be profitable *in the future*. Theories that help explain the returns to commodity speculation can help indicate whether investors should expect positive future returns.

As mentioned previously, there are two broad types of investors in futures markets, speculators and hedgers. Many theories that try to explain potential returns to commodity speculation deal with the interplay between speculators and hedgers. Because futures investing is a zero sum game, in order for speculators to earn positive returns, hedgers must earn negative returns. Evidence suggests that historically, this has been the case. By examining the Commitment of Traders (COT) report, compiled by the Commodity Futures Trading Commission (CFTC), researchers have determined that large speculators[8] tend to earn positive returns, and large hedgers tend to earn negative returns.[9] Intuitively, the idea that there is a positive return to commodities speculators makes sense. While at the margins there are certainly "gamblers" that participate in commodities markets, over the long-term speculators would cease to pour money into commodities if they did not expect some positive return.

There are multiple theories as to why speculators may earn positive returns:

- **Theory of Insurance**[10] – Keynes was one of the first to suggest that commodities speculators might provide "insurance" to commodities hedgers. In effect, hedgers pay a premium to speculators in order to hedge business risk. Keynes developed the idea of "normal backwardation," that commodities futures prices are normally below expected futures prices. Keynes theorized that commodities producers hedged their inherent long position in commodities by purchasing short futures contracts with speculators taking the corresponding long position. The short hedging by producers exerts downward pressure on futures prices, leading to normal backwardation and potential gains for long speculators.

- **Theory of Storage**[11] – As discussed in *Introduction to Futures Contracts*, futures prices can be related to spot prices by the equation: Futures Price = Spot Price + Storage Costs - Convenience Yield. The theory of storage proposes that when inventories are low, the benefit to producers for holding physical inventory is high (convenience yield). Thus, futures will trade below spot prices, leading to positive returns for speculators.

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[8] The COT breaks traders into the following categories: commercial traders, non-commercial traders, and non-reportable. It is convention to consider commercial traders as hedgers, and non-commercial traders as speculators.

[9] Sigl-Grub, Christof, et al. "Returns to Speculators in Commodity Futures Markets: A Comprehensive Revisit" International Research Journal of Finance and Economics. 2008.

[10] Keynes, John Maynard. A Treatise on Money: Volume 2, 1930.

[11] Fama, Eugene, et al. "Commodity Futures Prices: Some Evidence on Forecast Power, Premiums, and the Theory of Storage" Journal of Business: vol. 60. 1987.

- **Net Hedging Pressure**[12] – In real world markets, there exist both long and short hedgers. Additionally, for many commodities, hedgers do not maintain consistent positions year round. According to the net hedging pressure theory, speculators profit by going long when hedgers have large short positions, and going short when hedgers have large long positions.

- **Options Based Theories**[13] – Oil reserves are modeled as a call option on future oil. If expected future oil prices have high implied volatility, this option is more valuable, and producers opt to leave oil in the ground. This causes spot prices to rise leading to backwardation.

Keynes was one of the first theorists to come up with a model for possible returns to commodity speculation. Keynes' idea was that because commodity producers are net long commodities, they would hedge their exposure by shorting futures. In order to induce speculators to take the corresponding short position, hedgers would pay an insurance premium, leading to a positive return to long only speculation. This would depress the future price below the spot price, leading to "normal backwardation."

It turns out in practice that "normal backwardation" is not in fact normal. Many commodity markets are typically in contango. This led to the development of other theories, discussed above. Still, the general conception of how long only futures investors profit is the right one. If the futures price is an unbiased estimator of the future spot price, over time investors may gain or lose, but average returns will be zero. If the futures price, on average, underestimates the future spot price (like in Keynes' normal backwardation), there will be positive expected returns to speculation. Unless fundamental factors lead futures prices to underestimate realized future spot prices, long only investors should expect a zero return to speculation.

It is worth emphasizing this point. Just because speculators earn positive returns does not mean *long only* speculators earn positive returns. Traditionally, institutions and retail investors have been long only investors in commodity markets. Relating speculators' returns to normal backwardation is important only for long only investors.

Long Only Commodities Investing: Individual Commodities

Though futures markets enable investors to take both long and short positions, institutional investors have traditionally taken passive long-only investments in a diversified basket of commodity futures. As discussed in this paper and *Introduction to Futures Contracts*, the returns of investing in a single long commodity position can be broken down into the returns from continually rolling a futures contract to maintain a long position ("excess returns") and the returns of collateral held against the futures position:

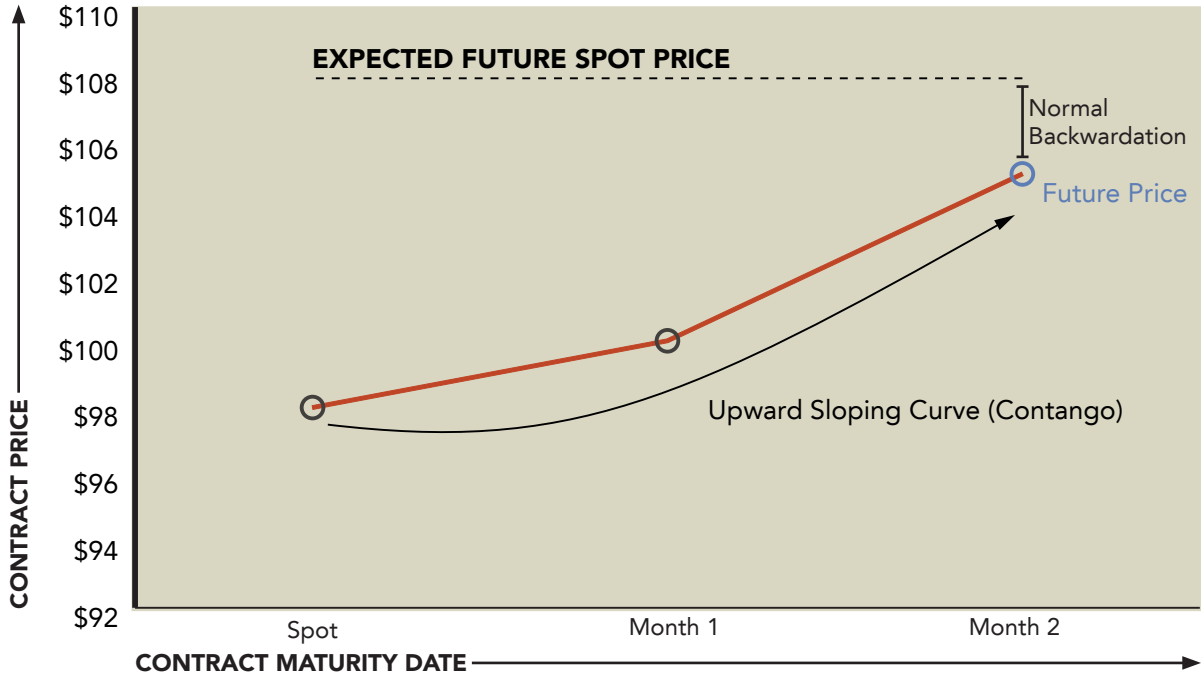
Total Returns = Excess Returns + Collateral Returns

Theoretical excess returns for an individual long only position should only be positive over the long-term if the commodity is *normally backwardated* as discussed in the previous section. This differs from a market that is market backwardated, as in Exhibit 7. A *normally backwardated* market is a market in which the futures price is lower than the expected future spot price. This "expected" spot price cannot actually be measured, unlike the market price. Thus, a market can potentially be in contango (upward sloping futures curve), but still normally backwardated. Exhibit 9 shows a hypothetical example of this concept.

[12] Hirshleifer, David. "Hedging Pressure and Futures Price Movements In a General Equilibrium Model" Econometrica: Vol. 58. 1990.

[13] Lizenberger, Robert, et al. "Backwardation in Oil Futures Markets: Theory and Empirical Evidence" Journal of Finance. 1993.

Exhibit 9: Normal Backwardation Illustration



In Exhibit 9, the spot price is $98 and the futures price two months from now is $106. Because the futures price is higher than the spot price, the futures curve is upward sloping and the market is in contango. However, in this example, the true *expected future spot price* is $108. Thus, the expected future spot price is higher than the futures price, and the market is normally backwardated. Theorists have developed commodity models beyond the Keynesian idea of insurance, but the idea of *normal backwardation* is a useful concept.

The key insight from Keynes' idea of normal backwardation is that long only positions in individual commodities contracts should only yield positive excess returns in the long run if there is some structural market element leading to normal backwardation (through insurance, storage, net hedging, etc.). Intuitively, this makes sense. If commodity prices are flat in the long-term (mean reverting), long only investors only earn a positive expected return if futures prices are lower than spot prices.[14] Futures prices converge to spot prices. If on average spot prices are not increasing, futures must be below spot prices (backwardation) for long-only investors to expect positive returns.[15] If commodity prices are rising, as for example, oil appears to be, commodity prices must rise by more than the futures price for long only investors to earn a positive return.

Partially because oil and gas prices have visibly risen in recent years, many investors think commodity investments earn positive returns. Exhibit 10 shows individual commodity futures returns since January 1992. Even in a commodities bull market, the average excess return across all contracts shown in Exhibit 10 is essentially zero.

[14] If commodity prices are mean reverting, the current spot price is a reasonable proxy for the expected future spot price. In this scenario, long only investors earn positive returns if futures curves tend to be in backwardation.

[15] Strictly speaking, it is possible for long-only investors to earn positive returns if the market does not spend more time in backwardation, if backwardated markets are steeper than contango markets.

Exhibit 10: Individual Commodity Excess Returns, Jan 1992 to Jun 2011

CONTRACT	Annualized Excess Return	Standard Deviation
Copper	9.30%	25.79%
Unleaded Gas	8.35%	34.95%
Silver	8.33%	28.52%
Sugar	5.44%	32.46%
Crude Oil	4.79%	32.32%
Heating Oil	4.43%	31.66%
Soybeans	4.25%	23.68%
Gold	0.78%	21.35%
Zinc	-1.43%	25.53%
Aluminum	-1.58%	18.99%
Live Cattle	-1.86%	13.56%
Coffee	-2.64%	39.88%
Cocoa	-4.15%	30.50%
Cotton	-4.84%	28.02%
Corn	-7.93%	25.49%
Wheat	-10.04%	27.80%
Lean Hogs	-10.10%	24.97%
AVERAGE	**0.06%**	**27.38%**

Source: Bloomberg

It makes sense to think of long commodities positions as *trading strategies*. Commodity spot prices are extremely volatile, so day-to-day returns are driven by underlying price fluctuations. Over time, however, unless the futures price systematically underestimates the future spot price, long-only investors will not earn positive returns. Thus, in the short term, spot price movements determine performance, but in the long-term, excess returns are determined by the structure of the futures market. Unfortunately, while useful as a concept, normal backwardation is impossible to measure in reality. However, if normal backwardation does explain commodity returns, observed backwardation in futures markets should be related to realized returns. This is because most commodity prices have historically been mean reverting.[16]

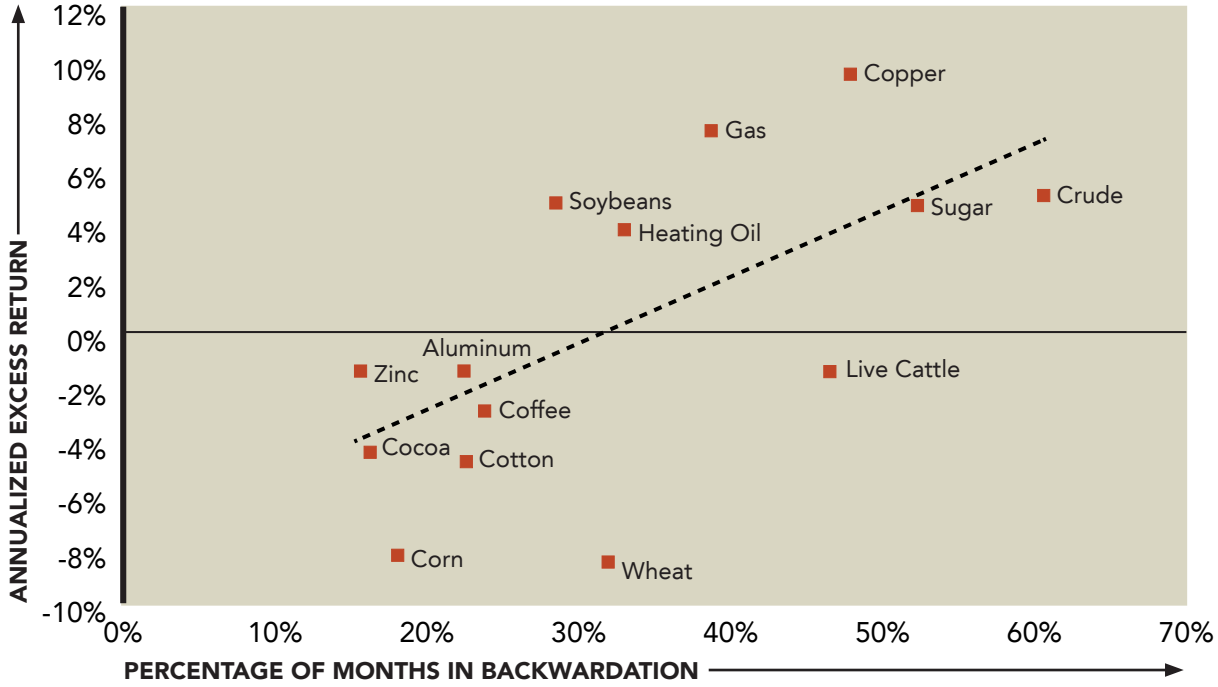
Exhibit 11 shows realized commodity returns and the percentage of months each commodity spent in backwardation. With an R^2 of 0.42, time in backwardation has a strong positive relationship with realized returns. Notably, energy commodities such as oil, industrial metals such as nickel, and livestock such as live cattle, spend the most time in backwardation. In fact, there is some evidence that these commodities have historically earned positive excess returns. Gasoline, crude oil, brent crude, heating oil, nickel, copper, and live cattle[17] all show statistically significant evidence of excess returns greater than zero.

[16] Oil markets may now be upward trending due to supply and demand imbalances.

[17] Note: since inception numbers, while Exhibit 11 uses values since 1992. One tailed t-test value of 2.45, 1.80, 2.44, 1.71, 1.66, 2.13, 1.69, respectively. Live cattle shows positive returns over a longer time frame than shown here. Statistical significance is dependent on the time frame the test is conducted due to commodity price volatility. Other researchers here found more or less evidence for positive returns in the past.

Research has shown some evidence that commodities that are "difficult to store" (heating oil, live cattle, live hogs, and copper) have higher excess returns.[18] Historical returns of commodities "in the ground" (energy and metals) indicate that there may be some positive expected return to commodities whose reserves act as options on future extraction. It is important to point out that because commodity returns are so volatile, estimates of statistical significance vary depending on when the test is conducted. Some studies have found more or less evidence of statistical significance of positive commodity excess returns. As highlighted in Exhibit 11, commodities with higher returns have tended to spend more time in backwardation. This is consistent with the idea of "normal backwardation" driving long-term commodity returns.

Exhibit 11: Annualized Excess Returns of Individual Commodity Positions vs. % of Months in Backwardation, 1992 - 2010[19]



Source: Bloomberg

So far, this paper has discussed the mechanics of investing in long only commodities and the drivers of returns for individual commodity positions. To summarize:

- Long only commodity positions are maintained by *rolling* futures contracts.
- Commodity traders can be broken in to *hedgers and speculators* (investors).
- There are many theories as to why *speculators* may earn positive returns.
- In order for long-only speculators to earn positive excess returns, commodity futures must underestimate expected future spot prices (normal backwardation).
- Historical evidence supports the idea of *normal backwardation*. Commodities that have had higher returns in the past have tended to spend more time in backwardation.

[18] Till, Hillary. "Two Types of Systematic Return Available in the Futures Markets" Commodities Now: vol. 4, no. 3. 2000.

[19] Individual commodity returns were calculated with the longest history available from 1983-2000. Gold and silver were excluded as they spend almost no time in backwardation, but are in the middle of a bull run due to declining global investor confidence.

- Historically, some commodities have earned positive compounded excess returns and some negative. On average, excess returns have been zero.

While it is encouraging that some commodities have offered positive returns to long only investors, it is also interesting that many commodities typically included in long only indices have not. Why do many long only commodities investors, such as index investors, still earn positive returns despite investing in commodities that do not necessarily offer positive excess returns? The answer lies in potential diversification benefits.

Long Only Portfolios: Diversification and Indexing

A popular method of investing in commodities is passive index investing. A long only diversified basket of commodities is selected and rebalanced in constant proportion on a regular basis (typically annually). There are two principle benefits of this type of diversification. First, while each underlying commodity is volatile the basket's components are relatively uncorrelated. Thus, a diversified portfolio of commodities will have substantially lower standard deviation than the underlying individual positions. For example, long crude oil returns have a standard deviation of 34%, while the Dow Jones-UBS Commodity Index (DJ-UBS) has a standard deviation of 14%, nearly two thirds less. Second, by consistently rebalancing a portfolio of volatile, uncorrelated positions, index investors earn a "diversification return." The compound return of a commodity index is higher than the weighted average return of its underlying investments.

As an example of the benefits of diversified commodities positions, assume a two-asset portfolio, containing equal weights to oil and copper that is rebalanced monthly.

Exhibit 12: Diversification Example, Jan 2000-Dec 2010

	Oil	Copper	Equal Weighted Portfolio
Average Return	8.16%	25.91%	16.73%
Compound Return	2.15%	20.42%	12.49%
Standard Deviation	33.48%	29.94%	26.77%

Exhibit 12[20] shows the risk and return for such a portfolio. Diversification reduces portfolio volatility significantly. The combined portfolio has a standard deviation of 26.77%, lower than either the standard deviation of oil or copper. Notably, the diversified portfolio earns more than "expected" given the strategic allocation to copper and oil. Define portfolio strategic return[21] as the weighted average of geometric returns of the underlying assets:

$$\text{Strategic Return} = \sum_{i}^{n} \text{weight}_i \text{ X geometric return}_i$$

Therefore, the strategic return of a portfolio equally divided between oil and copper would be:

$$0.5 \text{ X } 2.15\% + 0.5 \text{ X } 20.42\% = 11.29\%$$

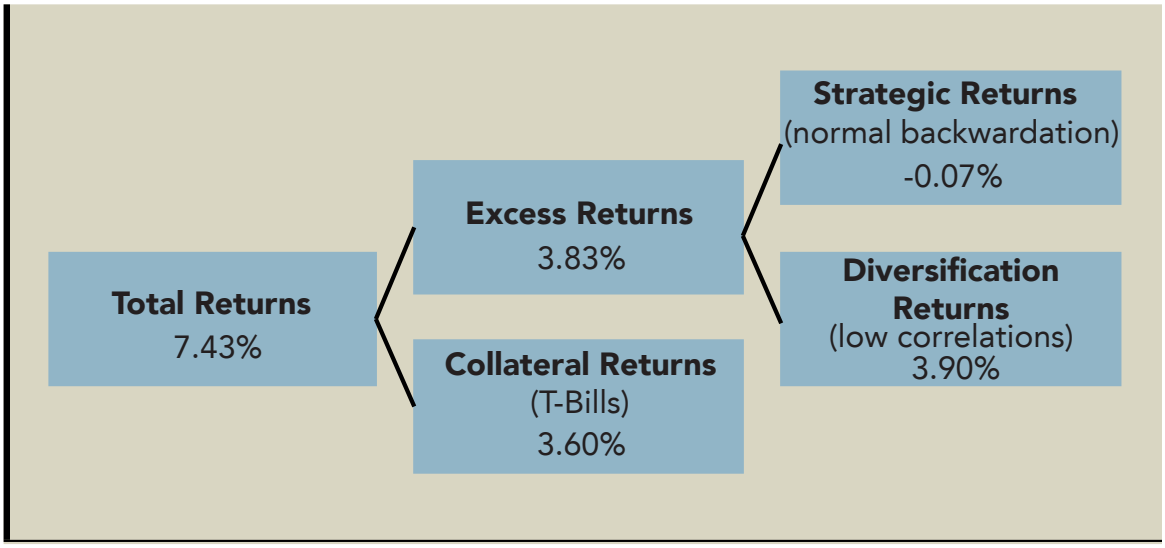
The realized compound return of the portfolio is 12.49%. Thus, the diversification return is 1.2%. In a rebalanced portfolio, the diversification return depends on the volatility of the underlying assets, and each asset's correlation with the rest of the portfolio. A portfolio of commodities, which are volatile and relatively uncorrelated, can earn a relatively high diversification return. In contrast, a portfolio of equities earns a relatively low diversification return. While each individual stock is volatile, the correlation amongst individual holdings is also high.

[20] Excess returns, as opposed to total returns (including collateral) are used in Exhibit 12.

[21] For a more in depth discussion of diversification return, see Willenbrock, Scott. "Diversification Return, Portfolio Rebalancing, and the Commodity Return Puzzle" Financial Analysts Journal. July/August 2011.

This diversification benefit leads to an additional source of return for portfolios of commodity contracts versus individual contracts. Like individual commodity positions, total returns to commodity index investors are comprised of collateral returns and excess returns. However, while excess returns of individual investments are driven entirely by normal backwardation, excess returns of commodity portfolios are driven by both normal backwardation of individual contracts (strategic returns) and the diversification benefit from a portfolio of uncorrelated contracts. The breakdown of index total returns is highlighted in Exhibit 13. The earnings of T-Bills drive collateral returns. Strategic returns are driven by positive returns of the underlying commodity positions, which in turn are driven by normal backwardation in the long run. Diversification returns are driven by rebalancing an uncorrelated portfolio of commodity investments.

Exhibit 13: Decomposing Commodity Index Total Returns (DJ - UBS)



Long Only Commodity Indices

Long only commodity index investors invest in a fully collateralized (unlevered), diversified basket of underlying commodities. There are several popular commodity indices in existence today. The important features of commodity indicies include:

- Index components
- Index weights
- Roll schedule
- Rebalancing methodology

The Thomson Reuters/Jeffries CRB Index ("CRB") is the oldest commodities index, with over 50 years of history. It has been revised ten times, however, so the long-term return history is not a reliable representation of its current incarnation. The Standard & Poor's Goldman Sachs Commodity Index ("GSCI") has the longest consistent track-record of any index, dating to 1970. GSCI also publishes a Light Energy index, which is less heavily weighted towards energy. Another common index is the Dow Jones-UBS Commodity Index ("DJ-UBS"). Exhibit 14 summarizes the features of popular commodity indices.

Exhibit 14: Commodity Indices

	CRB[22]	GSCI[23]	GSCI Light Energy	DJ-UBS[24]
# of Commodities	19	19	19	19
Energy	39.0%	49.8%	33.1%	32.6%
Industrial Metals	13.0%	12.5%	16.6%	14.9%
Precious Metals	7.0%	5.1%	6.8%	17.2%
Agriculture	34.0%	26.1%	34.8%	28.6%
Livestock	7.0%	6.5%	8.6%	6.6%
Roll Schedule	Contracts are rolled on the 1st to 4th business day each month	Contracts are rolled on the 5th to 9th business day each month	Contracts are rolled on the 5th to 9th business day each month	Contracts are rolled on the 4th to 8th business day each month
Methodology	Weighting frequently revised	Weighting based on world production	GSCI with lower energy weighting	Weighting based on production and liquidity. No group may be more than 33%

Note that the GSCI is the most heavily weighted toward energy, while the DJ-UBS is most heavily weighted toward precious metals. The DJ-UBS also weights contract liquidity more heavily than other indices. The CRB in its most recent formulation is similar in composition to other indices. Exhibit 15 shows historic risk and returns of these indices compared to stocks and bonds. As the CRB has significantly changed in composition over time, it is excluded.

Depending on the period of the analysis, commodity index returns are either comparable to stocks or bonds. Standard deviation is high and depends on index formulation. The standard deviation of the GSCI is the highest shown here, which makes sense as it has the largest weight to energy. The DJ-UBS has had a historic standard deviation comparable to stocks, while the GSCI Light Energy has a standard deviation higher than stocks, but lower than the GSCI.

Exhibit 15: Historic Risk and Return

	GSCI Light Energy	GSCI	DJ-UBS	S&P 500	BarCap Agg
Trailing 10 Years	4.36%	3.69%	6.62%	2.72%	5.75%
Trailing 20 Years	3.23%	3.99%	6.25%	8.73%	6.80%
Inception	9.03%	9.93%	5.80%	9.76%	8.28%
StDev	16.15%	20.00%	14.73%	14.79%	5.65%
Inception Ret-Rf[25]	3.37%	4.22%	2.36%	4.51%	2.73%
Sharpe Ratio	0.21	0.21	0.16	0.30	0.48
Periods	498	499	247	655	427

Source: Bloomberg

Inception Dates: S&P 500 - Jan 1957; GSCI - Jan 1970; BarCap Agg - Jan 1976; DJ-UBS - Jan 1991

[22] Thomson Reuters/Jeffries CRB Index Fact Sheet

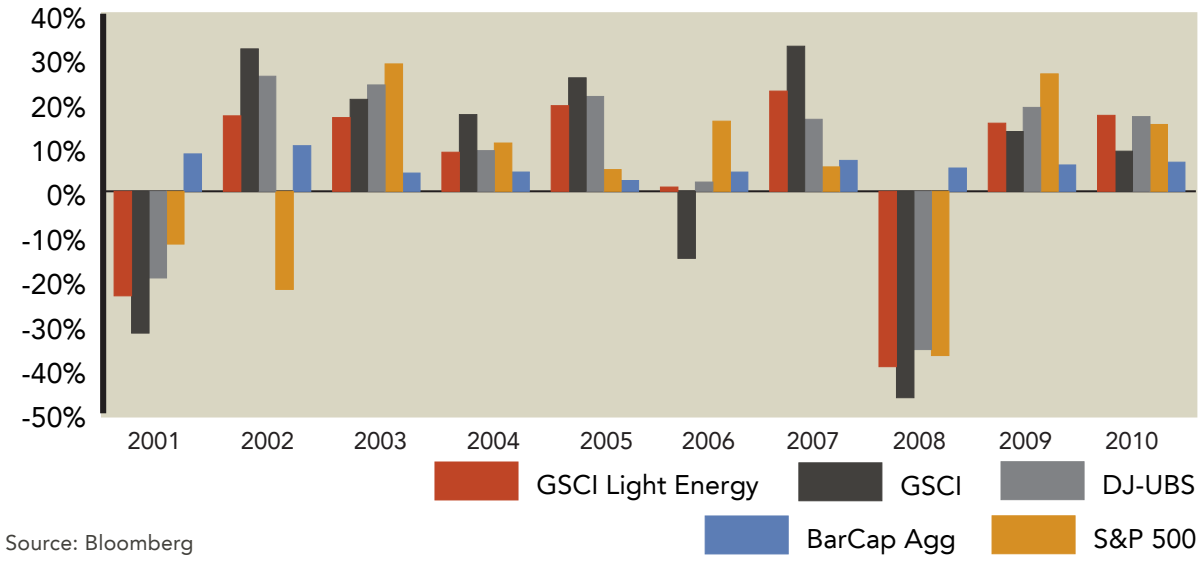
[23] S&P GSCI Commodity Indices Fact Sheet

[24] Dow Jones-UBS Commodity Index Methodology

[25] Indicates returns in excess of the risk free rate

Exhibit 16 shows calendar year returns of commodity indices, stocks, and bonds for the past ten years. Exhibit 16 highlights the volatility of commodity index returns, as well as the potential diversification benefits. In 2002 for example, the S&P 500 was down 22.1%, while the GSCI was up 32.1%. In 2006, the S&P 500 was up 15.8%, while the GSCI was down 15.1%. Exhibit 17 shows correlations of commodity indices with both stocks and bonds.

Exhibit 16: Calendar Year Returns



Source: Bloomberg

Exhibit 17: Correlations

	GSCI Light Energy	GSCI	DJ-UBS	S&P 500	BarCap Agg
GSCI Light Energy	1.00				
GSCI	0.93	1.00			
DJ-UBS	0.95	0.90	1.00		
S&P 500	0.12	0.07	0.27	1.00	
BarCap Agg	-0.01	-0.02	0.04	0.24	1.00

Source: Encorr

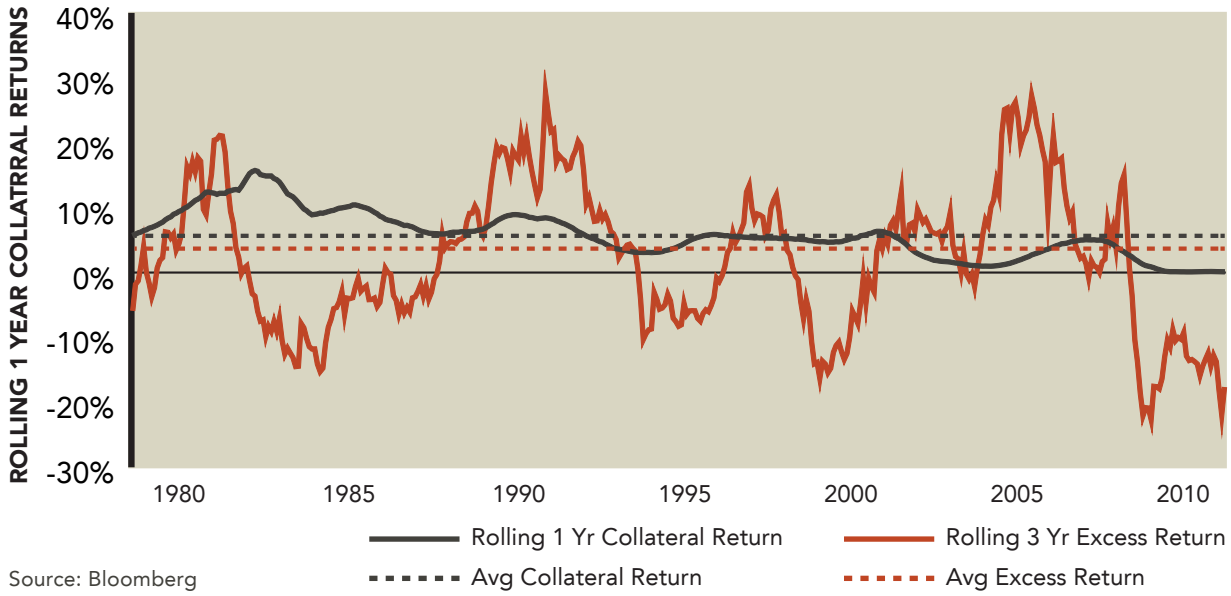
Drivers of Returns for Long Only Commodity Portfolios

Historically, commodity indices have exhibited positive excess returns and low or zero correlation to stocks and bonds. If future returns are similar to past returns, adding commodity index investments to a portfolio of stocks and bonds may improve portfolio risk and return. This has led many to argue that commodity index investments belong in the strategic portfolio allocation using *historic data*. However, long-term investors should care about expected long-term *future* returns.

Commodity index returns are broken down into collateral and excess returns. Collateral returns have historically made up a large portion of commodity index total returns. Since inception, the GSCI index has had a total return of 9.9%[26], with a collateral return of 6%. Thus, returns on collateral have made up nearly two thirds of historical commodity index total returns. Collateral for futures contracts is invested in short dated Treasuries, thus collateral returns are driven by short Treasury yields. It should be no surprise that collateral returns have been trending downward over time as yields have fallen. With the Fed committed to near zero rates through 2013, commodity index investors should expect little in the way of collateral returns for the near future. Exhibit 18 shows declining collateral returns over time, compared to the more volatile excess returns.

[26] Source: Bloomberg. As of June, 2011.

Exhibit 18: Rolling One Year GSCI Collateral Returns



Source: Bloomberg

Because collateral returns are low and determined by the risk free rate, it is simpler to just estimate future excess returns. As previously discussed, excess returns can be decomposed into strategic returns and diversification returns. Strategic index returns are determined by the returns of the underlying commodities in the index. An evenly weighted index of commodities should expect strategic returns close to zero, as many commodities do not exhibit positive long only returns. Over the long-term, to earn a positive strategic return a long only commodity portfolio must be invested in commodities that are normally backwardated. There is some evidence that certain energy, industrial metals, and livestock commodities may have met this criterion in the past. However, that does not mean these commodities will necessarily continue to offer positive excess returns in the future. Regardless, diversified portfolios may have an expected strategic return of zero.

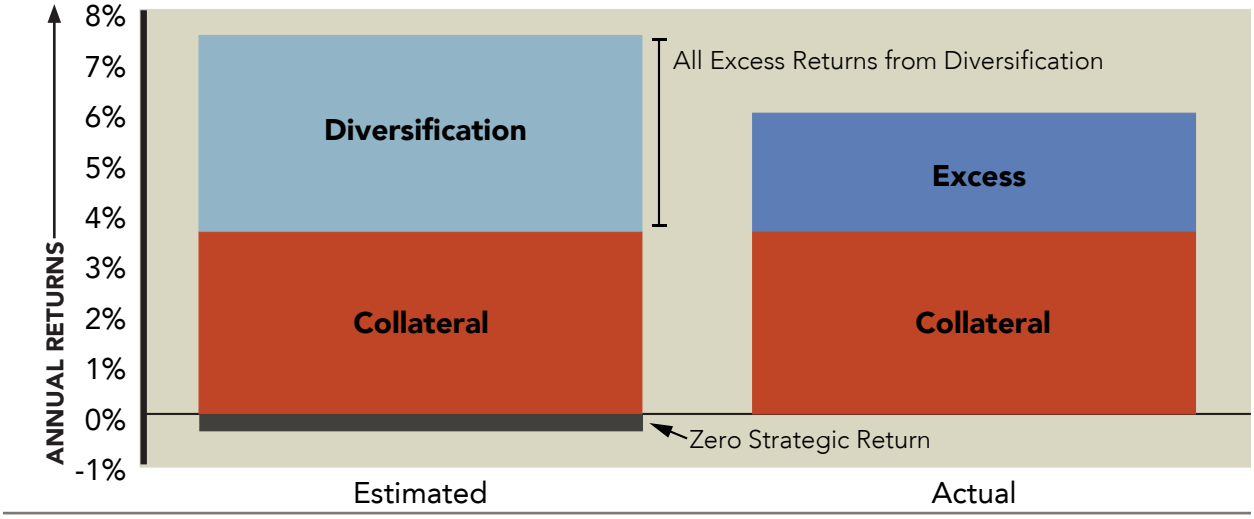
For evidence, we take the current weightings of the DJ-UBS, and back-test an annually rebalanced portfolio from January 1991 to August 2011. Total returns of such a portfolio would have been 7.43%, of which 3.60% can be attributed to collateral returns. Of the remaining 4.03%, strategic returns account for essentially zero returns (-0.07%). Thus, the diversification return of 3.90% drove nearly all excess returns of the portfolio. This diversification return of 3-4% is similar to the diversification return estimated by simulation and mathematically in academic literature. Portfolios of commodities that would have earned higher strategic returns historically would have been more heavily weighted toward commodities that exhibited positive excess returns, such as energy. Older formulations of the GSCI, which historically was nearly 80% weighted towards energy, may have earned positive strategic returns. Exhibit 19 shows the estimated breakdown of the sources of index return.

[27] This is higher than returns actually earned by the DJ-UBS over this period, as index weights have changed. Source: Bloomberg.

[28] Erb, Claude, CFA, et al. "The Strategic and Tactical value of Commodity Futures" Financial Analysts Journal: Vol. 62 No. 2. 2006.

[29] Willenbrock, Scott. "Diversification Return, Portfolio Rebalancing, and the Commodity Return Puzzle" Financial Analysts Journal. July/August 2011

Exhibit 19: Estimated Sources of Excess Returns and Actual Excess Returns



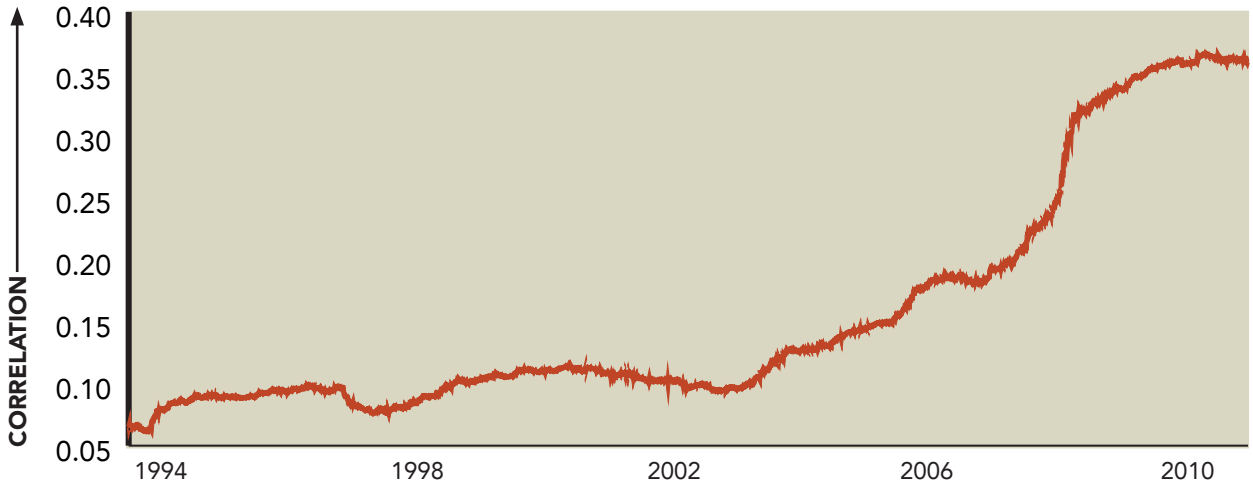
Based on the evidence, it seems reasonable to project a long-term strategic return of zero or less than zero. If some commodities have historically shown positive returns, why assume that the long-term average commodity return is zero? After all, a portfolio more heavily weighted towards energy would have earned positive excess returns over the past twenty years.

The main reason to assume a zero strategic return is the structure of the futures market itself. The fact that some commodities have at times earned positive excess returns only proves that in the past certain futures markets may have been normally backwardated. As normal backwardation is based upon an imbalance between short hedgers and long speculators, there is no reason to believe it will persist indefinitely. A large influx of long only investors could push futures prices up closer towards equilibrium. Unlike a financial asset, there are no future cash flows that lead to a positive expected return. Changes to the participant base or underlying economics of future markets could lead to zero or negative returns in commodities that have performed well in the past and vice versa. As it is impossible to forecast whether certain futures markets will continue to favor long biased investors, it makes sense to assume that the average long-term strategic return to commodities investing is zero, or even negative.

Assuming zero or negative strategic returns, estimating long-term commodity index excess returns only requires estimating expected diversification return. The determinants of diversification return are the correlation of the underlying assets and their volatility. It seems reasonable to assume that individual commodities will continue to be volatile. Historically, individual commodities have exhibited low correlation with each other. Commodities in the same category (such as oil and gasoline) have had relatively high correlation, but on average, correlation between different commodities has been low, about 0.1. Is it reasonable to assume that individual commodities will remain uncorrelated in the future? Exhibit 20 suggests that it may not be.

Exhibit 20 shows the rolling three-year average correlation of the nineteen underlying contracts of the DJ-UBS. Correlations over the long-term have been close to 0.1, but more recently trending higher. There was a large spike upward in correlations between commodity futures in 2008, but correlations had been trending up since 2004. This coincides with increasing investor allocations to commodity index funds.

Exhibit 20: Rolling 3 Year Average Correlations between Commodities



Source: Bloomberg

Increasing correlation between commodity contracts leads to decreasing diversification return benefits. This decrease can be estimated mathematically. To do so, we assume an evenly weighted portfolio of nineteen underlying commodity investments, each with a standard deviation of 30%. We also assume the same correlation between each commodity in the portfolio. Therefore, a correlation between commodities of zero would lead to the highest possible diversification return benefit,[30] while a correlation of one would lead to zero diversification benefit.

Diversification return can be estimated by the following equation:

$$\text{Diversification Return} \approx \tfrac{1}{2} \sum_i \text{weight of asset (variance of asset - covariance of asset and portfolio)}$$

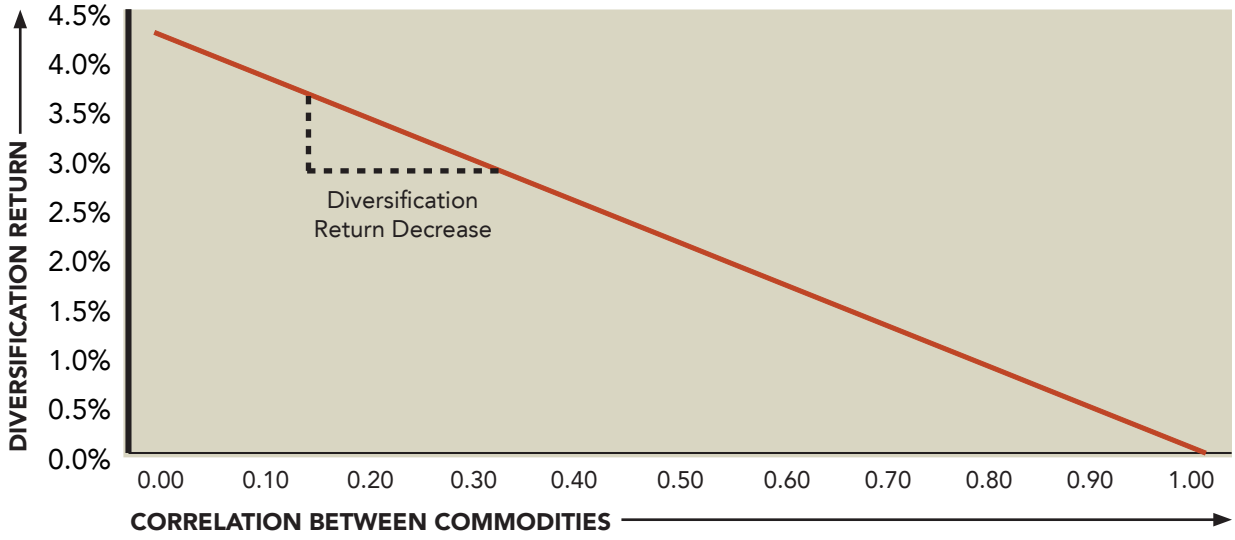
Increases as correlation increases

This equation shows mathematically why an increase in correlation between assets decreases diversification return. As correlation increases, the covariance of each asset within the portfolio as a whole increases; in effect, this decreases the diversification return.

Exhibit 21 shows how diversification return decreases as the correlation between portfolio assets increases. A correlation of 0.1 (the historic average between commodities) leads to an estimated diversification return of 3.84%. This is very close to the estimated historic diversification return of 3.90% using equivalent weights of current DJ-UBS index members. Assuming a correlation between commodities of 0.3 decreases estimated diversification return to 2.98%. If correlations remain elevated, increasing correlations between commodities may lead to a 25% decrease in diversification returns. This in turn would lead to lower estimates of future returns.

[30] Conceptually, negative correlations would lead to even greater benefits, but realistically a portfolio of 19 negatively correlated assets is not possible.

Exhibit 21: Diversification Return and Correlation Between Portfolio Assets



After examining an equally weighted portfolio, the obvious question is what about a portfolio of commodities more heavily weighted to positions with positive expected returns? There are several reasons this approach may not lead to better outcomes in a long only portfolio. The first reason to assume a zero strategic return is that portfolios with positive strategic returns – regardless of their composition - may not post better performance than more diversified indices. For example, say an investor displayed enough foresight to buy an equally weighted portfolio of the GSCI Energy index and the GSCI metals index in 1992 in an attempt to outperform the broader index. Such an investor would have realized a positive strategic return of 2.5%. However, the portfolio would have earned an excess return of 3.7% due to decreased diversification return, not an improvement over broader indices.[31] This return would have been significantly more volatile. Additionally, overweighting commodities with positive excess returns requires some ability to forecast *expected future excess returns*. Commodities that have exhibited positive excess returns in the past may not continue to do so in the future.

After examining individual long only commodity positions, this paper has examined a diversified portfolio of long only positions. In summary:

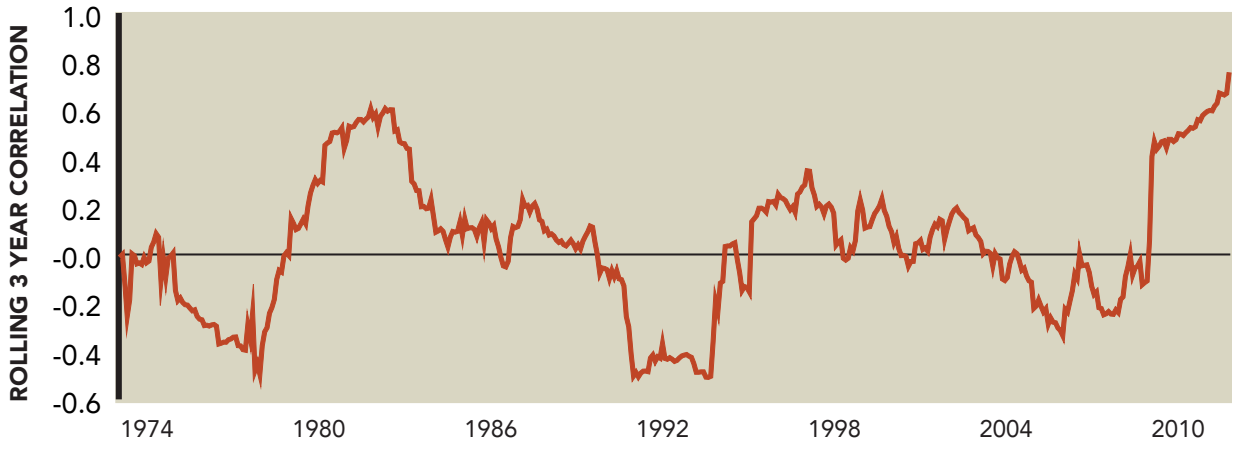
- Portfolio returns are driven by collateral returns and excess returns.
- Collateral returns are driven by three-month T-bill yields.
- Excess returns are driven by strategic returns and diversification returns.
- While individual commodities have zero excess returns on average, portfolios of commodities have positive excess returns.
- Theoretically, portfolios achieve positive excess returns by over-weighting commodities with positive excess returns, or through diversification returns.
- Historically, diversified portfolios such as the DJ-UBS have earned the majority of their returns from diversification returns.
- Because one of the main drivers of diversification returns is low correlations between commodities, increasing correlations between commodities may lead to lower expected excess returns in the future.

[31] Source: Bloomberg

Commodities in the Portfolio

Commodity investments are often touted for both their return potential and diversification benefits. Historic returns to commodity index investments have been comparable to equities, but these returns may not persist in the future. However, even if commodity indices have high volatility and relatively low return, adding them to a portfolio of stocks and bonds may still lead to improved risk adjusted returns as commodities have historically been uncorrelated with both stocks and bonds. Correlations between stocks and commodities have increased in recent years as shown in Exhibit 22, but this appears to be a recent phenomenon due to market stresses and is not unprecedented. While this may lead to lower portfolio diversification benefits in the short-term, it seems reasonable to assume in the long-term that correlations between stocks and commodities will remain low.

Exhibit 22: Rolling 3 Year Correlation Between the S&P 500 and GSCI



Source: Bloomberg

In order to determine what, if any, commodity allocation is reasonable in a portfolio of stocks and bonds, expected returns must be estimated. Because commodity index collateral returns are determined by T-Bill yields, we can focus on excess returns (returns over T-Bills) for all asset classes. Assuming the excess returns in Exhibit 15 for stocks (4.5%) and bonds (2.7%) are good long run estimates for future returns of these asset classes, we must only estimate future commodity returns. As shown in the previous section, it is reasonable to assume a long-term return of zero or lower for commodity index strategic returns, and 3-4% for diversification returns. Conservatively, returns of 1-4% seem a reasonable estimate of long-term commodity index excess returns, as diversification returns may decrease in the future, due to higher correlations between commodities.

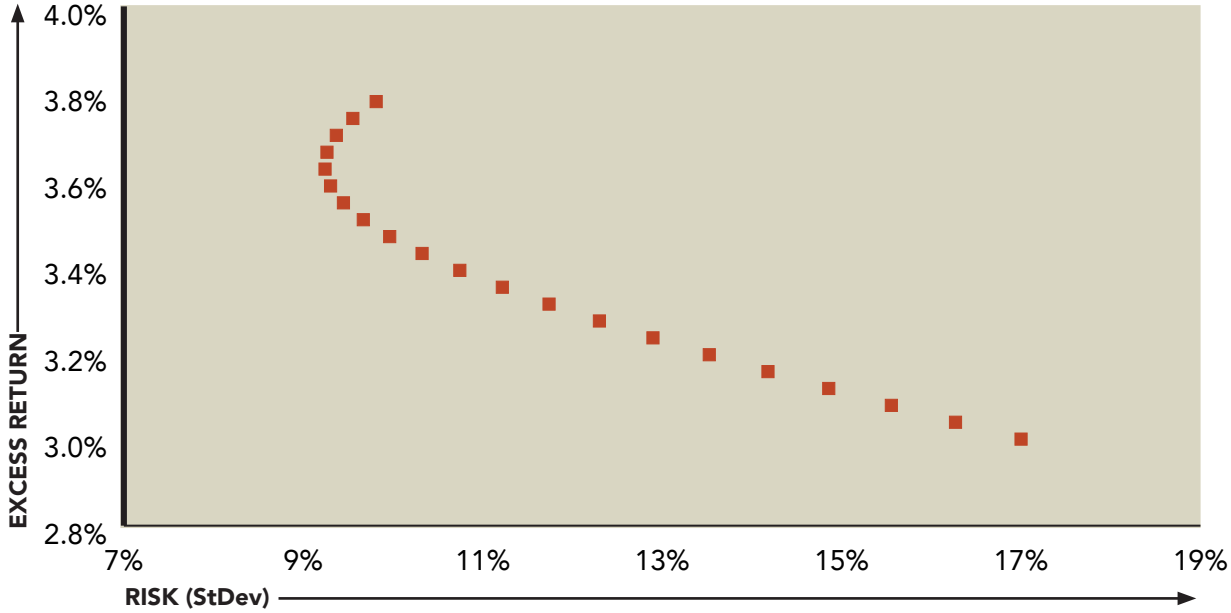
Exhibit 23 shows the optimal allocation to commodities (based on the Sharpe ratio) under different assumptions of expected commodity returns and standard deviations. The calculations in Exhibit 23 are based on the addition of commodities to a portfolio of 60% stocks and 40% bonds. Standard deviations of 15%, 17%, and 20% are used. A standard deviation of 15% represents the historic standard deviation of a diversified commodity index, such as the DJ-UBS. A standard deviation of 17% represents the estimated standard deviation of a diversified portfolio if correlations between commodities remain elevated, as in Exhibit 20. A standard deviation of 20% represents the historic standard deviation of a less diversified commodity index, such as the GSCI. To read the table, select an expected return on the left, and a standard deviation above. For example, assuming a return of 2% and a standard deviation of 17%, the optimal allocation to commodities based on the Sharpe ratio would be 5%.

Exhibit 23: Commodity Allocations with Different Return and Standard Deviation Assumptions

		Standard Deviation of Commodities		
		15%	17%	20%
Expected Excess Return	1%	0%	0%	0%
	2%	10%	5%	5%
	3%	20%	15%	10%
	4%	25%	20%	15%

Based on the data in Exhibit 23 and a reasonable set of assumptions, a strategic allocation to commodities index investments of 5-10% results in a better risk-adjusted return than a portfolio comprised of only stocks and bonds. Interestingly, unless equity-like returns of 4% or more are assumed, the benefit to a portfolio with a commodity allocation comes not from an increase in return, but from a reduction in volatility. Exhibit 24 shows an example assuming a 3% commodity return and 17% standard deviation. Adding a 10% allocation of commodities to a portfolio of stocks and bonds in this scenario would actually reduce expected return slightly (by 8 bps), but decrease portfolio standard deviation by 35bps, resulting in an improved Sharpe ratio.

Exhibit 24: Efficient Frontier: Stocks, Bonds, and Commodities



Active Management: The Case for Enhanced Indexing

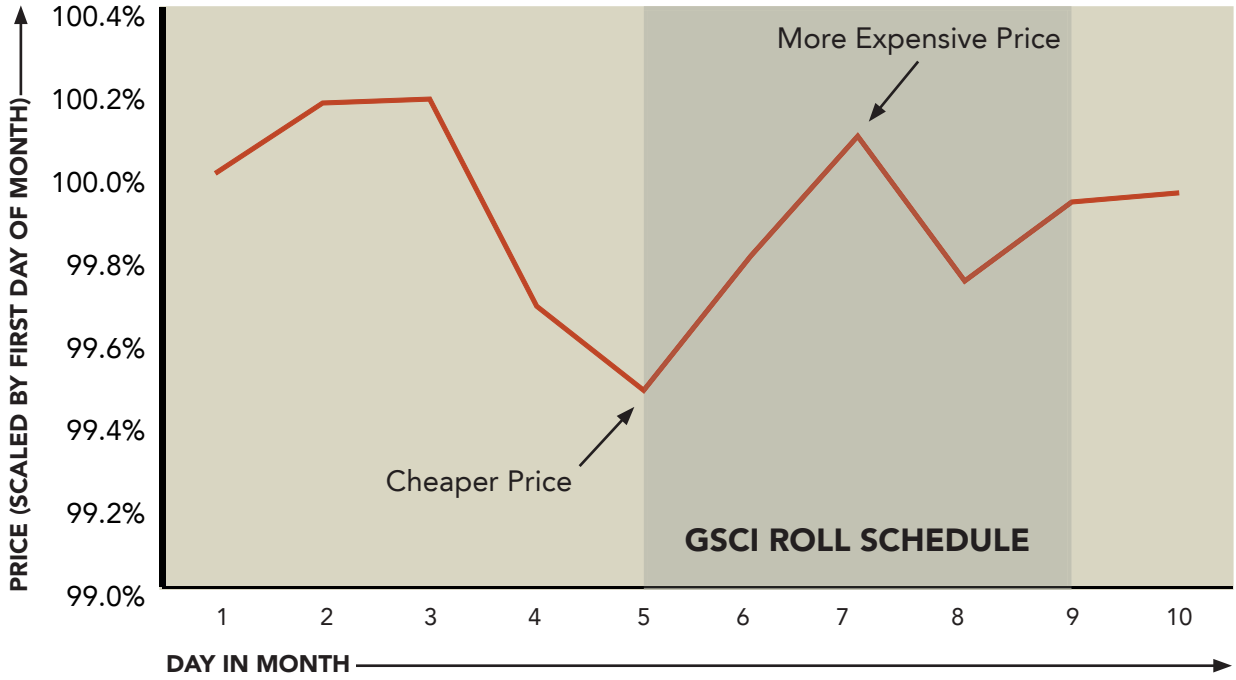
Investors allocating to long only commodities investments have a choice of investing passively or actively. Investors pursuing long only commodities allocations should consider using active management. Because a commodities investment is essentially a futures trading strategy, there are multiple ways that active managers may earn higher returns than passive index investments. The three primary tools used by active managers are collateral management, roll management, and contract selection.

Collateral management is an attempt to invest collateral that out yields the three-month T-Bill rate. For example, investing in collateral dated one year or less as opposed to three months or less would have boosted historical performance by 34 bps, with a negligible increase in volatility. However, it is crucial that managers using a collateral management strategy invest in high quality, short dated collateral for two reasons. First, the purpose of hiring a

commodity manager is to gain exposure to commodity risk and return, not fixed income risk and return. Second, overly risky collateral may exacerbate performance issues in times of market stress.

Roll management involves rolling futures contracts at different times than the underlying index. Each index has an arbitrary mechanical roll schedule. By rolling contracts on different dates, active managers may outperform a passive index. As an example, Exhibit 25 shows the average monthly price of crude oil futures based on the day of the month.[32] Each day's price is presented as a percentage of the first day of the month's price. The GSCI rolls contracts on days 5 through 9. Historically, crude oil prices are depressed at the beginning of the roll schedule, and rise on subsequent days. A strategy of rolling all contracts on the 4th and 5th day would have outperformed a passive index.

Exhibit 25: Average Crude Oil Contract

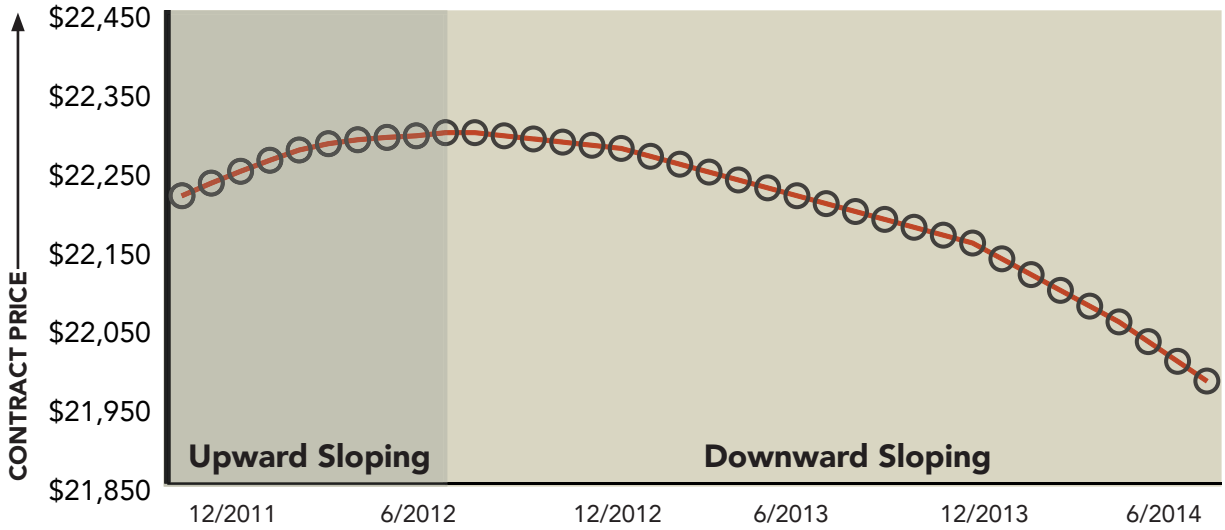


Source: Bloomberg

Contract selection allows active managers to select contracts with different expiration dates than the index that may represent better value. In practice, because indices typically invest in the contracts nearest to expiration, this means buying longer dated futures contracts. As an example of a possible strategy, Exhibit 26 shows the Nickel Futures curve as of September 2011. The front part of the curve is upward sloping and in contango. With no move in the spot price, rolling contracts in this part of the curve would lead to a loss. The back part of the curve, however, is downward sloping and in backwardation. If the Nickel curve maintains its shape, purchasing longer dated contracts may lead to a gain vs. shorter dated contracts.

[32] For each monthly roll, the next month's futures contract is normalized based on the first day of the month. For example, on January 1, the price of February crude is set to 100%. This is done for every month of the year for the last ten years. The graph displays average prices for the first through tenth day of the month.

Exhibit 26: Nickel Futures Curve, Sep 2011



Source: Bloomberg

Gathering data on actual active manager performance is more difficult. Because long only commodities have only recently been considered an asset class, there are few investment managers with long track records managing long only portfolios. Currently, there are only 68 commodity managers with three-year track records in eVestment Alliance, a database of institutional investment managers. Additionally, many active managers pursue other strategies such as trend following or spread trading as opposed to long only enhanced indexing. To mitigate this issue, managers can be sorted by their R-squared with the index.[33] R-squared is a measure of goodness of fit. The higher the R-squared, the more likely an investment manager's returns are explained by index beta combined with manager alpha. Investment managers with a low R-squared are likely pursuing non-index strategies. The higher a manager's R-squared, the more likely that manager is using an index-based strategy.

Exhibit 27 shows median trailing excess returns of commodity managers in the eVestment database, sorted by R-squared with the DJ-UBS index. Managers with an R-squared of less than 0.80 are dropped from the table, as they are more likely to be pursuing non-index strategies. As shown in Exhibit 27, the median investment manager has been able to generate significant outperformance versus the index over both three and five year periods. Additionally, this outperformance does not diminish as R-squared increases, indicating that outperforming managers are likely not taking large, out-of-index bets. While it must be cautioned that this data set represents a small and biased sample size, Exhibit 27 does provide some evidence for the ability of active management to generate outperformance.

Exhibit 27: Median Outperformance of Commodity Managers

R^2	Three Years		Five Years	
	Excess Returns	# of Managers	Excess Returns	# of Managers
>0.80	1.64%	44	1.75%	29
>0.90	1.55%	37	1.75%	25
>0.95	1.84%	24	1.84%	15

[33] DJ-UBS was used here.

Other Commodity Strategies

Although this paper has focused on long only commodity investing, it is worth mentioning the existence of other commodity investing strategies. While many speculative commodity futures strategies are employed other than long only, a full treatment of such strategies is outside the scope of this paper. Many of these alternative strategies are employed by hedge funds and Commodity Trading Advisors ("CTA's"). Some strategies, such as spread trading, have lower volatility. This allows traders to increase expected returns by adding leverage. For a discussion of leverage in futures contracts, see Marquette's white paper, *Introduction to Futures Contracts*. Examples of other commodity strategies include:

- Calendar Spreads: A long position in a commodity contract combined with a short position in the same commodity contract on a different date. For example, a short May natural gas position combined with a long June natural gas position. This trade would be profitable if May futures declined in price relative to June futures.

- Inter-market Spreads: A long position in one market, combined with short positions in other markets. A common inter-market spread is the "crack-spread," or the spread between crude oil and other products extracted from crude oil. For example, a 3:2:1 crack-spread trade features three long contracts in crude oil combined with two short contracts in gasoline and one in heating oil. This trade would be profitable if the price of crude oil rose in relation to the price of heating oil and gasoline.

- Trend Following: A trend following strategy involves purchasing commodity contracts that have recently increased in price, and selling commodity contracts that have decreased in price.

Conclusion

This paper considers long-only commodity investing from a long-term strategic perspective, as opposed to a short-term tactical decision. Investors seeking additional portfolio diversification should allocate to long only commodities. To summarize:

- Commodity index returns are determined by strategic and diversification returns. Strategic returns are driven by normal backwardation of underlying futures contracts, and may be zero or negative. Diversification returns are positive, but may be lower in the future due to increasing correlation between different commodities.

- In the short-term, correlations between commodities and stocks are high, leading to a low diversification benefit. However, expected returns for commodities may also be higher than normal, as commodities may offer some return potential given their historically strong performance in negative real rate environments.

- As discussed in the Marquette white paper *Investing in an Inflationary Environment*, long only commodities may post strong performance numbers in times of unexpected inflation, during which traditional investments tend to perform poorly.

- In the long-term, even with low return assumptions, adding commodities to a portfolio of stocks and bonds improves Sharpe ratios by decreasing portfolio volatility.

- Because of the way long only indices are constructed, evidence suggests that active management should be able to outperform passive management. Based on actual manager returns, the median active manager has historically been able to outperform passive indices. Thus, investors in long only commodities should pursue active management.

[34] See Marquette white paper "Investing in an Inflationary Environment"

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