Benefits of Commodity Investment

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Abstract

Direct commodity investment has historically been a minor part of investors' asset allocation. In recent years, however, investible commodity indices and commodity-linked assets have increased the number of available commodity-based products. In this study, the various theoretical arguments for the relative risk and return advantages of direct commodity investment are reviewed and then these theoretical foundations are tested with the Goldman Sachs Commodity Indices. Investment in the GSCI is shown to result in significant diversification benefits. These benefits are traced to the unique exposure of commodity investment to macroeconomic variables, as well as the potential to capture a positive roll return. This research places the use of commodity-linked or investible commodity indices as a central part of the investors' asset allocation decision.

Benefits of Commodity Investment

I. Introduction

Direct commodity investments have historically been a minor part of investors' asset allocation decision. In contrast, indirect investment (e.g., equity or debt ownership of firms specializing in direct commodity market production) was the principal means of obtaining claims on commodity investment. In recent years, however, investible commodity indices and commodity-linked assets have increased the number of available direct commodity-based investment products. In addition, there is increasing evidence that indirect commodity investment, through debt and equity instruments in commodity-linked firms, does not provide direct exposure to commodity price changes [Schneeweis et al., 1997b]. However, there is little information on the expected as well as the actual risk and return performance of a wide variety of investible commodity indices or commodity linked product) that have been marketed. The purpose of this study is, first, to detail the various theoretical arguments for the relative risk and return advantages for real commodity investment and, second, to test if currently available investible commodity forms such as the Goldman Sachs Commodity Indices offer means to obtain the prescribed theoretical risk and return processes embedded in commodity investment.

In the following section, the basis for and the structure of alternative indirect (e.g., stock funds) as well as direct passive and active option- and futures-based investible commodity products are reviewed. The expected return and risk structure for the GSCI indices (direct 'long-only' futures-based investible commodity indices) are analyzed as part of a fully diversified portfolio (stocks, bonds, hedge funds, and real estate). Results (section III) indicate that the GSCI indices have sources of risk and return (e.g. roll return, real options) that are distinct from traditional assets such as stocks and bonds as well as managed futures or hedge fund benchmark indices and offer investors an important area of diversification [Schneeweis et al., 1997a]. Conclusions and suggestions for future studies will be discussed in Section IV.

II. Commodity Investment in Asset Management

The increased use of commodity trading vehicles in investment management has led practitioners to create investible commodity indices and products that offer unique performance opportunities for investors in physical commodities. As is true for stock and bond performance as well as investment in managed futures and hedge fund products, commodity-based products have a variety of uses. They are a source of information on cash commodity and futures commodity market trends, are used as performance benchmarks for evaluation of commodity trading advisors, and provide a historical track record useful in developing asset allocation strategies. However, the investor benefits of commodity or commodity-based products lie primarily in their ability to offer risk and return trade-offs that cannot be easily replicated through other investment alternatives. Previous research [Schneeweis et al., 1997b] indicates that direct stock and bond investment offers little evidence of providing returns consistent with direct commodity investment. To the degree that firms hedge a major portion of the commodity risk [Chung, 2000], even commodity-based firms may not be exposed to the risk of commodity price movement. Thus for investors, direct commodity

investment may be the principal means by which one can obtain exposure to commodity price movements.

Academic research has examined the economic determinant of returns to commodity investment. For example, Fama and French [1988] and Schneeweis, Spurgin, and Georgiev [2000] identified a strong business cycle component in the variation of spot and futures prices of industrial metals. Fama and French [1987, 1988] perform tests of the theory of storage and present empirical evidence that in periods of increasing volatility and risk, convenience yields increase for a wide variety of metals prices (e.g., aluminum, copper, nickel and lead). The theory of storage [Kaldor, 1939, Working, 1948, 1949, and Telser, 1958] splits the difference between the futures price and the spot price into the forgone interest from purchasing and storing the commodity, storage costs and the convenience yield on the inventory. Convenience yield reflects an embedded consumption timing option in holding a storable commodity. Further, the theory predicts an inverse relationship between the level of inventories and convenience yield – at low inventory levels convenience yields are high and vice versa. A related implication is that the term structure of forward price volatility generally declines with time to expiration of the futures contract – the so-called "Samuelson [1965] effect". This is caused by the expectation that, while at shorter horizons mismatched supply and demand forces for the underlying commodity increase the volatility of cash prices, these forces will fall into equilibrium at longer horizons.

Litzenberger and Rabinowitz [1995] observe that oil futures prices are often below spot prices, that is futures markets are backwardated. Strong backwardation occurs when futures prices are below current spot prices. In weak backwardation, discounted futures prices are below spot prices. Strong backwardation is inconsistent with Hotelling's [1939] theory under certainty that the net price of an exhaustible resource rises over time at the rate of interest. Litzenberger and Rabinowitz explain the phenomenon with the existence of "real options" under uncertainty. They show that production occurs only if discounted futures are below spot prices and strong backwardation emerges if the riskiness of future prices is sufficiently high. Their empirical analysis presents evidence that U.S. oil production is inversely related and backwardation is directly related to implied volatility. Related option-based theories of backwardation and empirical tests can be found in the work of Milonas and Tsomadakis [1997] and Routledge, Seppi, and Spatt [2000]. A major consequence of a declining term structure of forward prices for investment in commodity futures is the opportunity to capture a positive roll return as investment in expiring contracts is moved to cheaper new outstanding contracts.

The question of whether commodities represent a separate asset class has been extensively debated in both the academic and practitioner literature [Huberman, 1995, Strongin and Petsch, 1995, Greer, 1994, Froot, 1996, Schneeweis et al., 1997a]. For many investors, the question no longer is whether commodity investment is an asset class, but whether this asset class is appropriate for a given investor, and if so what is the best approach to implementing the investment.

The diversification benefits of commodities have been studied in Ankrim and Hensel [1993], Anson [1998], Becker and Finnerty [2000], and Schneeweis and Spurgin [1997b], among others. For instance, Becker and Finnerty find that the inclusion of portfolios of long commodity futures contracts (CRB and GSCI) improves the risk and return performance of stock and bond portfolios for the period of 1970 through 1990. They observe that the improvement is more pronounced for the 1970s the 1980s due to the high inflation of the 1970s with commodities acting as an inflation hedge. Futures prices were also found to have little value in predicting inflation.

Schneeweis and Spurgin [1997b] examine the correlations of oil-based futures contracts with energy-related and non-energy related stock, bond, real estate and commodity markets, and CPI. Their results confirm that, except in periods of extreme energy price movement, many traditional forms of

indirect energy investment such as natural resource mutual funds or energy-based common stocks are not correlated with energy price movements. This is as expected. Given the risk management and firm diversification abilities of most corporate firms, unless a the price change in the underlying commodity is structural and long lasting, short term changes in commodity prices may have little impact on a firm's equity performance. They also show that in addition to energy-based passive long-only commodity indices offering returns not available in traditional equity investments, active long/short energy traders offer returns (positive returns in markets with declining energy prices) not available in long-only commodity indices or traditional commodity based equity investments.

Research on the LMEX [Scneeweis and Spurgin, 2000, Schneeweis, Spurgin, and Georgiev, 2000] and precious metals reflects both the benefits of commodity indices as an alternative means to capture commodity return not found through direct investing in the underlying production firm as well as possible existence of roll return and the benefits of active trading in metals.

The principal argument for investing in commodities is that investing in assets that rise in price with inflation provides a natural hedge against losses in equity and debt holdings that typically lose value during periods of unexpected inflation [see Bodie, 1983, Greer, 1978, Halpern and Warsager, 1998, Becker and Finnerty, 2000]. While previous studies have concentrated on measuring commodity returns during high and low inflation periods, the real benefits of commodity investment may lie in periods of unexpected rises in inflation. Anticipated inflation, which results in high bond yields and high equity earnings growth, may result in positive real returns for stocks and bonds. It is the unexpected inflation that should cause concern to every serious investor. The importance of being exposed directly to commodity price movements is due to the possibility of obtaining natural sources of commodity return and inflation protection. In periods of unexpected inflation, market conditions may often lead to increasing commodity prices and weakness in stocks and bonds.

Commodity Indices

One of the most attractive aspects of commodity investment today is that there are now a number of passive indexes that are fully investible. Most alternative assets do not have a passive, investible index, requiring the investor to select and monitor active managers. In addition to providing a simple method to access these returns, commodity indexes have a number of other uses. Commodity indexes are a source of information on cash commodity and futures commodity market trends, are used as performance benchmarks for evaluation of commodity trading advisors, and provide a historical track record useful in developing asset allocation strategies.

Commodity indices are generally based on the returns of futures contracts and/or cash markets. Included in this group are the Dow Jones-AIG, CRB, Goldman Sachs, and MLM indices. These indices provide returns comparable to passive long positions in listed futures contracts or, in the case of the MLM index, of long and short positions determined by a moving average trading rule. Of these indices, all but the CRB and Dow Jones-AIG indices are investable. The CRB is not generally considered investable because the formula for apportioning investment across the different contract months is too cumbersome. The Dow Jones-AIG index requires daily rebalancing of each position, making it expensive to replicate.

Commodity indices attempt to replicate the return available to holding long positions and short in agricultural, metal, energy, or livestock investment. Since the cost-of-carry model insures that the return on a fully margined position in a futures contract should mimic the return on an underlying spot deliverable, futures contract returns are often used as a surrogate for cash market performance. Futures-contract-based commodity indices have three separate sources of return: price, roll, and

collateral return. Price return derives from changes in commodity futures prices. Roll return arises from rolling long futures positions forward through time and may capture a liquidity premium through an increased convenience yield in periods of high volatility of the underlying due to demand and supply shocks. Collateral return assumes the full value of the underlying the futures contracts are invested at a risk-free interest rate. This is equivalent to assuming an investor posts 100% margin with Treasury bills.

The Goldman Sachs Commodity Index (GSCI) – the object of this study - is an arithmetic measure of the performance of actively traded, dollar-denominated nearby commodity futures contracts. The weights assigned to individual commodities are based on a five-year moving average of world production. Weights are determined each July and are made effective the following January. All contracts are rolled on the fifth business day of the month prior to the expiration month of the contract. Subindices are calculated for agricultural, energy, industrial, livestock, and precious metals contracts. Two versions of the indices are available: a total return version, which assumes that capital sufficient to purchase the basket of commodities is invested at the risk-free rate, and a spot version, which only tracks movements in the futures prices. The GSCI was officially launched in 1992.

III. Data, Methodology, and Empirical Results

Methodology and Data

The methodology is similar to that conducted in previous studies by the authors [Schneeweis et al., 1997b] as well as others [Ankrim and Hensel, 1993]. In general, these tests are consistent with performance modeling with which both retail and institutional investors are familiar.

Monthly returns are derived for a series of stock, bond, commodity, and hedge fund indices for the time period from January 1990 through December 2001. Data was obtained for each of the indices and relevant subindices (GSCI), as well as the Standard and Poors 500 and MSCI World Stock Indices, the Lehman Brothers U.S. Government/Corporate and World Bond Indices, the EACM 100 hedge fund index, one-month Treasury bill yields, and the U.S. Consumer Price Index. Stock, bond, commodity, currency and inflation indices are obtained from Datastream. The EACM 100 index returns are obtained from Evaluation Associates Capital Markets.

Empirical Results

In Exhibit 1, the average monthly arithmetic returns and standard deviations of monthly arithmetic returns, Sharpe ratios, minimum monthly returns, and correlations to the GSCI Index for the sample of stock, bond, hedge fund and commodity indices over the January 1990 through December 2001 period are presented, both as stand-alone investments as well as in various portfolio groupings.

Exhibit 1

	GSCI	EACM 100	S&P 500	Lehman Gov./Corp Bond	MSCI World	Lehman Global Bond
Performance 1990 - 2001						
Annualized Return	3.4%	13.8%	12.9%	8.1%	6.5%	6.9%
Annualized StDev	18.5%	4.3%	14.6%	4.2%	14.6%	4.9%
Sharpe Ratio	-0.11	1.94	0.51	0.63	0.08	0.31
Minimum Monthly Return	-12.2%	-4.4%	-14.5%	-2.5%	-13.4%	-3.0%
Correlation with GSCI		0.19	-0.04	0.02	-0.03	0.05

	Portfolio I S&P 500 & Lehman Bond	Portfolio II S&P 500, Lehman Bond & GSCI	Portfolio III S&P 500, Lehman Bond, GSCI, & EACM 100	Portfolio IV MSCI World, Lehman Global	Port V MSCI World, Lehman Global, & GSCI	Port VI MSCI World, Lehman Global, GSCI, & EACM 100
Annualized Return	10.7%	9.6%	10.5%	7.0%	6.6%	7.5%
Annualized StDev	8.1%	7.4%	6.9%	8.4%	7.6%	7.1%
Sharpe Ratio	0.65	0.56	0.74	0.19	0.16	0.29
Minimum Monthly Return	-6.3%	-6.2%	-6.0%	-5.6%	-5.7%	-5.5%
Correlation with GSCI	-0.03	0.48	0.25	-0.01	0.48	0.26

Note:
Portfolio I: 50% S&P 500 and 50% Lehman Gov./Corp. Bond
Portfolio II: 40% S&P 500, 40% Lehman Gov./Corp. Bond, and 20% GSCI
Portfolio III: 40% S&P 500, 40% Lehman Gov./Corp. Bond, 10% GSCI, and 10% EACM 100
Portfolio IV: 50% MSCI World and 50% Lehman Global Bond
Portfolio V: 40% MSCI World, 40% Lehman Global Bond, and 20% GSCI
Portfolio VI: 40% MSCI World, 40% Lehman Global Bond, 10% GSCI and 10% EACM 100

The annualized return, standard deviation, and Sharpe ratio for the GSCI composite index are 3.4 percent, 18.5 percent, and -0.11, respectively. Thus, both in absolute terms and on a risk-adjusted basis, commodities have underperformed US and world bonds and equities as well as US real estate. Only world real estate has registered a slightly weaker performance. Nonetheless, commodities may produce investment benefits when considered as an addition to a diversified portfolio. The decision to add an investment product to an existing portfolio depends on the relative means and variances of the investment vehicle and the existing portfolio as well as the correlation between the investment vehicle and the portfolio. The low or negative correlations of GSCI returns with returns to the S&P 500 (-0.04), Lehman Gov./Corp. Bond (0.02), and the EACM 100 (0.19) suggest such potential benefits. Similarly, when considered as a global investment, the GSCI exhibits low or negative correlations with the MSCI World Index (-0.03) and the Lehman Global Bond Index (0.05).

The above relationships are reflected in the performance of investment portfolios including the GSCI. When added to a domestic portfolio of stocks and bonds, the GSCI helps reduce the standard deviation of the portfolio from 8.1 percent to 7.4 percent. However, risk-adjusted performance (Sharpe ratio) also decreases from 0.65 to 0.56. This is due to the effect of the 2001 period which was dismal for physical commodities with the GSCI index losing nearly 32% of its value. Similarly, when added to a global stock/bond portfolio, the GSCI reduces volatility from 8.4 percent to 7.6 percent and decreases the Sharpe ratio from 0.19 to 0.16. Adding more assets such as hedge funds to the portfolio results in improved performance.

Exhibit 2 shows the performance statistics for the GSCI component subindices. Even though the performance is unimpressive on its own, the low or negative correlations with stock, bond, hedge fund, and real estate indices shown in Exhibit 3   again suggest that investors who wish to target

particular commodity sectors may still benefit from the addition of that sector to a diversified portfolio of assets.

Commodities as an Inflation Hedge

A significant part of the benefit of direct commodity investment is said to derive from unique fluctuations in commodity values as a function of shifting economic forces. One such aspect of the return process of commodities is that commodity cash prices benefit from periods of unexpected inflation, whereas stocks and bonds suffer. As a result, commodities should provide a positive return while other asset classes decrease in value. This premise is tested by calculating the correlation of spot GSCI returns, as well as stock, bond, hedge fund, and real estate returns, with a proxy for unexpected inflation. The proxy used is the monthly change in the rate of inflation.

Exhibit 2

Performance of GSCI Subindices (1990 - 2001)

	Return	St. Dev	Sharpe Ratio	Minimum Monthly Return
GSCI Agricultural	-2.7%	13.6%	-0.59	-9.6%
GSCI Energy	4.6%	32.4%	-0.03	-22.1%
GSCI Industrial Metals	1.8%	16.7%	-0.21	-12.9%
GSCI Livestock	3.4%	12.8%	-0.16	-10.4%
GSCI Non-Energy	0.1%	8.8%	-0.60	-6.3%
GSCI Precious Metals	-1.6%	11.9%	-0.59	-8.6%

Correlations were calculated using data in months in which the change in the rate of inflation was beyond one standard deviation from the average change. The results presented in the last column of Exhibit 3 lend some support to the theory. Stocks and bonds do exhibit a negative correlation with unexpected inflation (-0.22 and -0.26, respectively) and so do some commodity classes (e.g. Agricultural and Non-Energy). However, storable commodities directly related to the intensity of economic activity exhibit a high degree of positive correlation with unexpected inflation (0.30 for Industrial Metals and 0.34 for Energy). Similarly, Precious Metals have a correlation of 0.34. These results suggest that direct investing in Industrial and Precious Metals, as well as Energy may provide a significant inflation hedge.

Exhibit 3

	S&P 500	Lehman Bond	Change in Credit Spread (Baa-Aaa)	Change in VIX	Change in Term Term Spread	Change in Bond vol	Change in Stk Vol	Unexpected Inflation
				Factor Correlations (1990 - 2001)				
GSCI	-0.04	0.02	-0.05	-0.02	-0.14	0.02	-0.07	0.31
GSCI Agricultural	0.21	-0.05	0.03	-0.24	-0.08	-0.05	-0.08	-0.35
GSCI Energy	-0.08	0.02	-0.05	0.03	-0.11	0.05	-0.03	0.34
GSCI Industrial Metals	0.15	-0.12	-0.26	-0.10	0.01	-0.03	-0.09	0.30
GSCI Livestock	0.02	0.08	-0.03	-0.06	-0.01	-0.02	-0.04	-0.02
GSCI Non-Energy	0.21	-0.02	-0.08	-0.24	-0.05	-0.06	-0.13	-0.10
GSCI Precious Metals	-0.10	-0.06	0.12	0.01	0.12	-0.08	-0.06	0.34
S&P 500	1.00	0.28	-0.15	-0.63	-0.11	0.10	-0.29	-0.22
Lehman Gov./Corp. Bond	0.28	1.00	-0.06	-0.12	-0.53	0.21	-0.03	-0.26
EACM 100	0.40	0.17	-0.24	-0.22	-0.09	0.02	-0.32	0.41

Note: Monthly changes in inflation beyond one standard deviation of the average are used to proxy for unexpected inflation

Direct and Indirect Commodity Investment

It is well known that many commodity-based firms hedge their exposure to commodity price fluctuations. As a result, investment in commodity-liked equities does not replicate the unique price-return behavior of direct commodity investment. This issue is explored here by studying the relationship between the return properties of commodity-linked equities (S&P 500 Agricultural Products, Metals Mining, Energy, and Gold and Precious Metals Mining) and the corresponding GSCI indices. Returns to the four pairs of indices above were ranked in ascending order according to the GSCI indices. Exhibit 4 shows plots of the indices in each of the groups. It is apparent from the plots that often direct investment in commodities can provide a positive return when commodity-linked stocks lose money. Clearly, direct commodity investment can provide downside portfolio protection in this sense.

Roll Return

Finally, futures-based commodity investment can benefit from increased roll returns in periods of increased volatility of the underlying commodity and backwardation. For example, monthly roll returns on the GSCI Composite index were ranked against the intra-month volatility of the GSCI Composite spot price index. Exhibit 5-a shows a clear upward trend in average roll return with increasing intra-month spot volatility in the Composite index. Exhibit 5-b contains similar graphs for the six GSCI subindices. The described relationship between spot volatility and roll return is not observed for all commodity groups, but it is quite pronounced in the cases of Energy and Industrial Metals. This explains why the effect is observed in the Composite index as these groups dominate the index.

Exhibit 4
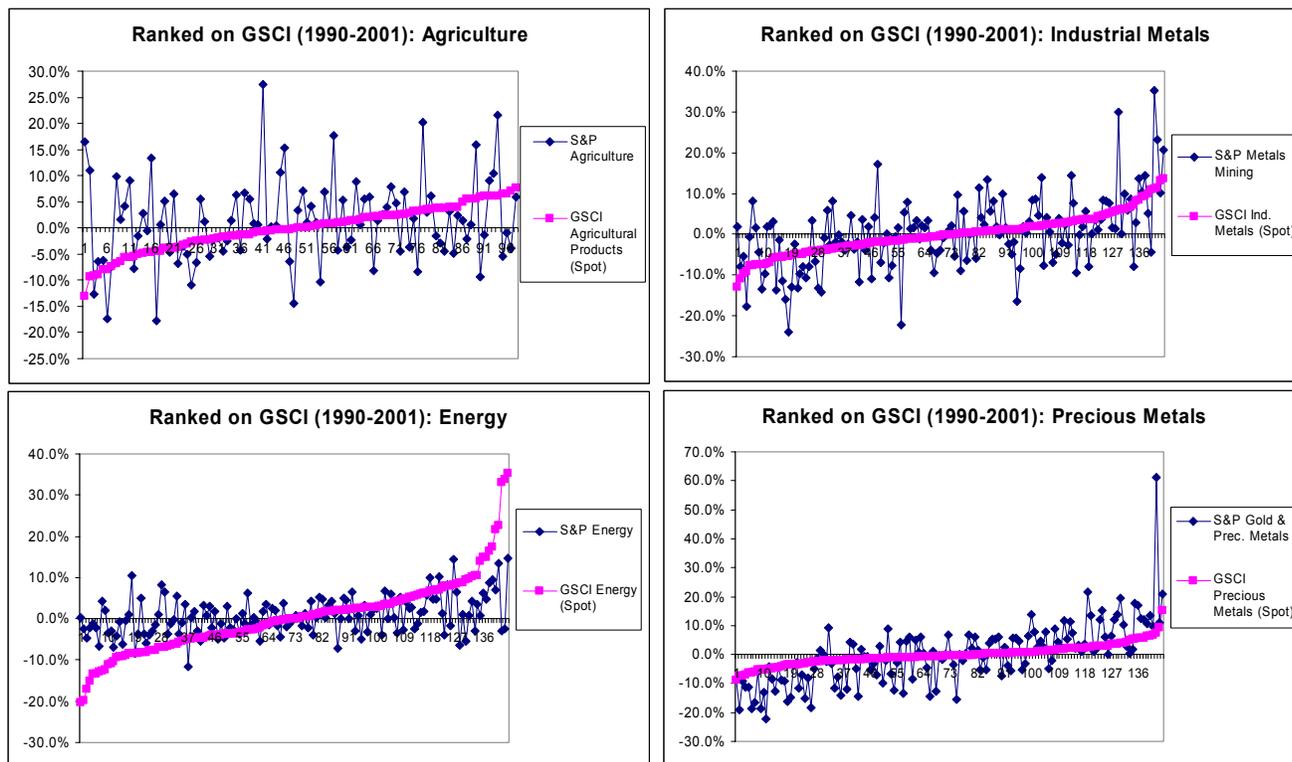
Mean roll returns and standard deviations for the Composite index and the six subindices in the least volatile and the most volatile 36 months (spot price volatility is meant here) are presented in the second and third columns of Exhibit 6, respectively. For each index, F-tests were run for equal variances of roll returns in the least volatile and the most volatile 36 months. Next, we tested for equality of the means of roll returns in each index/subindex pair, assuming either equal variance or unequal variance, depending on the results from the F-tests. The p-values of the variance and mean tests are presented in the last two columns of Exhibit 6.

As previously suggested by the graphs, mean roll returns for the Energy and Industrial Metals subindices, as well as the GSCI Composite Index, significantly increase and are positive with increased spot volatility. In contrast, mean roll return for the Livestock subindex decreases and becomes negative. The effect of spot price volatility on the mean roll return of the Agricultural, Non-Energy, and Precious Metals subindices is insignificant. In general, the effect is more pronounced for non-perishable, storable commodities, whose convenience yield rises in periods of increased volatility due to demand and supply shocks.

IV. Conclusions

In recent years, investible commodity indices and commodity linked assets have increased the number of available commodity-based products. This paper has shown that direct commodity investment can provide significant portfolio diversification benefits beyond those achievable from commodity-based stock and bond investment. These benefits stem from the unique exposure of commodities to markets forces such as unexpected inflation as well the potential of a

positive roll return in futures-based commodity investment in periods of high spot price volatility. Adding a commodity component to a diversified portfolio of assets has been demonstrated to results in enhanced risk-adjusted performance. We believe that this research would place the use of investible commodity indices as a central part of the institutional investors' asset allocation decision.

The present research can be extended by studying the potential benefits of active trading in various commodity indices. Also, future studies might consider the impact of alternative asset allocation strategies under varying market conditions (e.g., business cycle) and the impact of investment into commodity linked-products or investible commodity indices under these economic conditions.
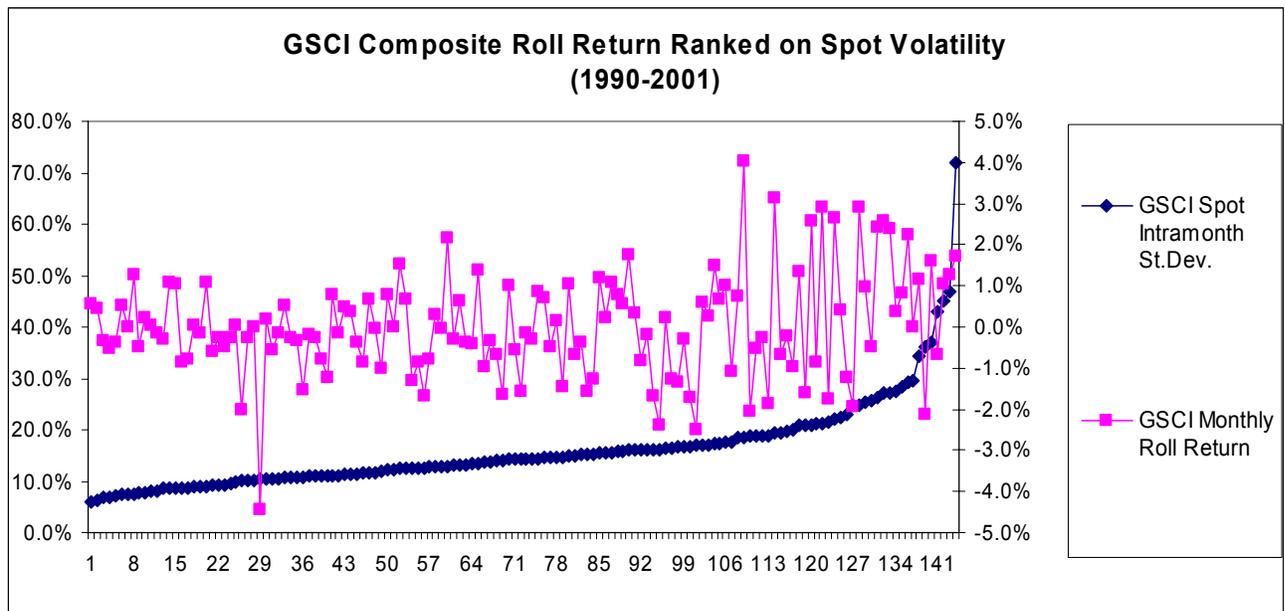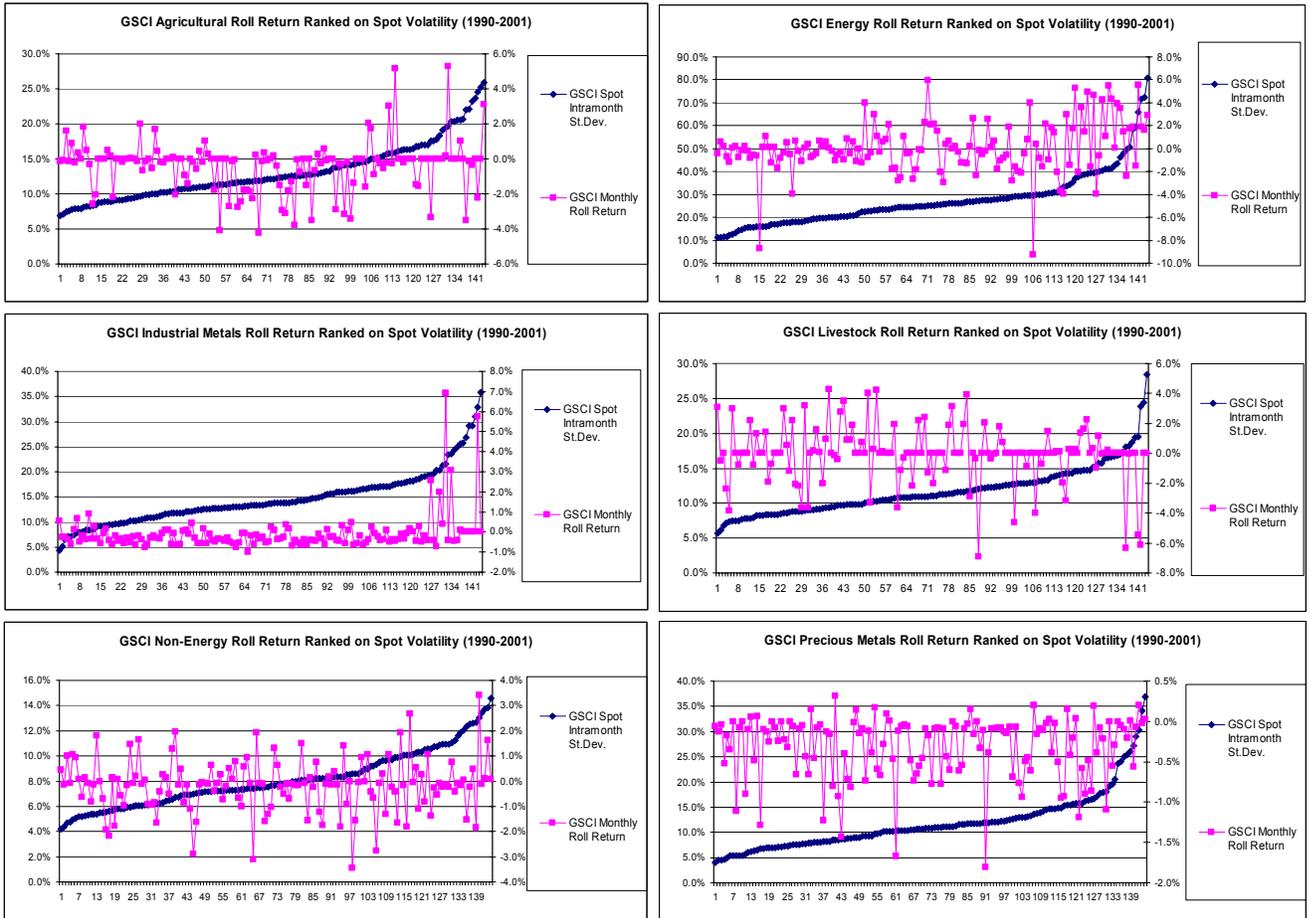
Exhibit 5-a

GSCI Composite Roll Return Ranked on Spot Volatility (1990-2001)

Exhibit 5-b

Exhibit 6

GSCI Roll Return Ranked on Monthly Spot Standard Deviation (1990-2001): Statistics and Tests

	Least Volatile 36 Months		Most Volatile 36 Months		H0: Equal St.Dev	H0: Equal Means
	Mean	St.Dev.	Mean	St.Dev.	P-Value (one-tail)	P-Value (one-tail)
Composite	-0.23%	0.984%	0.59%	1.747%	0.051%	1.775%
Agricultural	0.01%	0.941%	0.10%	1.753%	0.020%	77.784%
Energy	-0.57%	1.649%	1.22%	2.811%	0.109%	0.165%
Industrial Metals	-0.24%	0.369%	0.40%	1.680%	0.000%	3.373%
Livestock	-0.11%	1.854%	-0.43%	1.923%	23.782%	46.899%
Non-Energy	-0.16%	0.932%	-0.02%	1.153%	10.669%	58.147%
Precious Metals	-0.25%	0.332%	-0.30%	0.381%	20.733%	55.782%

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