Commodities:
A Case for Active Management*

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May 11, 2005

*The author has benefited from numerous conversations with HilaryTill of Premia Capital Management and wishes to thank her for her assistance in developing this paper. The author would also like to thank RQSI/Access for access to its proprietary data on active commodity managers – specifically Anil Mudholkar for his efforts in compiling the data; and to The Barclay Group, for providing other CTA and index data.

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Abstract

We highlight recent arguments for favorable macro conditions for commodities investments, including cyclical properties, inflation hedging characteristics, and global demand and consumption matters. We then discuss recent arguments for the case that there are inherent returns in commodities that are similar to equity returns. We then note, however, that while both short and long-term studies support the existence of inherent return in the asset class, their research relies largely on passive, long-only commodities exposure via futures in Total Return Indexes. As we document a variety of the limitations inherent in passive commodities investments via these indexes, we hypothesize that the commodities asset class has a number of distinct characteristics which may make it particularly suitable for skillful active managers to find alpha opportunities; and, further, that investors considering the asset class may achieve enhanced returns by investing in actively managed commodity futures and/or actively managed natural resources related securities and derivatives (hedge funds). We then create two equally weighted portfolios of actively managed commodity strategies (from a data set we believe to be among the most comprehensive and accurate sources of known actively managed commodity strategies that has been compiled), as follows: 1) a portfolio of all known active and inactive commodity futures traders; and 2) a portfolio combining all known commodity futures traders and natural resources hedge funds. We conclude by comparing these equally weighted portfolios with passive commodity indexes to determine whether active management in commodities can indeed provide superior performance to investors.

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I. Introduction – Changing Perception of Commodities Investments

When a currency weakens (as the US dollar has recently), the Federal Reserve has a variety of tools available to manage valuation and promote stability. Similarly, central banks can massage interest rates to address economic concerns like inflation and deflation. Companies, also, can address many near-term over- or under-performance matters through a variety of corporate actions. When a drought damages a grain crop on a large-scale basis or a hurricane destroys a key energy distribution channel, however, governments, banks, and companies often have limited options to encourage short-term stability in commodity markets. Even Alan Greenspan can't make more corn.

While all markets face periodic crises and disruptions, financial market contracts can be filed in a drawer or a hard drive. Commodity storage and distribution is a far more complex and expensive endeavor, so the production cycles of many natural resources are designed to reduce cost-of-carry and spoilage expenses. Many commodities, therefore, are mined (or grown or extracted) in quantities commensurate to anticipated consumption. With limited intervention capabilities and slow production responses, the market has basically one response to short-term supply/demand disruptions: Price. The result? The notorious volatility of commodities prices – and investments.

Raw materials prices, then, often move independently of financial markets (with little correlation); however, many of even the most sophisticated investors have long ignored the diversification benefits of commodity investments because of the inherent volatility in the asset class. White papers from as recently as mid-2004 characterize commodities as "a relatively unknown asset class" [Gorton and Rouwenhorst, 2004], and as historically "inappropriate investments because of their perceived risky character" [Vrugt, et al, 2004].

But like the crude oil surge in October 2004, interest in commodities investments has risen to historic levels. Commodities have emerged from recent obscurity to the front pages of both alternative and mainstream investment publications. Assets are piling into commodity linked indexes and products. As of September 2004, more than $25 billion in assets was tied to the Goldman Sachs Commodities Index, up from $8 billion four years ago; another $8 - $10 billion was linked to the Dow Jones – AIG Commodity Index, up from just $200 million a few years ago [Sesit, 2004]. December 2004 estimates suggest that the amount of pension and mutual fund money tracking commodity indexes has risen from about $15 billion in the middle of 2003 to $40 billion this year [Morrison, 2004].

The Harvard University Endowment, a bellwether for many as an indicator of progressive thinking in institutional portfolio management, is widely cited as one investor bullish on commodities. Accordingly, it has 13% of its funds in the sector: that's just under $3 billion of its $22.6 billion endowment [Cohn, 2004]. Many investors view Harvard's stake in the asset class as an important testament to the growing interest in the sector.

Changing Perception of Commodities Investments Summary

- Commodities, with their unique properties and reputation for high volatility, were once eschewed by many investors as too risky for serious consideration.
- The last couple of years have witnessed unprecedented interest in commodities. Assets have followed this interest in record levels as investors have begun to make sincere evaluations of commodities and found them to be an appropriate investments.

II. Why Commodities . . . Now?

A variety of macroeconomic factors have aligned to prompt once-shy investors to consider commodities. The bullish outlook for commodities over the next decade or more is based on a confluence of long term and short term themes, encompassing everything from long-term increases in global consumption to the precarious state of the current US economy. In order to provide some context for our discussion, we provide a summary of some of the main cases for commodity inflows.

Anticipated Global Consumption Increases

The most widely noted rationale for a bullish commodity outlook is a prolonged, anticipated increase in consumption from China. The country's combination of population (1.3 billion people – approximately 300 million under age 30) and dearth of resources means that increasing demand for consumer goods and rapid industrialization will prompt a dizzying increase in raw materials consumption, in everything from lead and oil to corn and coffee.

While discussions on the China Story are widespread and include a laundry list of commodities, the plots are all generally the same: the sheer number of people beginning to adopt an improving standard of middle class living will prompt an unprecedented run on consumer goods (from cars and cell phones to coffee, confections, and meat) that requires a commensurate increase in the production and acquisition of raw materials for distribution and manufacturing.

Rogers [2004] uses automobiles as one example. In 2004, only 4% of the Chinese population had automobiles, but production of automobiles has increased from 750,000 in 2002 to 4 million in 2003. With 1.3 billion people, each 1% increase in per capita automobile ownership brings an additional 13 million automobiles to China. If automobile ownership in China grows to just 12% of the population, China will have more automobiles than the US (where cars number approximately 50% of the 290 million population). Any meaningful increase in automobile ownership in China will impact a wide range of commodities, from oil and corn (fuel and fuel additives) to lead (batteries), platinum (catalytic converters), and others.

Growth in China's automobile industry, among other developments, has already impacted the country's position as a global consumer of natural resources. Rogers notes that China's oil consumption has increased from approximately 2 million barrels a day in 1987 to 5.4 million barrels a day at the end of 2003; aluminum imports doubled between 2001 and 2003; copper imports have risen 25% since 2001. He projects that within the next 20 years, China will become the world's largest economy, and that commodity prices will respond accordingly over the long term.

While China commands much of the attention from those anticipating consumption increases, regions like Brazil, India, and Russia have many believing future demand for commodities will be more global in scope. The story for each of these countries is similar to that of China, though to a lesser degree. Independently, none of these countries has the population of China or an infrastructure quite as poised to make a near-term charge. Collectively, however, these three regions lead a more general global movement toward an improved standard of living for millions

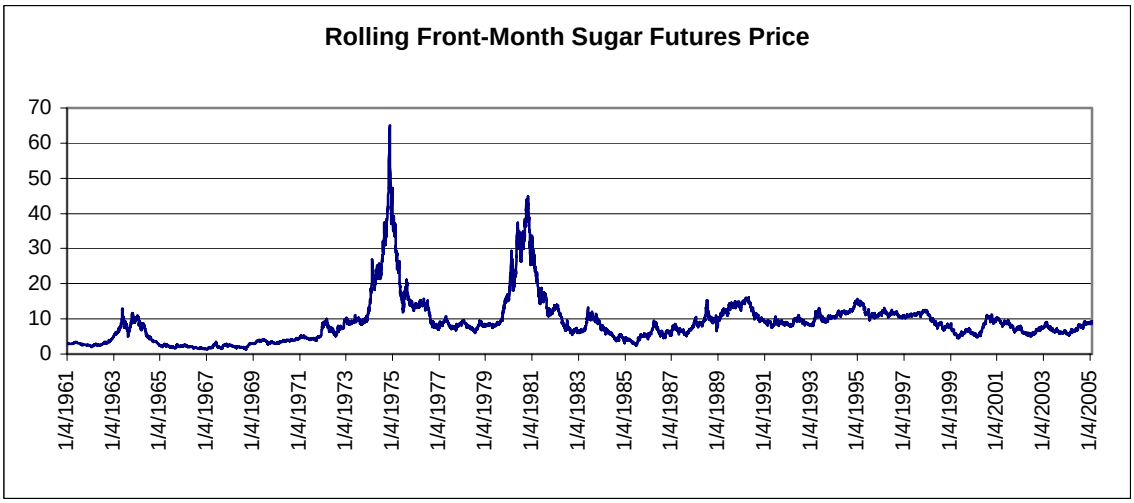
of people that has the potential, over the long term, to exceed the impact of China alone [Stone, 2004].

Rebound from Weak Historic Prices, and Supply Limitations

The expected increases in global commodities consumption comes at the heels of a broad, extended decline in commodity prices. It is widely noted that many commodities experienced price highs in the late 1970s and early 1980s, then settled into two decades of declining prices – some experiencing all-time inflation-adjusted lows in the late 1990s. Figure 1, for example, illustrates Sugar prices from 1961 – 2000. Many commodities are just beginning to emerge from historic lows (either on an absolute or inflation adjusted basis).

Figure 1

Front Month Sugar Prices, 1961 – 2000



During this extended period of weak commodity prices, producers and venture capitalists alike avoided investments in production and distribution infrastructure. Furthermore, with no economic incentive to increase production, existing facilities have been left to deteriorate. Rogers notes:

> Virtually no new mine shafts have been opened in 20 years worldwide. As the demand for copper, silver, iron ore, aluminum, palladium, and lead increases, where are the new mines, not to mention the new deposits? Small mining and metals exploration firms have reported that venture capitalists have ignored them for years. . . . But even if more metals mines were on the horizon, where are the new smelters to make them usable? . . . The last lead smelter was built in the US in 1969 [Rogers, pages 18 -19].

Rogers extends similar arguments across other markets, from sugar plantations to oil refineries, noting that infrastructural and discovery investments have focused on low hanging fruit – a

response to the long period of flat or declining prices that limited the economic viability of pursuing more speculative – and expensive – exploration. As a result, even commodity producers that are currently investing in new production and distribution infrastructure may not have the ability to bring meaningful new supplies to the marketplace for five or more years, with demand expected to increase all the while.

Inventory Stockpiles

Impact of under-investment in production infrastructure has already proven problematic in the face of near-term demand increases. Allen [2004] notes another upshot of weak commodity prices in the assumption of just-in-time inventory management practices by many resource consumers like manufacturers. Rather than taking on high storage expenses, purchasers who have come to rely on low commodity prices have kept inventories low, acquiring materials on an as-needed basis. However, just-in-time purchasing demands that the supplies of raw materials be readily available. With consumption on the upswing and limited resources in inventory, distribution pipelines, or even in production, consumers of some commodities have already experienced short-term commodity shortages – in some cases so acute that materials could not be purchased at any price without facing allocation limits or significant lag times.

Manufacturers' reliance on low commodity prices may have made sense in the past, but Allen believes that just-in-time inventory management routines may give way to a practice of amassing inventories as manufacturers look to avoid any reincarnation of these shortages. Any incremental demand that arises from stockpiling will create an additional bullish case for industrial commodities of all types.

Other Factors Impacting Commodity Inflows

While supply, demand, and price matters are at the core of most bullish commodity scenarios, there may be other reasons investors are considering commodities.

Many find a link between increasing inflation and commodity prices. The idea, in principle, is that the rising commodity prices should accompany a sustained period of inflation. Investors expecting an inflationary environment may consider commodities investments as a speculative opportunity; those who are uncertain may like their potential hedging characteristics.

Bannister [2002], specifically, cites a 200-year cycle of alternating leadership between paper assets and hard assets, corresponding to falling and rising inflation cycles. Currently at an inflection point, this inversion suggests commodity prices are coming into favor. Figure 2 demonstrates how this alternating relationship has impacted equities relative to hard assets.

Figure 2
Equity Returns vs. Commodity Returns in Rising and Falling Inflation Cycles

Cylces, Stock Index, Commodity Prices

Period	US Stock Market Composite	PPI for All Commodities Index
1898-1920	61%	228%
1920-1929	196%	-38%
1929-1951*	-12%	-58%
1951-1965	256%	6%
1965-1981	49%	204%
1981-2001	828%	37%

*Includes distortions from the Depression years

Source: Legg, Mason, US Department of Commerce, US Census, Standard & Poor's, National Burueau of Economic Research

Anecdotally, inflation arguments tend to find that rising prices affect companies because their supply costs increase: higher costs squeeze margins and contribute to a deflating stock price. However, inflationary environments also attract additional producers, since higher prices increase margins, and therefore incentives, for supplying raw materials. Over time, as producers crowd the space, supply builds; meanwhile, companies trapped by high materials prices may delay or limit production, weakening demand. When the period of inflation stalls or reverses, prices begin to decline, but increased production capabilities continue to supply the marketplace. Oversupply and deflationary pressures combine to weaken commodity prices and, in time, companies' raw materials prices require less of their margin: the companies earn more, and their stock prices increase.

Whether investors agree that the economy is poised to encounter a period of sustained inflation, many find the simultaneous timing of general equity highs and commodity lows late in the 1990s reason to proceed with care; considering commodities as a hedge against inflation is a natural extension of that cautionary mindset.

Not all of the cases for commodities consider long-term viewpoints or have well-developed themes. Some current arguments suggest the weak US dollar adds another reason to view commodities favorably. Commodities are valued in US dollars and with a weak currency it takes more money to purchase them. This adds further price pressure to resources that are already facing potential demand/supply imbalances [Spence, 2004].

We also see anecdotal evidence that suggests psychological factors for the current flow of investments into commodities. The overall willingness of professional investors to consider alternative investment strategies has increased immeasurably in the last two decades, starting with hedge funds in the late 1980s and continuing to managed futures (largely financial futures) in the 1990s. Now, with difficult equity and debt markets and limited volatility translating to flat

performance in many traditional hedge fund strategies, investors looking for movement are pressed to consider once “inappropriate” asset classes. And where better to find movement than commodities?

Why Commodities . . . Now? Summary

- Growth of consumption of raw materials in developing economies (primarily China with additional impact from India, Russia, and Brazil) will create unprecedented demand for commodities across all sectors. In many cases, consumption increases have already been dramatic. Consensus outlook is for prolonged growth in demand.
- Commodity producers, uninspired to improve production capabilities during two decades of weak commodity prices, are ill-equipped to meet increased demand expectations. Current initiatives may take more than five years to produce meaningful supply.
- Manufacturers, faced with potential near-term shortages, may begin holding more inventory, further limiting available commodity supplies.
- Investors with economic views on inflation or weakened currencies may find commodities a valuable instrument hedging.
- Investors are more likely than ever to consider non-traditional investments when assembling portfolios.

III. Quantitative Cases for Commodities as an Asset Class

Emerging interest in commodities has not been the exclusive realm of investors. Several recent academic papers have dissected the asset class and helped to bolster the viability of commodities as a source of both portfolio diversification and investment return. Results of these studies suggest that commodities may be more viable for investor consideration than previously thought, regardless of any sense of immediacy that has come about based on assessments of the current market environment.

Gorton and Rouenhorst [2004] provide one of the most comprehensive long-term studies of the asset class. By constructing an index from data provided by the Commodities Research Bureau (CRB), their study incorporates a more substantial range of market conditions and cycles – and provides a more comprehensive snapshot – than many shorter-term studies. They create an equally weighted index of 34 commodity futures markets for the period July 1959 – March 2004 and measure this index against properties of traditional benchmarks, namely risk and return, correlation, and reaction to inflation; and incorporates a segmented view over a variety of economic cycles.

The study finds that the equally weighted commodity futures index produced returns comparable to stocks with about 80% of the volatility over the period (see Figure 3). It also notes that the return distribution of stocks has negative skewness while commodity returns have positive skewness. Combined with the higher standard deviation of equity returns, the data implies that equities have more downside risk than commodities.

Figure 3:
Average Returns (Monthly Returns Annualized), July 1959 – March 2004
Source: Gorton and Rouwenhorst

	Tbills	Stocks	Bonds	Commodity Futures
Mean Return	5.52%	11.02%	7.71%	11.02%
Std. Dev.	0.78%	14.90%	8.47%	12.12%

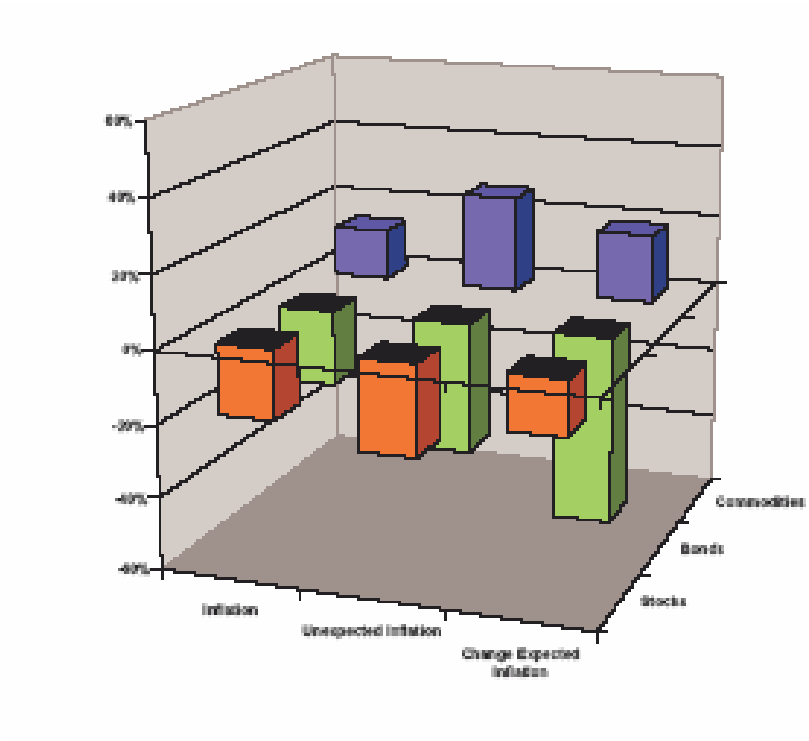
Gorton and Rouwenhorst also demonstrate limited to negative correlation of commodity returns relative to stocks and bonds, suggesting that commodity futures may be an effective diversifier of traditional portfolios. Overall correlation of commodities to stocks is found to be -0.06; to bonds -0.28. Furthermore, noting that equities demonstrated more left tail observations in the return distribution than commodities, the study isolates the 5% and 1% of worst equity market months, observing that these diversification benefits persist during crashing equity markets, when non-correlation may be especially valuable (see Figure 4).

Figure 4:
Commodity Returns During Worst Equity Periods, July 1959 – March 2004
Source: Gorton and Rouwenhorst [2004]

	Overall Mean Return	5% of Worst Equity Market Periods	1% of Worst Equity Market Periods
S&P	0.88%	-9.18%	-13.87%
Commodities	0.88%	1.43%	2.32%

Inflation hedging properties, which we previously discussed anecdotally as a macroeconomic factor impacting investor interest in commodities, is also handled empirically by Gorton and Rouwenhorst. The study finds commodity returns demonstrate a positive correlation to periods of inflation, in contrast to a negative correlation for both stocks and bonds. Both of these observations are found to be more pronounced (higher degree of positive correlation for commodities and higher degree of negative correlation for stocks and bonds) when periods of unexpected inflation are isolated from overall periods of inflation (noting that commodity futures will typically have already factored expected inflation into their prices). In addition, when further isolating periods to evaluate response to changes in expected inflation, bond returns appear to be particularly negatively influenced by revisions about future expected inflation.

Figure 5:
Correlation with Inflation Components,
Overlapping Quarterly Return Data from July 1959 – March 2004
Source: Gorton and Rouwenhorst [2004]



Additional observations from the pair demonstrate that the relative return, volatility, correlation, and inflation properties of commodities discussed here persist when compared to stock and bond indexes from the United Kingdom and Japan, so that these relationships are not limited to US markets or benchmarks.

While the Gorton and Rouwenhorst study combines a top-down review of the asset class with a long-term horizon that is unmatched by many other commodity studies, other recent papers corroborate many of the favorable observations outlined here.

Among them, Georgiev [2001], in a study using three indexes (the Goldman Sachs Commodity Index or GSCI, the Dow Jones – AIG Commodity Index, and the S&P Commodity Index) for the period from 1990 – 2003, finds that adding a commodity component to a diversified portfolio of assets has been demonstrated to result in enhanced risk-adjusted performance, and that inflation hedging properties exist in commodities (particularly within energy and metal sub-sectors). Nihman and Swinkels [2003], in a study focused on retirement savings schemes (pensions) that incorporates the GSCI for the period from January 1970 to December 2001, find that the use of commodities may reduce the volatility on the funding ratio in excess of 30 percent. Yet another study from Jensen, Johnson, and Mercer [2002] considers the GSCI and various GSCI sub-sector Indexes from January 1973 – December 1999 and demonstrates that commodities have limited correlation to other asset classes and that adding commodity futures to a typical diversified portfolio substantially enhances performance.

Whether the corroborating theoretical viewpoints emerging from these academic studies has impacted the flow of assets into commodities or vice versa, it's clear that there is a convergence of mindsets among investors, economic thinkers, and statisticians in favoring commodities; an accord that is not insignificant. In observing releases from Hollywood, we know that the critics and consumer public rarely agree; but, the occasional film that attracts cross-market kudos typically has the makings of a blockbuster.

Quantitative Cases for Commodities as an Asset Class – Summary

- Recent academic studies demonstrate long-term viability of commodities as an asset class that has produced similar returns to equities, with less historical volatility and negative skewness.
- Research illustrates that commodity return have been non-correlated to financial assets like stocks and bonds; and that commodities demonstrate inflation hedging properties favorable to stocks and bonds
- Studies find that adding commodities to a traditional stock and bond portfolio can enhance returns and decrease volatility
- While we have speculated that current investor interest in commodities has been a product of a bullish economic outlook for the asset class and its inflation hedging characteristics, results of these recent academic studies suggest long-term viability of commodities as an asset class that may supersede matters exclusively related to the current environment.

IV. Review of Passive Commodity Indexes

Georgiev observes a similar consensus of opinions from investors on the viability of commodities, noting that "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."

At the risk of undercutting the empirical case for commodities via pure overkill, we have introduced a range of studies that produce similar results not only to demonstrate consensus, but also to identify the trend by researchers toward aligning the fortunes of a commodity investment with those of a passive, long-only commodity index. While the various total return commodities indexes (many of which are investable) cited among these studies provide a meaningful basis for research, we find that the very omnipresence of the indexes may create a *de facto* impression that an index is the best means to access the asset class. The staggering growth of assets linked to the GSCI suggests that many investors have already subscribed to an index solution.

As discussed previously, commodity markets face certain idiosyncracies that are unique (short-term supply/demand disconnects, cyclical and at-demand production cycles, weather, etc.) relative to many financial markets. While these and other anomalies help to distinguish commodities as a non-correlated asset class, they also create a number of problems when attempting to index and passively invest in the asset class. In this section we outline commodity indexes that provide investable components for investors; we then discuss some of the differences among these indexes and how the differences impact performance.

In order to provide a comprehensive review that considers a variety of commodity index options, we consider the following total return indexes:

- Commodities Research Bureau - Reuters Total Return Index (CRB-R)
- Deutsche Bank Liquid Commodity Index (DBLCI)
- Dow Jones – AIG Commodity Index (DJ-AIG)
- Goldman Sachs Commodity Index (GSCI)
- Rogers International Commodities Index (RICI)
- Standard and Poor's Commodities Index (SPCI)

We begin by demonstrating the correlation of monthly returns of these five indexes over our common data period from January 1991 – December 2004. The relatively high degree of correlation suggests that any of these indexes may provide investors with similar, broad commodity exposure (see Figure 6).

Figure 6:
Monthly Return Correlation, January 1991 – December 2004

	CRBR	DBLCI	DJAIG	GSCI	RICI	SPCI
CRBR	1.00					
DBLCI	0.59	1.00				
DJAIG	0.82	0.85	1.00			
GSCI	0.65	0.92	0.89	1.00		
RICI	0.72	0.96	0.90	0.92	1.00	
SPCI	0.81	0.75	0.91	0.88	0.82	1.00

This correlation data, however, may be deceptive. While each of these indexes is a total return index with three components to its return (spot return, futures "roll", and interest on collateral, which we will discuss subsequently in further detail), actual construction and asset allocation varies dramatically among them. To highlight some of the main differences in these commodity indexes, we have constructed one comparative matrix of key components (see Figure 7), and another that provides a detailed review of each index's constituent market allocations for 2005 (see Figure 8). We will discuss certain important characteristics of index construction as part of this review; others we will revisit later, within the context of specific topics.

Figure 7:

Comparative Matrix of Index Construction and Methodology

	Reuters - CRB	DBLCI	Goldman Sachs	Dow Jones - AIG	Rogers' Raw Materials	Standard & Poors
Inception of Backfilled Data	Jan-82	Dec-88	Jan-69	Jan-91	Jan-84	Jan-70
Inception of Investable Component	1986 (Month not noted)	Feb-03	Jul-92	Jul-98	Aug-98	Aug-01
Number of Underlying Markets	17	6	24	19	35	17
How Underlying Markets are Selected	Attempts to create broad measure of overall commodity price trends	Selects the most liquid markets from each respective sector	Based on world production. Must meet liquidity requirements	Relies primarily on liquidity data, along with dollar-adjusted production data	Attempts to create a true "worldwide commodity index"	Only "consumed" commodities so excludes gold
How Underlying Markets are Weighted	Evenly Weighted	Attempts to be broadly consistent with global production, usage, and stocks	World-production weighted; determined by average quantity of production in last five years	Primarily based on liquidity over most recently available five years ... considers U.S.dollar-weighted production data and other factors	Based generally on world consumption patterns for raw materials	Based on commercial open interest; adjusts for double counting upstream/downstream commodities (Eg, Corn - Cattle)
Domestic / International Commodities	International	International	International	International	International	Domestic Only
Diversification Constraints	None	None	None	33% sector max; 2% market minimum	None	None
Most Recent Change in Markets / Weightings	1995	2004	2005	2005	2004	2005
Futures Price Considered for Index Calculation	Arithmetic average of contract months expiring w/in 6 months of current date; min. 2, max. 5 contracts	Nearest month for Metals and Ags; following December for Energy	Nearest month with adequate liquidity	Nearby futures contract	Nearby futures contract, not in delivery or notice period	Average of the 2 nearest active contract months that are not in delivery
How Index is Calculated	Geometric average of each market's average price	Arithmetic average of each market's price	Arithmetic average of each market's price	Arithmetic average of each market's price	Arithmetic average of each market's price	Geometric average of each market's price
Key Uniquenesses	Equal Weighting; Considers 'farthest out' futures; Geometric Averaging	Energy rolled monthly; metals and ags rolled annually each December; only 6 markets	Production based average brings energy bias; can be 75% or more of portfolio	Emphasis on liquidity for weighting; diversification rules	Most diversified; most subjective; most "exotics"; highest exposure to a single market (35% in crude oil)	Excludes Gold; adjustment for "double counting"

Figure 8:

Comparative Matrix of Index Constituent Markets

		CRB	DBLCI	DJ-AIG	GSCI	RRM	S&P
Metals	Aluminum		12.50%	7.06%	3.31%	4.00%	
	Copper	5.88%		5.89%	2.42%	4.00%	3.50%
	Gold	5.88%	10.00%	5.98%	2.12%	3.00%	
	Lead				0.31%	2.00%	
	Nickel			2.61%	0.93%	1.00%	
	Palladium					0.30%	
	Platinum	5.88%				1.80%	
	Silver	5.88%		2.00%	0.23%	2.00%	3.78%
	Tin					1.00%	
	Zinc			2.69%	0.57%	2.00%	
Sector Total		**23.52%**	**22.50%**	**26.23%**	**9.89%**	**21.10%**	**7.28%**
Energy	Brent Crude Oil				11.75%		
	Crude Oil	5.88%	35.00%	12.81%	25.79%	35.00%	9.74%
	GasOil				3.83%		
	Heating Oil	5.88%	20.00%	3.85%	7.14%	3.00%	11.49%
	Natural Gas	5.88%		12.28%	10.29%	3.00%	17.65%
	Unleaded Gas			4.05%	7.90%	3.00%	10.32%
Sector Total		**17.64%**	**55.00%**	**32.99%**	**66.70%**	**44.00%**	**49.20%**
Ags	Azuki Beans					1.00%	
	Barley					0.77%	
	Canola					0.67%	
	Corn	5.88%	11.25%	5.94%	4.11%	4.00%	4.96%
	Feeder Cattle				0.90%		
	Lean Hogs	5.88%		4.39%	2.39%	1.00%	1.78%
	Live Cattle	5.88%		6.15%	3.74%	2.00%	5.03%
	Oats					0.50%	
	Rice					2.00%	
	Soybean Meal					0.15%	3.81%
	Soybean Oil			2.67%		2.00%	3.90%
	Soybeans	5.88%		7.60%	3.01%	3.00%	4.79%
	Wheat	5.88%	11.25%	4.87%	5.28%	7.00%	5.05%
Sector Total		**29.40%**	**22.50%**	**31.62%**	**19.43%**	**24.09%**	**29.32%**
Softs	Orange Juice	5.88%				0.66%	
	Cocoa	5.88%			0.30%	1.00%	3.27%
	Coffee	5.88%		3.02%	0.68%	2.00%	3.36%
	Cotton	5.88%		3.23%	1.74%	3.00%	4.18%
	Sugar	5.88%		2.93%	1.26%	1.00%	3.39%
Sector Total		**29.40%**	**0.00%**	**9.18%**	**3.98%**	**7.66%**	**14.20%**
Exotics	Lumber					1.00%	
	Rubber					1.00%	
	Silk					0.15%	
	Wool					1.00%	
Sector Total		**0.00%**	**0.00%**	**0.00%**	**0.00%**	**3.15%**	**0.00%**
TOTALS		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

These comparative tables present a significant amount of information for the reader to digest; however, we think it is critical to recognize some of the key differences among these commodity indexes. Many of the differences in the indexes (like diversification and market exposure) are obvious; others require some navigational assistance.

Consider, for example, the various methodologies for weighting the indexes: Liquidity-based portfolio weights (like Dow Jones – AIG and SPCI) emphasize storable commodities such as gold, while production-weighted portfolios emphasize non-storable commodities like oil [Erb and Harvey, 2005]. The GSCI, a production-weighted index, is heavily weighted to energy with nearly 70% of the index exposed to that single sector.

Another factor that can impact weightings is the averaging technique used to calculate each index price. While most of the indexes are re-weighted annually (or otherwise, at least occasionally) by committees – with the aid of objective and /or subjective guidelines – those that are calculated using arithmetic averages are, theoretically, re-weighted every day by the markets. If a component market in an arithmetic index increases in price relative to other constituents, that component will become overweighted. Geometric indexes effectively re-balance with any price changes; this feature maintains the constant component weightings assigned by those that manage the index. Since commodity prices can display dramatic swings, arithmetic indexes that are manually re-weighted only once a year can be subject significant over- or under-weighting to markets that experience substantial growth or decline.

Because futures investors almost never intend to take delivery of a commodity, futures indexes are also subject to "rolling" requirements. That is, they must continuously roll market exposure into future contract months as expiration (and impending delivery) approaches. Each index handles this rolling process differently. The GSCI and DJ-AIG indexes, for example have rules which mandate when a near-term futures contract is rolled into a more distant contract. They roll into the new contract over a five-day period, transitioning 20% of the exposure per day until the index exposure is entirely in the new contract. Other indexes roll into more distant contracts all at once. The DBLCI rolls different sectors at different times: its metals and agricultural exposure is rolled monthly or as needed into the newest near-month contract, while its energy exposure is rolled annually each November.

While we will discuss the significance of the DBLCI roll methodology more thoroughly in a subsequent section, we do suspect that the chronology of the different indexes has some impact on their construction. Released in 2003, the DBLCI is the most recently created commodity index; its creators have had the benefit of reviewing and modifying the constructs of indexes developed previously. For that precise reason, research from Erb and Harvey [2005] suggests that data biases may exist in these indexes. While the majority of these indexes have rules-based construction methodologies, initial formation of the rules is a subjective process. It is this process that may be subject to bias:

> For instance, the GSCI has been traded since 1992, yet its performance history was backfilled to 1969. From 1969 to 1991, the GSCI had a compound annual return of 15.3%, beating the 11.6% return for the S&P 500. From 1991 to May 2004, the compound annualized return of the GSCI was 7.0% and the S&P 500 had a return of 10.4%. Is it possible that the GSCI weights were

> determined with an eye towards creating an index that outperformed stocks and to enhance the ability of Goldman Sachs to convince investors of the appeal of commodity futures investment? The historical performance of the DJ AIG index potentially suffers from similar construction bias since it has been traded since 1998 but its history goes back to 1991. From the inception of the performance history of the DJ AIG Commodity Index to its first trade date in July of 1998, the AIG index had a compound annualized return of 4.1% while the GSCI only had a return of 0.5% during the same period Is it possible that the DJ AIG index was created with an emphasis on demonstrating hypothetical historical outperformance relative to the GSCI? The CRB index's performance history commences in 1982 and the futures contracts first started trading in 1986. For each of these indices, the returns since trading actually started are tangible while the pretrading returns are to some degree hypothetical [Erb and Harvey 2004, pages 6-7].

Our quantitative comparisons of these commodity indexes include data from both live and pre-trading timeframes and does not delineate the two, so we wanted to equip readers with an awareness of this potential bias as they draw their own evaluations from the information.

Performance Comparisons

Despite the differences in construction, each individual index generally seeks to create an indicator of broad-based commodity price trends. The correlation data led us to believe the indexes were quite similar. Here, we consider some selected performance snapshots in order to evaluate whether these indexes produce returns that are more similar to each other (like their goals) or more different (like their construction).

Figure 9 demonstrates basic return and risk characteristics of the six indexes for the common data period of January 1991 – December 2004. While we recognize that this period combines both actual and backfilled data, we still feel that the 14-year period produces a notably wide range of results for indexes with similar objectives: Compound annual returns vary by more than 700 basis points; risk measures vary be even greater degrees.

Figure 9:

Index Risk and Return Characteristics, January 1991 – December 2004

Index	Compound Annual Return	Annualized Standard Deviation	Sharpe Ratio	Worst Draw Down
CRB-R	3.30%	8.34%	-0.07	-28.37%
DBLCI	10.09%	18.49%	0.34	-46.11%
DJ-AIG	6.98%	11.82%	0.26	-36.20%
GSCI	5.66%	18.06%	0.1	-48.25%
RICI	10.10%	14.04%	0.44	-36.94%
SPCI	4.79%	13.04%	0.07	-37.95%

In Figure 10, we break out the returns from August 2001 – December 2004. This timeframe encompasses the beginning of a period that has been generally more bullish for commodities. As we can see, significant performance discrepancies persist during this abbreviated period.

Figure 10:
Index Risk and Return Characteristics, August 2001 – December 2004

Index	Compound Annual Return	Annualized Standard Deviation	Sharpe Ratio	Worst Draw Down
CRB-R	9.65%	9.33%	0.88	-9.60%
DBLCI	18.53%	19.28%	0.89	-20.26%
DJ-AIG	12.46%	13.48%	0.82	-12.88%
GSCI	12.39%	21.97%	0.5	-23.51%
RICI	19.51%	14.84%	1.22	-15.61%
SPCI	10.14%	15.88%	0.55	-20.57%

Isolating periods even further, we consider the months of October and November 2004, when the crude oil market saw a dramatic run-up in October to all-time high prices, and a subsequent reversal in November. Returns among the indexes for these two months vary significantly, explainable in large part based on the differences in underlying market exposure (note GSCI's energy weighting, for example). Figure 11 provides returns of each index during this two month period.

Figure 11:
Monthly Returns, October and November 2004

Index	Oct-04	Nov-04
CRB Reuters Total Return Index	-0.07%	2.05%
DBLCI	3.85%	-3.38%
Dow Jones - AIG Commodity Index	1.69%	-1.20%
GSCI Total Return	4.15%	-4.84%
Rogers Intl Commodity Index (RICI)	1.67%	-1.00%
SPCI	3.49%	-3.26%

In comparing the returns of these indexes, it is important to remember that these indexes are *indicative* and not necessarily reflective of actual returns an investor has earned. Namely, these indexes do not accommodate transaction costs. These costs become significant in two primary areas: Whether the index uses arithmetic or geometric calculations, and to what degree the index includes thinly traded markets.

Mathematically, an index that is calculated using geometric averages will, in almost every case, under-perform an index calculated with arithmetic averages. Only in the rare case where all components move the exact same percentage up or down will the geometric return equal the arithmetic return. According to Knapp [2004], market makers involved in executing these transactions understand this mathematical phenomenon and factor it into their pricing and execution, typically by carrying an arithmetic hedge in the underlying commodities. The arithmetic hedge will gain more than the geometric index when markets move up and lose less than the geometric index when markets move down. The market maker will often pass a portion of the economics of this hedge to an investor in a geometric index by offering the future at a discount to fair value. After factoring in these discounts, investors in a geometric index may experience actual results that increase annualized returns by more than 100 basis points.

At the same time, investors in an arithmetic index (where the hedge opportunities do not exist for the market maker) may find that those who execute the transaction charge a premium over fair value to create a position. Even the largest of institutional investors may realize an annualized premium of 125-200 basis points over fair value for an arithmetic index investment.

In reviewing the performance disparities illustrated in Figure 9 and Figure 10 in the context of calculation methodology illustrated in Figure 7, we find that the two indexes calculated with geometric averages (CRB and SPCI) produced the lowest indicative performance. However, when factoring in the combined effects of execution costs based on geometric versus arithmetic index calculations, we see the potential for a meaningful collapse in the discrepancies between these two groups.

Exposure to thinly traded markets can also impact actual investor returns. The RICI, for example, is the only index to include exposure to lumber, rubber, wool, and silk (see Figure 8). While the allocation to these markets is just 1% or less, the potential for slippage in these thinly traded markets can be dramatic. Consider the Rogers Raw Materials Fund, LP, a private fund that provides access to returns linked to the RICI. From August 1998 (when the Fund began trading) through December 2004, it produced an annualized return of 14.38%, compared to an annualized return of 17.15% for the RICI, a difference of nearly 300 basis points. With stated fees of a flat 1.0% per year, the investable Fund has still under-performed the RICI by nearly 200 basis points per year. While it is impossible to quantify the precise impact of execution inefficiencies in the thinly traded exotic markets of the RICI, it is likely that at least a portion of this under-performance can be traced to the exposure to these illiquid markets. As indexes like the GSCI increase assets by the billions, investors may want to consider how execution costs in moderately traded markets like lean hogs or cocoa will be impacted by these asset increases.

Our exercise in this section is designed to demonstrate some of the initial problems an investor may face in selecting a passive index to implement a commodity investment. Underlying market exposure is so different among the indexes that even selecting a passive vehicle requires a "view." Many investors choose passive index investments to avoid such a requirement, but choosing the GSCI is equivalent to over-weighting the energy sector; choosing the CRB may overweight exposure to softs; choosing the SPCI eliminates any exposure to gold, and so on. Furthermore, actual returns an investor may achieve by investing in a commodity index may vary significantly from indicative results. Selecting an index with exposure to illiquid underlying markets or an index that uses arithmetic construction methodology may result in under-performing the comparable indicative index. Ultimately, though, merely selecting an index is, only the first challenge an investor must overcome in deciding whether passive exposure is the best means to access commodity returns.

Review of Passive Commodity Indexes – Summary

- In theory, commodity indexes share a similar goal: To create a broad indicator of commodity price movement.

- In practice, portfolio weightings, construction, and calculation methodology vary dramatically from one index to another.
- While longer-term correlation among indexes suggests similar exposures and performance results, return and risk characteristics vary widely.
- Over short-term timeframes, underlying portfolio exposures can have even more pronounced impact on performance variability.
- When comparing actual investor results to indicative index performance, transaction costs may have a meaningful impact, depending on index calculation methodology and liquidity of underlying markets.
- Investors accessing commodity exposure via passive indexes must be aware of how index selection may impact their experience with the asset class.

V. Limitations of Passive, Long-Only Commodity Investments

Regardless of differing construction methodologies or portfolio weightings, each of these indexes share similarities that may introduce common limitations. In this section, we outline some examples of potential passive commodity index shortcomings.

Return Sources in Commodity Futures
Each of these indexes invests in commodities via futures and are Total Return Indexes. The source of the return, then, comes from three components: change in price of the commodity, roll yield, and interest on collateral.

Till [2003] provides a thorough summary of the interplay among these components, which we summarize here.

The source of return from change in spot prices is the most straightforward for commodity investors to understand – this is the directional exposure to commodities many are looking for, particularly if their interest is based on a bullish outlook. If an index has long exposure to natural gas and the price of natural gas increases, the position is profitable (in this basic example).

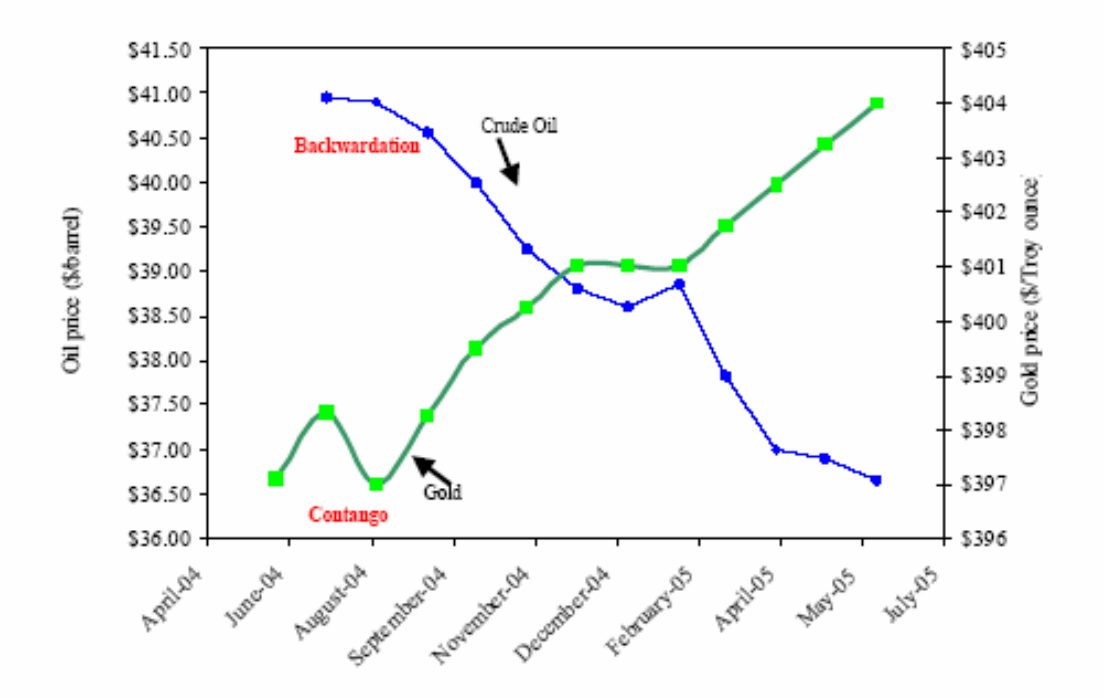
The collateral returns are similarly straightforward. A collateralized commodity futures program is unleveraged. That is, for every desired US$1 in commodity futures exposure, an investor sets aside US$1 in money-market funds or similar cash equivalents, making the futures program fully collateralized. When calculating the returns to a collateralized commodity futures program or total return index, one typically includes the collateral returns (interest on the cash equivalent) as well.

Understanding the portion of return attributable to roll yield requires a bit more effort. Our first step is to review the concepts of *backwardation* and *contango* as they apply to pricing of commodity futures. When a futures contract's price is at a discount to the spot price, the shape of the futures curve is called backwardation. When the futures contract's price is at a premium to the spot price, the shape of the futures curve is called contango.

The concepts can be difficult to grasp. For some clarity, Anson [2002] provides an explanation that distinguishes between markets that provide a hedges for producers (backwardated markets), and markets that provide a hedge for consumers (contango markets). He points out that a commodity producer such as Exxon, whose business requires it to be long oil, can reduce exposure to oil price fluctuations by being short crude oil futures. Hedging by risk averse producers causes futures prices to be below the expected spot rate in the future. Alternatively, a manufacturer such as Boeing is a consumer of aluminum, it is short aluminum, and it can reduce the impact of aluminum price fluctuations by purchasing aluminum futures. Hedging by risk averse consumers causes futures prices to be higher than the expected spot rate in the future. For example, Exxon is willing to sell oil futures at an expected loss and Boeing is willing to purchase aluminum futures at an expected loss.

Most observers find the difference between typically backwardated versus typically contangoed markets to be storability of the specific resource. Gold, for example is easy and cheap to store; it is therefore typically in contango. Oil, on the other hand, is more difficult and expensive to store; it may therefore be more frequently backwardated. Figure 12 provides an illustration of oil and gold as backwardated and contango markets.

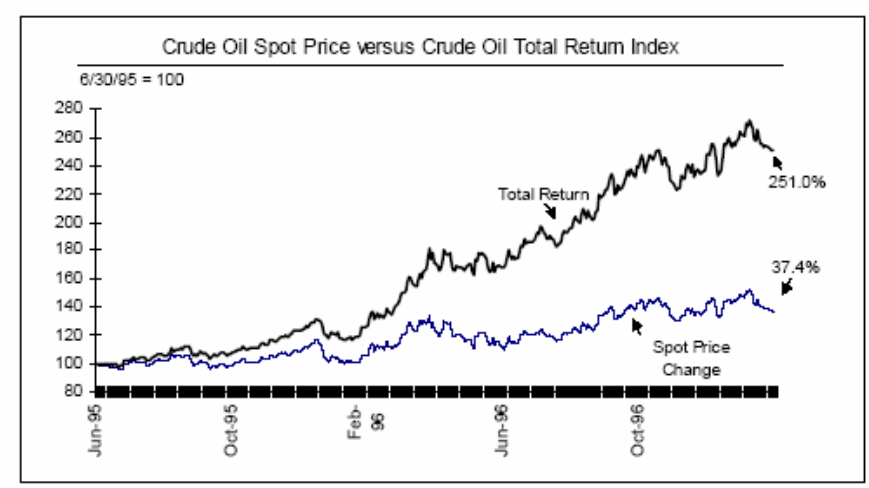
Figure 12:
Term Structure of Commodity Prices at May 30, 2004
(Source: Erb and Harvey [2005])



Futures returns are a combination of spot price returns plus the effect of the futures price converging to spot. In a backwardated futures market, a futures contract converges (or rolls up) to the spot price as the delivery date approaches. This is the roll yield that an investor captures. The spot price can stay constant, but one will still earn returns from buying discounted futures contracts, which continuously roll up to the constant spot price. In a contangoed market, the reverse occurs: an investor continuously locks in losses from the futures contracts converging to a lower spot price.

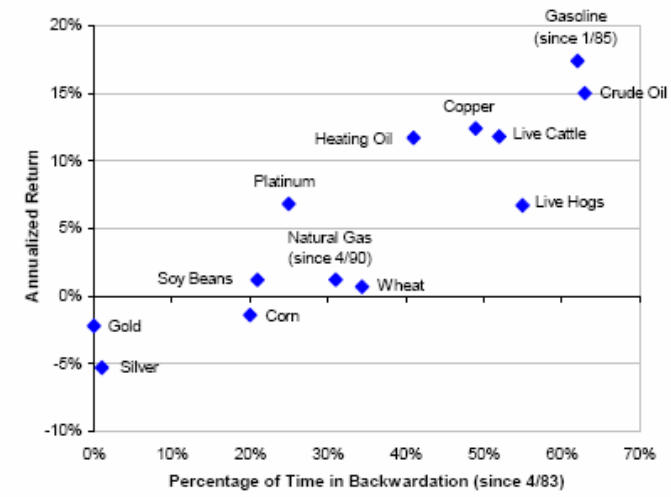
It is important to note that this roll yield is not related to direct exposure to actual commodities. Rather, it is a risk premium priced into the futures contract to compensate the holder for bearing the commodity price risk. Both Till [2003] and Nash [2001] find that this risk premium is the main, reliable source of return for commodity investors, typically accounting for the majority of a long commodity program's futures-only returns. To illustrate this phenomenon, Figure 13 compares the change in the crude oil spot price vs. the Goldman Sachs Crude Oil Total Return Index over an eighteen month period. The difference in returns is largely due to roll yield.

Figure 13:
Crude Oil Spot Price vs. Crude Oil Total Return Index, July 1995 – February 1997
(Source: Goldman Sachs, Commodity Watch, February 6, 1997)



The impact (and drawback) the roll yield phenomenon can have on a passive, long-only commodity index can be illuminated if we take the argument one step further. Nash [2001] indicates a direct relationship between the amount of time a commodity is in backwardation and the return from the roll yield (see Figure 14) by demonstrating that commodity futures markets that are more frequently backwardated demonstrate higher returns.

Figure 14:
Annualized Return vs. Time in Backwardation, August 1983 – December 2000
(Source: Morgan Stanley Dean Witter)



Nash cites gold, specifically, as a point of interest:

> Often when people think of investing in commodities, they think of buying Gold. The problem with this strategy is that typically there is plenty of Gold around and plenty of people willing to lend it. The result is that, in general, the fee paid by the market to borrow Gold is appreciably less than the borrowing costs of dollars (this means that Gold is almost always in a steep contango). Hence a strategy of buying Gold and lending it to the market should lose money. Since 1983, the price of Gold has fallen by 2.6% annually, yet a long position in Gold that is rolled every three months has lost 7.8% annually over the same period. [Nash, pages 29-30]

To quantify this problem for passive index investors, consider Erb and Harvey [2005], who found that since the inception of GSCI futures trading in July 1992, the GSCI has been backwardated as often as it has been in contango, and that a backwardated GSCI has significantly out-performed a contangoed GSCI (See Figure 15).

Figure 15:
Using the Information in the GSCI Term Structure for a Tactical Strategy, July 1992 – May 2004 (Source: Erb and Harvey [2005])

	Compound Annualized Return	Annualized Standard Deviation	Sharpe Ratio
GSCI Backwardated	11.25%	18.71%	0.6
GSCI Contangoed	-5.01%	17.57%	-0.29
Long if Backwardated, Short if Contangoed	8.18%	18.12%	0.45
GSCI Total Return Index	2.68%	18.23%	0.15

Passive, long-only investments in underlying commodity futures markets (the positions taken by the indexes) make no distinction between markets trading in backwardation or contango, either on a persistent or short-term basis. As illustrated previously, all of the indexes have at least some exposure to markets which spend the majority of time in contango. If we agree with the research that documents roll yield as the **main, reliable source of return** [emphasis of the author], then this exposure immediately handicaps the index by locking in roll yield losses of underlying contangoed markets.

Constituent Market Independence
While the roll yield may constitute the most significant portion of commodity returns for passive index futures exposure, price changes remain a factor worthy of consideration. The volatility in commodity prices discussed earlier takes on particular importance when considering that commodity markets often move far more independently of each other than many financial

markets. Consider Figures 16 and 17 which compare selected sub-markets in equities with those of selected sub-markets in commodities.

Figure 16:
Correlation of Selected Equity Indexes, July 1995 – December 2004

	NASDAQ	Russell 2000	Russell 2000	S&P 500
Nasdaq	1.00			
Russell 2000 Growth	0.91	1.00		
Russell 2000 Value	0.59	0.77	1.00	
S&P 500	0.80	0.70	0.67	1.00

Figure 17:
Correlation of Selected Commodity Sub-Indexes, July 1995 – November 2004

	CRB Total Return	CRB Energy	CRB Fats & Oils	CRB Foodstuff	CRB Livestock	CRB Metals
CRB Total Return Index	1.00					
CRB Energy	0.10	1.00				
CRB Fats & Oils	0.09	0.73	1.00			
CRB Foodstuffs	0.12	0.74	0.56	1.00		
CRB Livestock	0.25	0.06	0.14	0.21	1.00	
CRB Metals	0.54	0.24	0.36	0.23	0.46	1.00

Commodity sub-markets demonstrate considerably less correlation to each other and to the broad index than equity sub-markets. Viewed another way, consider crude oil and wheat prices during 2004 (see Figure 18) when crude oil breeched new all-time highs and wheat moved simultaneously to multi-year lows.

Figure 18:
Crude Oil and Wheat Spot Prices, 2004
(Source:FutureSource.com)

Faber [2004] notes this market independence and suggests that investors betting on commodity price increases due to rising demand from China should be aware that significant downside volatility for individual commodities – even in the context of a long-term commodities bull market – is almost a certainty. Even within a secular bullish cycle for commodities, short-term supply/demand disconnects will mean that individual markets will likely experience dramatic downturns, at least on occasion. Faber cautions that these markets can reach all-time highs and subsequently new lows within a brief period of time, and that investors should be prepared to see occasional 50% declines in the prices of individual commodities, regardless of general commodity market trends.

Passive, long-only indexes have little protection from these downward spikes. They have no stops, no ability to sell short, and many only re-balance once a year. While investors may choose indexed exposure to commodities in order to benefit from a bullish macroeconomic view, passive exposure may come at a greater cost than with index exposure in other asset classes, as interim moves against even a prolonged trend are may be both more frequent and severe within this sector.

Other Limitations for Passive Indexes

Limitations based on the backwardation/roll yield phenomenon and market independence are not the only constraints passive indexes face in the commodities sector. Knowable opportunities related to cyclicality, seasonality, cross-correlation, and weather premiums all present tactical trading scenarios that an index cannot exploit or avoid. Agricultural commodities, for example, typically demonstrate active price volatility during only a few key months of the year, when the market is adapting to potential crop yields for that year. [Author's note: we intend to explore these additional inefficiencies more thoroughly in subsequent versions of this paper.]

Indexes are typically designed to create broad, diversified exposure to an asset class. The drawbacks discussed in this section are not intended to be critical of any (or all) of the indexes *per se*. Rather, we have attempted to illuminate how some of the uniquenesses in commodity markets and instruments may create alpha opportunities that a passive, indexed approach to an investment in the asset class could miss. Reverting to Georgiev, we think that investors who have found a commodity investment to be appropriate may want to consider whether an index approach is, in fact, the best approach to implementing the investment.

Limitations of Passive, Long-Only Commodity Investments – Summary

- The main, reliable source of return in commodity total return indexes is not a product of changes in commodity prices; it is a risk premium related to commodity futures' roll yield.
- Roll yield has a demonstrated link to commodity markets in backwardation.
- Passive commodity futures indexes may trade in backwardation or contango. A contangoed GSCI has produced demonstrably lower returns than a backwardated GSCI. Research suggests that a contangoed GSCI may be constrained from earning roll yield.

- Underlying markets within a commodity futures index may trade in backwardation or contango. Passive indexes cannot discern between those markets positioned favorably to earn a positive roll yield (backwardated markets) and those which are not (contangoed markets) and must maintain long positions regardless of commodity term structure.
- Commodity markets demonstrate a high degree of independent movement, which may be manifested by dramatic price swings.
- While passive commodity futures indexes are likely to experience beta in a long-term secular bullish environment, they cannot avoid interim price crashes in individual commodity markets facing short-term disruptions.
- We hypothesize that these and other market inefficiencies may be exploitable by actively managed commodity strategies; and further, that within a sector which demonstrates a combination of "knowable" return sources, volatility, and inefficiencies, the tactical capability of active commodities managers to identify – and act upon – alpha opportunities may provide investors with superior returns.

VI. Creating an "Active" Commodity Benchmark – Construction and Comparative Characteristics of an Actively Managed Commodity Futures Portfolio

We hope to have distinguished the need to view commodities "as an asset class" differently from commodities "as an investment." That is, we find the use of passive, long-only indexes invaluable in terms of ascertaining whether commodities possess inherent return or diversification properties. The question remains, however, whether these same vehicles present best opportunity for commodity investors.

We are not alone in presenting some of the limitations of passive exposure to commodities or to identify some of the unique characteristics of the asset class which may create opportunities for a more active approach:

- Both Till [2003] and Erb and Harvey [2005] focus on timing an investment in the GSCI when its futures curve is backwardated in order to take advantage of the roll yield more dynamically.
- Jensen, Johnson, and Mercer [2002][1] illustrate an approach to timing a commodities investment (via the GSCI) based on prevailing restrictive monetary policies.
- Vrugt, Bauer, et al [2004] introduces a similar but more dynamic, multi-factor approach to timing an investment in commodities (again via the GSCI).

Once again, we see a default to use of a passive, long-only index (albeit "timed") as a proxy for more active investment in commodities. While the results of each of these approaches offer incrementally better performance (whether risk-adjusted or absolute), the use of a broad index like the GSCI offers little relief from the dramatic, independent volatility of underlying commodity markets. If an investor is long the GSCI, he is long crude oil, sugar, live cattle, and gold, regardless of what is occurring fundamentally, seasonally, technically, or – perhaps most importantly - within the futures term structure in any of these individual markets.

In addition, we believe these approaches do not reflect short-term, tactical response to price movements in either the constituent or aggregate commodity markets. Rather, they promote longer-term outlooks that maintain a reliance on roll yield as the primary return driver: a return source that is a risk premium and not representative of direct exposure to actual commodities, *regardless even* of sustained market direction.

Our effort, then, to determine whether distinctive properties of commodity markets may be especially suited to active management, is first contingent on establishing an "active" commodity benchmark.

To accomplish this, we assembled a proprietary data set of all known Commodities Trading Advisers (CTAs), active in the last five years, who trade exclusively in non-financial commodities.[2] While the number of CTAs in existence approaches one thousand, the majority include, in whole or in part, exposure to financial futures. Those focused exclusively on non-financial commodities number 84. From here forward we identify these non-financial CTAs merely as commodity traders or traders.

Once we isolated active commodity traders, we created an equally weighted portfolio that includes all traders for any given monthly period to create a monthly data stream from April 1982 – December 2004. To limit survivor bias, the equally weighted portfolio includes both active and inactive programs (although we were not able to include traders who existed prior to but not after 1999 due to data availability) and excludes no traders based on size, methodology, tenure, or any subjective factor. The equally weighted portfolio includes at its minimum one trader (April 1982 – June 1984) and at its maximum 47 traders (April 2004). **We believe this data set to be among the most comprehensive and accurate sources of known commodity traders in the world.**

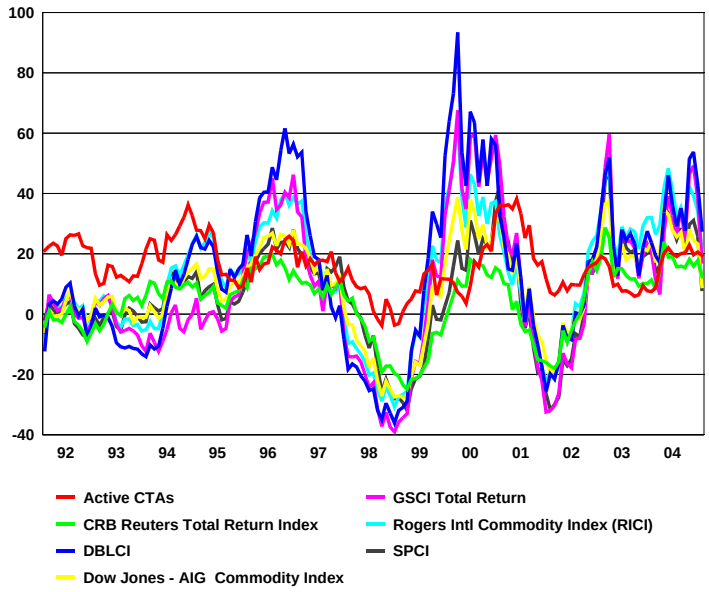
Figure 19 demonstrates risk and return characteristics of the equally weighted portfolio relative to the five previously discussed commodity indexes over our common data period.

Figure 19:
Commodities: Active Futures Traders vs. Passive Indexes, January 1991 – December 2004

Index or Portfolio	Compound Annual Return	Annualized Standard Deviation	Sharpe Ratio	Worst Draw Down
Active Commodity Traders	15.89%	7.60%	1.58	-7.02%
CRB-R	3.30%	8.34%	-0.07	-28.37%
DBLCI	10.09%	18.49%	0.34	-46.11%
DJ-AIG	6.98%	11.82%	0.26	-36.20%
GSCI	5.66%	18.06%	0.1	-48.25%
RICI	10.10%	14.04%	0.44	-36.94%
SPCI	4.79%	13.04%	0.07	-37.95%

These results suggest that active traders have significantly out-performed all passive commodity indexes, on an absolute and risk-adjusted basis and with significantly lower drawdown. Figure 20 illustrates 12-month rolling returns of the equally weighted active portfolio and the six indexes for the same period.

Figure 20:
Commodities: Active Futures Traders vs. Passive Indexes, January 1991 – November 2004, 12-Month Rolling Returns



In figure 21, we isolate the data comparison to include only the August 2001 – December 2004 timeframe that encompasses the "live" trading period for all of the indexes. This allows us to review the relative performance of active commodity traders to the indexes during a more bullish commodity environment and also to eliminate the years 1993-1996, where much of the out-performance for the active commodity traders appears to originate.

Figure 21:
Commodities: Active Futures Traders vs. Passive Indexes, August 2001 – December 2004

Index or Portfolio	Compound Annual Return	Annualized Standard Deviation	Sharpe Ratio	Worst Draw Down
Active Commodity Traders	12.70%	5.18%	2.17	-3.71%
CRB-R	9.65%	9.33%	0.88	9.60%
DBLCI	18.53%	19.28%	0.89	-20.26%
DJ-AIG	12.46%	13.48%	0.82	12.88%
GSCI	12.39%	21.97%	0.5	23.51%
RICI	19.51%	14.84%	1.22	-15.61%
SPCI	10.14%	15.88%	0.55	-20.57%

In the shortened timeframe, the active commodity portfolio produces absolute returns that are more comparable to the indexes; risk-adjusted performance maintains its dominance.

A last review of performance comparison considers the correlation of monthly returns. Figure 22 demonstrates that the active commodity portfolio achieves its results with limited correlation to any of the indexes.

Figure 22:
Commodities: Active Futures Traders vs. Passive Indexes, January 1991 – December 2004, Correlation of Monthly Returns

	Active CTAs	CRBR	DBLCI	DJAIG	GSCI	RICI	SPCI
Active CTAs	1.00						
CRBR	0.30	1.00					
DBLCI	0.35	0.59	1.00				
DJAIG	0.42	0.82	0.85	1.00			
GSCI	0.35	0.65	0.92	0.89	1.00		
RICI	0.38	0.72	0.96	0.90	0.92	1.00	
SPCI	0.37	0.81	0.75	0.91	0.88	0.82	1.00

While a thorough evaluation of active commodity strategies is required to evaluate an investment in an actively managed commodity portfolio, this preliminary review of return, risk, and correlation characteristics supports a hypothesis that active traders may be well-positioned to produce a superior commodity-linked return source for investors.

Creating an "Active" Commodity Benchmark – Construction and Comparative Characteristics of an Actively Managed Commodity Futures Portfolio – Summary

- Previous evaluations of dynamic or *active* commodity investments have focused on strategies that implement a timed index investment. While valuable, these strategies ignore the independent and often dramatic volatility of underlying, individual commodity markets.
- We produce a more tactical active commodity benchmark by creating an equally weighted portfolio of all known commodity traders.
- Comparisons of this equally weighted portfolio to indexes suggests that active commodity traders, in the aggregate, have produced absolute or risk-adjusted returns that are comparable or superior to those of passive indexes.
- Correlation data suggests that active commodity traders have produced these returns with limited correlation to passive benchmarks.
- This data supports our hypothesis that active commodity traders may be well-positioned to identify alpha opportunities within the sector.

VII. Adding Natural Resources Securities to an Actively Managed Commodity Futures Portfolio

Commodity traders occupy a niche within the sector more widely known as managed futures. Commodity Trading Advisors (CTAs) are recognized as a distinct alternative investment classification by many institutional and professional investors. The CTA designation, however, includes traders with exposure to financial market-linked futures (including equity, fixed income, and foreign exchange markets). In fact, we estimate that approximately 90% of the assets in managed futures products as of August 2004 were linked to financial market futures, with just 4% in the energy sector, 4% in the metals sector, and 2% in other commodity sectors.[3]

Within the managed futures community, it is widely understood that the dominance of financial futures in many CTA strategies is related to the vastly greater liquidity available in these markets. Quite simply, CTAs can expect to manage a $1 billion portfolio of foreign exchange futures without the market-moving and liquidity concerns of another CTA managing even $100 million in grain markets.

The issue of liquidity introduces one reason investors may find an active commodity investment via futures traders to be problematic. Large investors may not feel assets can deployed efficiently in thinly traded non-financial futures; therein lies the one attractive characteristic of a passive, indexed investment.

Another limitation of a futures-only approach to an actively managed commodity portfolio is related to limitations in the opportunity set. While commodity futures include such wide ranging markets as silk, orange juice, or milk, unique opportunities with direct links to natural resources exist outside global commodity exchanges.

One example is water. Water is, arguably, the world's most precious commodity, and its utility is un-matched by any other natural resource. The complexities related to the sourcing and distribution of water offer a myriad of business and investment opportunities; yet, there is no water futures contract for CTAs to consider.

Tying the matter of water as a natural resource investment back to global consumption matters, consider the viewpoint of Dickerson [2005] with regard to developments in China:

> While world markets have avidly bid most "China plays" to premium price levels, little attention has been paid to the most basic and compelling requirement for the sustained growth of the Chinese economy: Adequate water and sanitation facilities. . . . Most don't realize that China is presently undergoing the largest population migration in human history. Indeed, some 120 million people, 40% the size of the U.S., have already been forced to leave their rural villages and move to the industrial zones in search of employment, which is virtually non-existent in the rural countryside. As the Chinese economy grows, the huge wave of humanity towards the factories continues, and the problem of providing adequate basic facilities for those masses of workers has become critical: Only 20% of the cities currently have any sewage treatment whatsoever, and the first drinking water treatment facility in the country was only installed in 1985. The infrastructure supporting the worker force is

> critically lagging and this has become a substantial impediment to continued economic growth. . . . While the Chinese government may not be very responsive to humanistic and/or environmental concerns, they are very sensitive to economic problems, and water has become the most important limitation on the growth of the economy in China. Recently, the Government has started to reveal their severe water problems in public: Just a few days ago, on December 27, 2004, the Minster of Water Resources stated publicly that, The price of China's economic boom is being paid in water", and you can be sure he didn't make those remarks without the approval of the central government.

Even a casual observer can imagine a wide range of investment opportunities related to just this one water-related theme – from financing strategies to distribution entities to manufacturers of water-related hardware.

Similarly, all of these water-related investment sub-opportunities can be extended to other natural resources as well: Eg, strategies related to energy distribution and agricultural trade finance. These related opportunities are not directly available to futures investors, regardless of passive or active approach.

Adding Natural Resources Securities to an Actively Managed Commodity Futures Portfolio - Summary

- Including actively managed natural resource sector investment in an active commodity investment can accomplish two significant benefits: First, it adds depth to the capacity of the portfolio by including opportunities in global securities markets; and second, it extends the breadth of the portfolio to include natural resources that are not available via futures markets, and strategies that cannot be accessed via futures investments.

VIII. Creating an "Active" Commodity Benchmark – Construction and Comparative Characteristics of an Actively Managed Commodity Futures and Natural Resources Securities Portfolio

In order to evaluate the impact of actively managed securities investments within the context of an active commodity investment, we supplemented the equally weighted portfolio of non-financial CTAs discussed in Section VI with natural resource sector hedge funds. To accomplish this, we assembled a proprietary data set of all known Commodities Trading Advisers (CTAs) and natural resource sector hedge funds, active in the last five years, who trade exclusively in non-financial commodities or within the natural resources sector.[4] In combination, we found a universe of 128 distinct programs.

Once we identified this universe, we created an equally weighted portfolio that includes all traders and hedge funds for any given monthly period to create a monthly data stream from April 1982 – November 2004. To limit survivor bias, the equally weighted portfolio includes both active and inactive programs (although we were not able to include traders or hedge funds who existed prior to but not after 1999 due to data availability) and excludes no trader or hedge fund based on size, methodology, tenure, or any subjective factor. The equally weighted portfolio includes at its minimum one manager (April 1982 – June 1984) and at its maximum 70 managers (February 2004). **We believe this data set to be among the most comprehensive and accurate sources of known commodity traders and natural resources hedge funds in the world.**

We reviewed the portfolio performance characteristics for the futures and hedge fund portfolio under timeframes similar to those of the commodity traders-only portfolio. This section discusses the results.

Figure 23 demonstrates risk and return characteristics of both equally weighted portfolios relative to the five previously discussed commodity indexes over our common data period.

Figure 23:
Commodities: Active Futures Traders, Active Futures and Hedge Funds vs. Passive Indexes, January 1991 – December 2004

Index or Portfolio	Compound Annual Return	Annualized Standard Deviation	Sharpe Ratio	Worst Draw Down
Active Commodity Traders	15.89%	7.60%	1.58	-7.02%
Active Commod. Traders & HF	18.44%	8.19%	1.78	-16.58%
CRB-R	3.30%	8.34%	-0.07	-28.37%
DBLCI	10.09%	18.49%	0.34	-46.11%
DJ-AIG	6.98%	11.82%	0.26	-36.20%
GSCI	5.66%	18.06%	0.1	-48.25%
RICI	10.10%	14.04%	0.44	-36.94%
SPCI	4.79%	13.04%	0.07	-37.95%

The combined futures and hedge fund portfolio produces similar return and volatility characteristics relative to the futures-only portfolio. Out-performance for the common period timeframe relative to passive indexes persists when including hedge funds in the active commodity portfolio. However, the worst drawdown for the portfolio increases dramatically when including hedge funds. These results suggest that investors may add capacity and investment opportunities to an active portfolio via securities investments with limited impact on risk-adjusted return or absolute returns, but with additional downside volatility.

Reverting to a data comparison that includes only the August 2001 – December 2004 timeframe (which encompasses the "live" trading period for all of the indexes) allows us to review the relative performance of active commodity traders and hedge funds to the indexes during a more bullish commodity environment. Figure 24 presents these results.

Figure 24:
Commodities: Active Futures Traders, Active Futures and Hedge Funds vs. Passive Indexes, August 2001 - December 2004

Index or Portfolio	Compound Annual Return	Annualized Standard Deviation	Sharpe Ratio	Worst Draw Down
Active Commodity Traders	12.70%	5.18%	2.17	-3.71%
Active Commod. Traders & HF	18.30%	6.04%	2.79	-2.95%
CRB-R	9.65%	9.33%	0.88	9.60%
DBLCI	18.53%	19.28%	0.89	-20.26%
DJ-AIG	12.46%	13.48%	0.82	12.88%
GSCI	12.39%	21.97%	0.5	23.51%
RICI	19.51%	14.84%	1.22	-15.61%
SPCI	10.14%	15.88%	0.55	-20.57%

In the shortened timeframe, the combined futures and hedge fund active commodity portfolio produces absolute returns that are more comparable to the indexes; risk-adjusted performance maintains its dominance. Adding hedge funds to the active portfolio over this timeframe also demonstrably increases the absolute return of the active commodity portfolio while decreasing worst drawdown characteristics.

A last review of performance comparison considers the correlation of monthly returns (see Figure 25). In this case, we have also included the S&P 500 index in order to consider the degree to which adding hedge funds to an active commodity portfolio increases the portfolio's correlation to traditional equity markets.

Figure 25:
Commodities: Active Futures Traders vs. Passive Indexes, January 1991 – December 2004, Correlation of Monthly Returns

	Active CTAs	Active CTAs & HFs	CRBR	DBLCI	DJAIG	GSCI	RICI	SPCI
Active CTAs	1.00							
Active CTAs & HFs	0.85	1.00						
CRBR	0.30	0.39	1.00					
DBLCI	0.35	0.42	0.59	1.00				
DJAIG	0.42	0.51	0.82	0.85	1.00			
GSCI	0.35	0.43	0.65	0.92	0.89	1.00		
RICI	0.38	0.45	0.72	0.96	0.90	0.92	1.00	
SPCI	0.37	0.47	0.81	0.75	0.91	0.88	0.82	1.00

The correlation data in Figure 25 suggests that including hedge funds in the active commodity portfolio adds a small degree of correlation to the active commodity portfolio relative to the passive indexes. Correlation to equities, while increasing, remains insignificant for both active portfolios.

Creating an "Active" Commodity Benchmark – Construction and Comparative Characteristics of an Actively Managed Commodity Futures and Natural Resources Securities Portfolio – Summary

- We produce an active commodity benchmark of futures and securities by creating an equally weighted portfolio of all known commodity traders and all known natural resources hedge funds.
- Comparisons of this equally weighted portfolio to indexes suggests that an active commodity portfolio has produced absolute or risk-adjusted returns that are comparable or superior to those of passive indexes.
- Adding actively managed natural resources securities to the portfolio demonstrates minor risk-adjusted performance improvement over the longer-term timeframe and more pronounced risk-adjusted performance improvements and absolute performance improvements over the shorter-term timeframe.
- Correlation data suggests that adding actively managed natural resources securities to an active commodity portfolio does not meaningfully increase correlation to passive commodity indexes.
- Correlation data suggests that adding actively managed natural resources securities to an active commodity portfolio does not meaningfully increase correlation to an equity benchmark.

IX. Combined Summary

- Commodities, with their unique properties and reputation for high volatility, were once eschewed by many investors as too risky for serious consideration.
- The last couple of years have witnessed unprecedented interest in commodities. Assets have followed this interest in record levels as investors have begun to make sincere evaluations of commodities and found them to be an appropriate investments.
- Growth of consumption of raw materials in developing economies (primarily China with additional impact from India, Russia, and Brazil) will create unprecedented demand for commodities across all sectors. In many cases, consumption increases have already been dramatic. Consensus outlook is for prolonged growth in demand.
- Commodity producers, uninspired to improve production capabilities during two decades of weak commodity prices, are ill-equipped to meet increased demand expectations. Current initiatives may take more than five years to produce meaningful supply.
- Manufacturers, faced with potential near-term shortages, may begin holding more inventory, further limiting available commodity supplies.
- Investors with economic views on inflation or weakened currencies may find commodities a valuable instrument hedging.
- Investors are more likely than ever to consider non-traditional investments when assembling portfolios.
- Recent academic studies demonstrate long-term viability of commodities as an asset class that has produced similar returns to equities, with less historical volatility and negative skewness.
- Research illustrates that commodity return have been non-correlated to financial assets like stocks and bonds; and that commodities demonstrate inflation hedging properties favorable to stocks and bonds
- Studies find that adding commodities to a traditional stock and bond portfolio can enhance returns and decrease volatility
- While we have speculated that current investor interest in commodities has been a product of a bullish economic outlook for the asset class and its inflation hedging characteristics, results of these recent academic studies suggest long-term viability of commodities as an asset class that may supersede matters exclusively related to the current environment.
- In theory, commodity indexes share a similar goal: To create a broad indicator of commodity price movement.
- In practice, portfolio weightings, construction, and calculation methodology vary dramatically from one index to another.
- While longer-term correlation among indexes suggests similar exposures and performance results, return and risk characteristics vary widely.
- Over short-term timeframes, underlying portfolio exposures can have even more pronounced impact on performance variability.
- Investors accessing commodity exposure via passive indexes must be aware of how index selection may impact their experience with the asset class.

- The main, reliable source of return in commodity total return indexes is not a product of changes in commodity prices; it is a risk premium related to commodity futures' roll yield.
- Roll yield has a demonstrated link to commodity markets in backwardation.
- Passive commodity futures indexes may trade in backwardation or contango. A contangoed GSCI has produced demonstrably lower returns than a backwardated GSCI. Research suggests that a contangoed GSCI may be constrained from earning roll yield.
- Underlying markets within a commodity futures index may trade in backwardation or contango. Passive indexes cannot discern between those markets positioned favorably to earn a positive roll yield (backwardated markets) and those which are not (contangoed markets) and must maintain long positions regardless of commodity term structure.
- Commodity markets demonstrate a high degree of independent movement, which may be manifested by dramatic price swings.
- While passive commodity futures indexes are likely to experience beta in a long-term secular bullish environment, they cannot avoid interim price crashes in individual commodity markets facing short-term disruptions.
- We hypothesize that these and other market inefficiencies may be exploitable by actively managed commodity strategies; and further, that within a sector which demonstrates a combination of "knowable" return sources, volatility, and inefficiencies, the tactical capability of active commodities managers to identify – and act upon – alpha opportunities may provide investors with superior returns.
- Previous evaluations of dynamic or *active* commodity investments have focused on strategies that implement a timed index investment. While valuable, these strategies ignore the independent and often dramatic volatility of underlying, individual commodity markets.
- We produce a more tactical active commodity benchmark by creating an equally weighted portfolio of all known commodity traders.
- Comparisons of this equally weighted portfolio to indexes suggests that active commodity traders, in the aggregate, have produced absolute or risk-adjusted returns that are comparable or superior to those of passive indexes.
- Correlation data suggests that active commodity traders have produced these returns with limited correlation to passive benchmarks.
- This data supports our hypothesis that active commodity traders may be well-positioned to identify alpha opportunities within the sector.
- Including actively managed natural resource sector investment in an active commodity investment can accomplish two significant benefits: First, it adds depth to the capacity of the portfolio by including opportunities in global securities markets; and second, it extends the breadth of the portfolio to include natural resources that are not available via futures markets, and strategies that cannot be accessed via futures investments.
- We produce an active commodity benchmark of futures and securities by creating an equally weighted portfolio of all known commodity traders and all known natural resources hedge funds.

- Comparisons of this equally weighted portfolio to indexes suggests that an active commodity portfolio has produced absolute or risk-adjusted returns that are comparable or superior to those of passive indexes.
- Adding actively managed natural resources securities to the portfolio demonstrates minor risk-adjusted performance improvement over the longer-term timeframe and more pronounced risk-adjusted performance improvements and absolute performance improvements over the shorter-term timeframe.
- Correlation data suggests that adding actively managed natural resources securities to an active commodity portfolio does not meaningfully increase correlation to passive commodity indexes.
- Correlation data suggests that adding actively managed natural resources securities to an active commodity portfolio does not meaningfully increase correlation to an equity benchmark.
- Active management in commodities may provide investors with an opportunity to earn returns superior to those of passive commodity indexes.

X. Bibliography and Notes

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Notes

1. Jensen, Johnson, and Mercer included in their study a “managed” futures component as well, namely the MLM Index. While the MLM Index allows for long and short positions in underlying market futures, its equally weighted construction includes exposure to financial futures and foreign exchange futures.
2. Data for the equally weighted portfolio was provided by RQSI/Access.
3. Based on internal analysis of data provided courtesy of The Barclay Group.
4. Data for the equally weighted portfolio was provided by RQSI/Access.