

Commodities as an Asset Class

By

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Commodities are attracting a growing number of institutional investors. Over the past five years the largest pension funds and endowments allocated a small part of their assets (typically 1 to 3%) to commodities. A number of smaller pension funds are contemplating a similar move.

The decision to invest in commodities hinges on two issues:

- Do commodity futures benefit a strategic portfolio?
- Is now an opportune time to invest in commodities?

The first question has been the subject of interesting academic research lately. In this note we will make many references to two important papers on the subject: by Gorton and Rouwenhorst (2006) and by Erb and Harvey (2006).

The second question has been intensely debated. The controversy lies in whether the investment growth has created a price bubble and reversed normal patterns in roll returns³ on one hand, and on whether the economy is on the verge of recession on the other hand.

In this note, we try to shed light on both issues.

We find that historically the risk premium in commodity futures has been similar to the risk premium in equities, and we find good reasons for this to persist in the future. Commodities are a great source of portfolio diversification both in normal times (they are negatively correlated to equities and bonds) and in bad times (extreme negative events in commodities do not coincide with extreme negative returns in equities or bonds). Two properties create these benefits:

- Commodities are tied to the economic cycle, while financial assets anticipate the onset of expansion and recession; this creates negative correlation between commodities and financial assets
- Commodities are a good inflation hedge by definition: they have about a 40% weight in the CPI.

Finally, we gauge the impact of the rapid increase in commodity investment on commodity prices. We find evidence that it has contributed to a bubble creation in industrial metals and in the energy sector.

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³ We explain the meaning of roll return in the next section.

Prospective risk premium in commodity futures

Research suggests that long-only portfolios of commodity futures yield returns similar to the S&P500. Gorton and Rouwenhorst (2006) constructed an equally-weighted index of commodity futures for the period July 1959 to December 2004. They found that an investor in their index of collateralized futures would have earned 5% over Treasury bills per annum. The risk premium in commodities appeared to be equal to that in equities.

But what matters to investors is not the historic but the prospective risk premium. Is there any fundamental reason for investors to be compensated for commodity futures risk?

One answer is Keynes' theory of "normal backwardation." Producers need to hedge their long exposure in the commodity and sell the futures to speculators at a discount to the expected price of the commodity in the future. The speculators collect the risk premium by buying a long-dated future and holding it to maturity. Alternatively, they collect the risk premium in installments by holding, say, the near future and rolling it to the next future, before it expires⁴.

But this assumes that only producers hedge. If users desire to hedge, speculators would be short the futures and they would profit from a curve in contango. However, in many commodity markets consumers are much less likely to hedge than producers, because consumption is much more thinly spread, so each consumer's risk is lower (e.g. do individuals hedge their gasoline?) and because most consumers lack access to derivative markets.

Historically, backwardation is indeed the norm in most commodity markets (but not all; for example, aluminium is in contango).

Erb and Harvey (2006) propose an alternative explanation for the existence of a prospective commodity risk premium. Although returns on individual commodity futures are close to zero, a commodity futures portfolio with equal weights, regularly rebalanced, yields equity-like returns. The source of this return is diversification. They show that an equally weighted portfolio of 30 securities, with average individual standard deviation 30% per annum and average correlation ranging from 0 to 0.3, has a diversification return ranging from 3.05% to 4.35%; the return is higher, the higher the volatility of the constituents and the lower the correlation. Most importantly, the investor can count on receiving this return even if spot and roll returns are zero.

A portfolio that initially has equal weights but is not rebalanced, may beat the rebalanced portfolio in some scenarios, but it will have a lower information ratio.

⁴ Therefore, the return on commodity futures has two components: price change (spot return) and roll return.

How about prospective spot returns?

Cashin and McDermott (2002) analyzed the behavior of real commodity prices over the period 1862-1999. They found that commodity prices follow a boom-bust pattern: periods of sharp rise are followed by periods of sharp decline. The variability in price dominates a small downward trend in real prices (about 1% a year). The amplitude of price movement increased in the early 1900s, whereas the frequency of the price movements increased after the collapse of the Bretton Woods regime of fixed exchange rates in the early 1970s.

Why would the future be any different? We can imagine two reasons that could drive prices higher: reserve depletion (if scientists fail to discover substitutes), and the spread of economic development to large parts of the globe (the BRIC phenomenon on a larger scale).

In summary, the prospective excess return on a portfolio of commodity futures can be decomposed into three elements in decreasing order of certainty: diversification return, roll return, and price return.

In Table 1 we show the average return over the different phases of the business cycle on a collateralized investment in the CRB index⁵, on the SP500 (price return and dividend yield) and on the 10 year Treasury note (price return and coupon yield) from October 1970 to October 2001. Proceeds are reinvested.

The last column contains the average period CPI-U inflation

During this period there are 5 business cycles as defined by NBER⁶. To define the four phases of the cycle, we divide the expansion and the recession into half.

Table 1 shows that in a portfolio comprising the collateralized CRB index, equities and bonds, commodities save the day in the late stages of expansion-early stages of recession, while bonds save the day in the late recession.

	CRB	Equities	Bonds	Inflation
Early Expansion	25.15%	68.05%	35.55%	10.65%
Late expansion	36.41%	33.25%	15.05%	14.66%
Early Recession	3.65%	-6.94%	-1.76%	3.66%
Late Recession	-4.51%	-1.45%	11.63%	2.94%
Expansion	70.72%	123.93%	55.94%	26.88%
Recession	-1.03%	-8.29%	9.67%	6.71%
Whole Cycle	68.97%	105.36%	71.02%	35.39%

Table 1. Period (start to finish) return for the CRB commodity index, equities and bonds over various economic regimes together with period CPI-U inflation. The numbers represent the average over 5 full business cycles from October 1970 to October 2001.

⁵ We chose the CRB index because it weighs the different commodity sectors equally and renders our results comparable to the results in Gorton and Rouwenhorst (2006)

⁶ For the NBER definition of business cycle, see: <http://www.nber.org/cycles.html/>

Risk in commodities

We next compare the risk characteristics of the aforementioned investments in Table 2.

Commodity futures returns are positively skewed whereas equity returns are skewed negatively. The return per unit risk in commodity futures is comparable to that in equities. The last row indicates that all three asset classes have fatter tails than the normal distribution.

	CRB Index	Equities	Bonds
Average Return (%)	0.77	1.07	0.75
Standard Deviation (%)	3.48	4.46	2.24
Information Ratio	0.80	0.88	1.21
Skewness	0.77	-0.35	0.47
Excess Kurtosis	3.15	2.12	2.15

Table 2. Monthly return characteristics of the CRB commodity index, equities and bonds (October 1970-October 2001).

Commodity correlations to stocks and bonds

Equity and bond prices anticipate the economy. As Figure 1 indicates (and Table 1 confirms) equity gains are largest in early expansion and losses are largest in early recessions.

Bonds lead equities by approximately a quarter of a cycle⁷. This creates a small positive correlation between bonds and equities.

Commodity prices are tied to the real economy: demand for commodities rises during periods of expansion generating positive returns, and falls during recession periods creating negative returns. While financial assets lead the cycle, commodity futures are in phase with it.

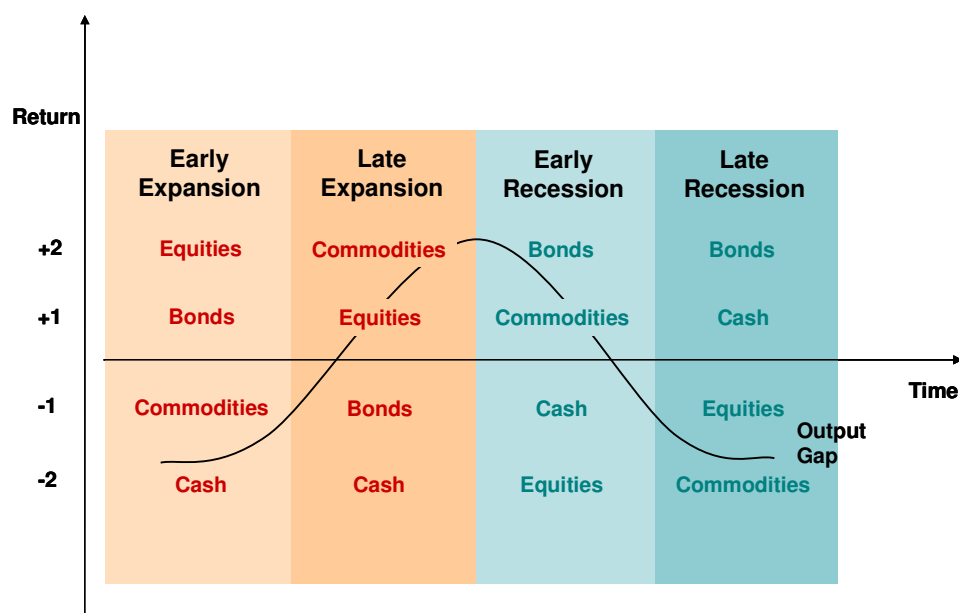


Figure 1. The business cycle and asset returns. Financial asset returns lead the cycle. Commodity returns are linked to the real economy and consequently tied to the cycle.

⁷ Immannen (2003) divides the cycle into 6 subperiods and finds that bonds peak 1/6th of the cycle before equities and equities peak 1/6th of the cycle before the cycle's trough.

When we consider monthly returns, we find that commodities have almost zero correlation with equities and significant negative correlation with bonds.

When we consider returns over 1- and 5- year overlapping periods, we find that the commodity-equity and commodity-bond correlation is negative, significant and increases in absolute value with the length of the period.

Groton and Rouwenhorst (2006) reported similar correlations by examining a longer period (July 1959-December 2004).

The reader must keep in mind that the universe of commodity futures has expanded during this period; in the seventies most futures were in the agriculture market.

Monthly returns

CRB Index	Equities	Bonds	Inflation
1	0.02	-0.16*	0.03
	1	0.27*	-0.16*
		1	-0.18*
			1

1-year returns

CRB Index	Equities	Bonds	Inflation
1	-0.20*	-0.42*	0.39*
	1	0.36*	-0.32*
		1	-0.41*
			1

5-year returns

CRB Index	Equities	Bonds	Inflation
1	-0.59*	-0.54*	0.78*
	1	0.45*	-0.60*
		1	-0.51*
			1

Table 3. The correlation between returns on the CRB commodity index, equities and bonds over various time periods. As the period expands, the negative correlation increases in magnitude. An asterisk indicates that the number is significant with 95% probability. The data cover October 1970 to October 2001.

A naïve strategy exploiting the fact that commodities lag bonds and equities

A powerful way to test the validity of a market related observation, is to create a simple strategy based on the observation, and check how profitable it turns out to be.

We have observed that the commodity price cycle lags the bond and equity price cycles.

Groton and Rouwenhorst (2006) noted that results similar to those in Table 1 do not imply a trading strategy, because business cycles are dated "after the fact".

But because monetary policy leads the business cycle and the equity market leads the commodity market, it is possible to create a simple strategy for generating alpha in commodity futures:

The idea is to go long the CRB⁸ index when the Fed is tightening or when the stock market has had a strong performance; conversely to go short the CRB index when the Fed is easing or when the stock market has suffered substantial losses

More precisely, the strategy is:

- go long the CRB index when:
 - the last move in the Fed Funds rate was up; exit when the Fed Funds rate was unchanged or was down
 - or**
 - the SP500 return crosses into the top 25% percentile in a moving window⁹; exit when the equity return normalizes (crosses into the bottom 50% percentile)
- go short the CRB when the last move in the Fed Funds rate was down **and** the equity return crosses the bottom 25% percentile.

This naïve strategy yields an information ratio of 0.54 (based on daily returns and including a transaction cost of 0.5%) compared to 0.27 for always holding the CRB index.

Erb and Harvey (2006) present two other naïve trading strategies that have historically generated alpha in commodities: one based on momentum¹⁰ and one based on the term structure of futures prices¹¹.

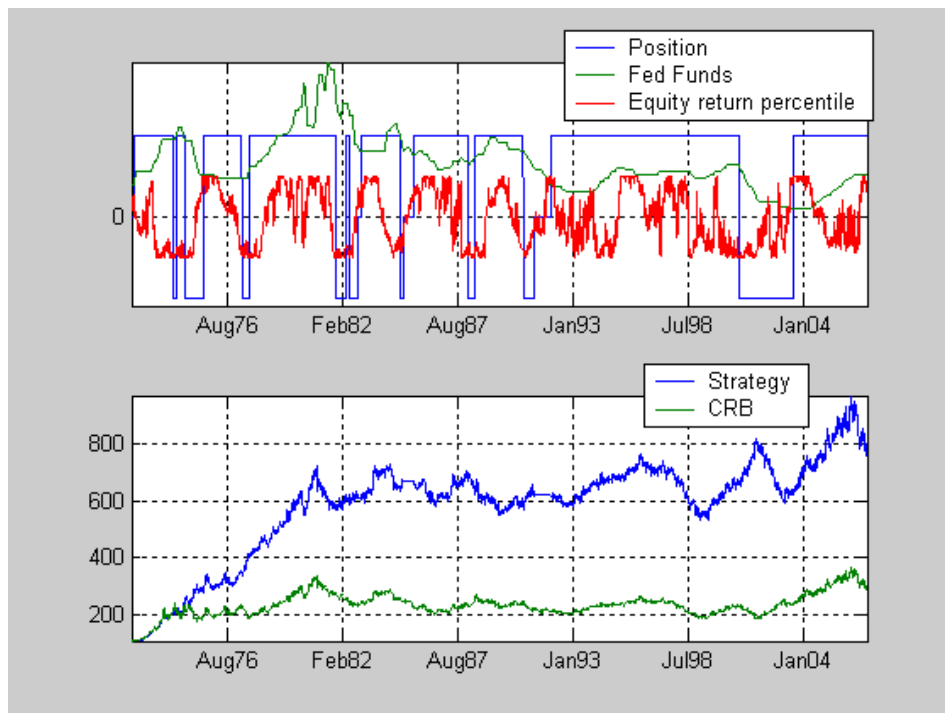


Figure 2. A naïve strategy exploiting the fact that commodity prices lag monetary policy changes and equity prices. The top window depicts the position (blue line), the Fed Funds rate (green line) and the equity return percentile (red line). The bottom window compares the strategy to the CRB index.

⁸ In this example, the CRB returns do not include collateral.

⁹ The performance of the strategy is robust to the choice of period used to calculate returns and the size of the sample window (300 and 500 days for the results shown here).

¹⁰ Go long (short) when prior returns have been positive (negative).

¹¹ Go long (short) when in backwardation (contango).

Tail Dependence

Large portfolio drawdowns are caused by the coincidence of negative tail events in two or more of its components. The correlation coefficient describes codependence around the means of two distributions. In order to describe codependence in the tails of the two distributions, we use the tail dependence coefficient. It is defined as the conditional probability that one investment (e.g. commodity) suffers a large loss given that another investment (e.g. equity) suffers a large loss. The numbers we present here are the asymptotic values, when losses become large and cover the period October 1970 to October 2001.

While there is 0.7% probability that an extreme loss in equities coincides with a large loss in bonds, the probability that an extreme loss in commodities coincides with a large loss in equities or bonds is practically zero.

Figure 3 shows the returns on collateralized commodity futures when equities fell sharply during the past 35 years. When US equities experienced losses exceeding 10% over 1 year (overlapping windows), commodity futures returns were either large and positive (1972-73, 1987), or small negative (1981, 2000).

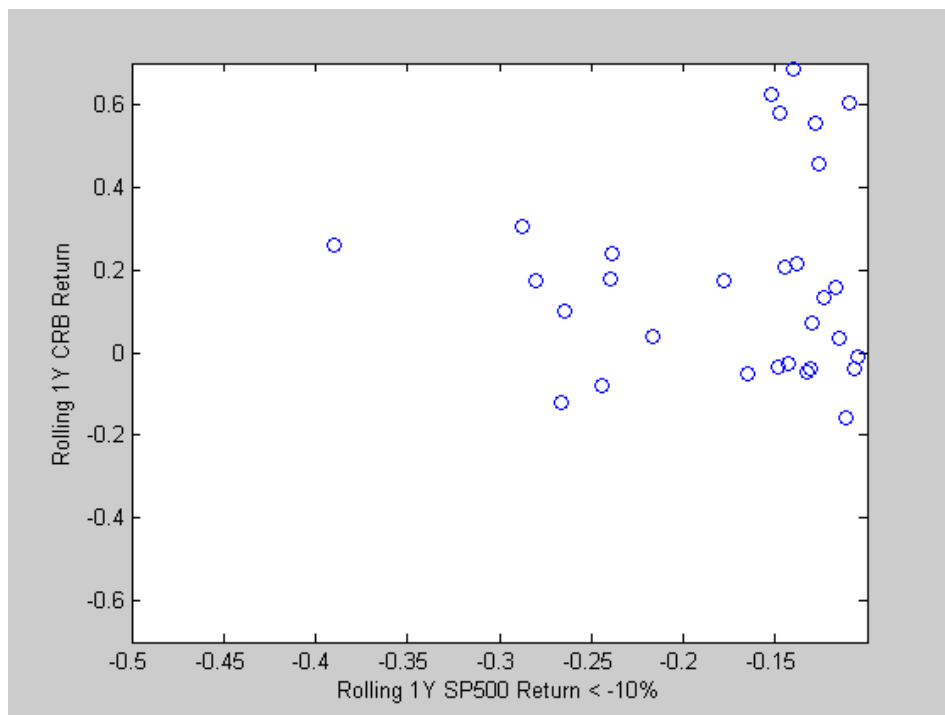


Figure 3. CRB commodity index returns corresponding to large falls in equity markets.

Commodities are an effective inflation hedge

Commodities have about a 40% weight in the CPI, and services have a 60% weight. It is no surprise therefore, that commodity futures are a good inflation hedge. Table 4 shows the sensitivity to inflation of the three asset classes we consider. This sensitivity is the regression coefficient relating the asset's monthly returns to the monthly CPI-U.

During periods of high inflation commodities help the performance of the portfolio.

	CRB Index	Equities	Bonds
Sensitivity to Inflation	0.35	-2.15	-1.18
t-statistic	0.65	-3.17	-3.48

Table 4. The sensitivity of commodity futures, equities and bonds to CPI-U inflation (October 1970 - October 2001).

Commodities in a liability matching portfolio

It is common practice to use the 10Y Treasury notes as a proxy for liabilities.

To measure the sensitivity of an asset to the liability it targets, we calculate the asset's duration. The duration is the regression coefficient relating the asset's returns to bond returns. An asset with a large positive duration is a good liability match.

As one expects from the sign of the correlation between commodity futures (collateralized CRB returns) and bonds, commodity futures have negative duration

versus bonds. Table 5 shows that the duration of commodity futures (in contrast to the duration of equities) is negative and thus commodity futures are not a good match for liabilities.

	CRB Index	Equities
Duration	-0.25	0.53
t-statistic	-3.12	5.31

Table 5. The duration of commodity futures and equities.

What percentage of the strategic portfolio should be invested in commodity futures?

Using the risk parameters in Table 2 and assuming excess returns of 5% for equities and 2% for bonds, we find that the optimal stock-bond portfolio is the 60-40 portfolio. That portfolio has 10.5% volatility.

We then add commodity futures to the mix. Under various assumptions for the commodity excess return¹² we find the portfolio weights that maximize return while keeping the portfolio risk at the 10.5% level. We use the correlations of monthly returns in Table 3 to construct the covariance matrix.

The results are summarized in Table 6.

The small allocation to commodity futures by investors (typically 1-3%) is not a reflection of their risk-return properties: It is because these investors are not familiar with commodities and because the capacity in commodities is smaller than in equities and bonds

In the following section we study the effect of capacity constraints on commodity prices.

Commodity Excess Return	Commodity Weight	Equity Weight	Bond Weight	Portfolio Excess Return
0%	0%	60%	40%	3.80%
1%	3%	61%	36%	3.80%
2%	19%	64%	17%	3.91%
3%	39%	61%	1%	4.20%
4%	40%	60%	0%	4.60%
5%	50%	50%	0%	5.00%

Table 6. Optimal portfolio weights for different commodity excess return assumptions.

¹² We remind the reader that the prospective excess return on commodity futures is the sum of the diversification return (about 3%), the roll return and the spot return.

Is this a good time to invest in commodities?

The answer to this question depends on the answer to two related questions:

Has the increase in commodity investment created a bubble, in which case it is better to wait till it bursts¹³? To answer this question, we compare the size of the investment increase to the size of the inventories. The increase in long positions is equivalent to an increase in demand for the commodity. When the increase in demand is large compared to the normal size of the commodity stocks, the price is driven upwards.

What are the prospects for the economy? If investors believe that the economy is running strong, they should initiate a commodity investment for reasons already explained; if they fear the onset of a recession, they should not.

We will not attempt to answer the second question: every investor has his own view on the subject. We will concentrate on the first question.

The investment in commodities has increased from \$5B in 2002 to \$20B in 2004, to \$110B in 2006 (source UBS).

According to our estimates, pension funds and endowments have around \$33B invested in commodities: \$17B in the Netherlands, \$11B in North America, \$4B in the UK, and \$1B in Scandinavia.

There are about 80 retail commodity (mutual) funds with approximately \$30B in assets.

The direct exposure of hedge funds to commodities probably does not exceed \$15B (this figure translates the leveraged hedge fund exposures to zero-leverage exposures).

The remaining \$32B should primarily represent holdings of investment banks (hedged for index swaps that they have sold to investors).

To gauge the impact of the recent investment growth on prices, we compare this investment increase to the inventories in 7 key commodities (listed below). A long-only investment in a commodity future creates a claim on part of the inventory. Whenever this claim is a large proportion of the inventory, the price is driven upwards.

To estimate the capital allocated to each commodity, we multiply the corresponding GSCI weight by \$110 B.

We use the follow inventory numbers:

Hydrocarbons: the average over 2005 and 2006 excluding the strategic reserves (source DOE)

Copper: the average of the sum of the LME, Comex, and Shanghai Futures Exchange inventories, from February 2003 to February 2007 (source Bloomberg)

Aluminium: the average commercial stock from February 2003 to February 2007 (source IAI)

Grains: the average of the eight crops over 2004 and 2005 (source USDA).

Cattle: the January 2007 number (which is not too far from average of the last 5 years) (source USDA).

¹³ One might argue of course, that the prospect of higher prices has drawn investors to commodities. The price increase is the cause rather than the effect of increased investment in commodities.

We then calculate the dollar value of the inventories and compare it to the investment increase.

Based on the investment to inventory comparison in Table 7, we deem it very likely that the investment boom has contributed to the large price increase in the cases of copper, aluminium, and hydrocarbons.

Consequently, we advocate a tactical approach to investing in commodities as opposed to a passive approach. Alternatively, we recommend that a passive investment be protected by an active overlay.

Commodity	Investment Increase (2002-2006, USD B)	Inventory	Investment Increase / Inventory Value
Energy	75.7	1030 million barrels	113%
Copper	5.0	0.42 million metric tons	147%
Aluminium	3.9	3.05 million metric tons	45%
Wheat	4.3	1.25 billion bushels	67%
Corn	3.6	4.97 billion bushels	20%
Soybeans	1.9	0.97 billion bushels	27%
Cattle	3.7	97 million heads	4%

Table 7. Comparison between investment growth (2002-2006) and inventories.

Furthermore, we have observed that traditional roll-return patterns have been changing since 2003. For example, oil markets have moved into contango because higher short-term prices do not generally motivate producers to invest in incremental production as effectively as higher long-dated forward prices.

We believe that speculators do affect prices and consequently a successful trader (or trading system) must take price action into account. We are aware of one study that contradicts this belief: IMF (2006) studied the effect of hedge funds on the price movement in five commodities and found "little support for the hypothesis that speculative activity (as measured by net long noncommercial positions¹⁴) affects either price levels over the long run or price swings in the short run."

As commodity futures become more widely used as financial instruments, the traditional relationship between commodity prices and the business cycle might be disturbed.

At IPM we have recognized this fact, and in addition to quantifying the impact of shifts in supply and demand, we analyze the trading patterns of the financial operators and distill the fears and expectations of the market participants from the option markets and the time structure of the futures curve.

This will be the subject of a future note, in which we will outline our approach to earning alpha from commodities and to protecting a passive commodity investment via an overlay.

¹⁴ Note that commodity index traders are classified as commercial traders. As we have mentioned, index investments comprise 90% of the commodity investment.

Conclusions

We think that a strategic portfolio benefits from an investment in commodities:

An asset-only portfolio benefits both from the positive prospective risk premium in commodities and from their negative correlation with equities and bonds.

Commodity futures are a good hedge against inflation.

The rapid increase in passive commodity investment has contributed to the creation of a bubble in industrial metals and in hydrocarbons. Now is not an opportune time to invest passively in the commodity markets. On the other hand, price excesses are one of the inefficiencies that may benefit active commodity strategies.

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