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PERSPECTIVES

Conquering Misperceptions about Commodity Futures Investing

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Long-only commodity futures returns have been very disappointing over the last decade, leading some to wonder whether investing in commodities was a mistake. The poor performance is largely the result of poor "income returns," a return building block similar to a stock's dividend yield or a bond's yield. Three misperceptions have contributed to this disappointment: (1) Commodities are a play on commodity prices, (2) commodity prices provide an inflation hedge, and (3) commodity markets, which are smaller than Facebook's market capitalization, can absorb abundant capital. Learning from mistakes and conquering misperceptions are key to becoming a better investor.

The last 10 years have been challenging for many long-only commodity futures investors, giving many a reason to question whether a "bad" investment strategy drove a bad outcome or a "good" strategy experienced an unlucky outcome. Picking up roughly where Gorton and Rouwenhorst (2006) and Erb and Harvey (2006) ended their analyses of commodity returns, **Table 1** provides some perspective on the performance of widely used indexes of stocks, bonds, and commodities.[1] For instance, from December 2004 to June 2015, the total return of the S&P GSCI commodity index was –4.6% a year, much lower than the +7.4% return of the S&P 500 Index and the +4.5% return of the Barclays US Aggregate Bond Index. The key driver of the poor S&P GSCI performance was a –8.0% income return (the Bloomberg Commodity Index, another widely used commodity index, also had low total and income returns[2]). Buffett (1988) noted that "as they say in poker, if you've been in the game 30 minutes and do not know who the patsy is, you're the patsy." Whether it is equally difficult to forecast price and income returns for stocks, bonds, and commodities is debatable. Nonetheless, to avoid the impact of outcome bias linking past performance to the value of a strategy or the cognitive dissonance of ignoring past performance in favor of personally held beliefs, investors must correctly forecast the drivers of total return or risk ending up as patsies.[3]

Many investors may find it hard to contemplate what a –8.0% income return means. For the S&P 500, the income return would be equivalent to a –8.0% dividend yield (shareholders would be paying to own stocks). For the Barclays US Aggregate Fixed Income Index, the income return would be roughly equivalent to investing in bonds with a yield of –8.0% (bondholders would be paying interest to own bonds). One way to think about a –8.0% commodity income return is that commodity index investors paid 8.0% a year to "own" commodities. Each of these income returns can also be viewed broadly as a more general "carry return": "the income you earn if the price stays the same over the holding period" and a "model-free measure of the risk premium in a given asset class" (Koijen, Moskowitz, Pedersen, and Vrugt 2015, p. 1).[4] It may be appealing to want, or expect, commodity income returns to be positive, but negative income returns are clearly possible with commodity futures (just as negative income returns are currently possible with some German and Swiss sovereign bonds).

So, what is the income return for a commodity portfolio? As **Table 2** illustrates with the decomposition of the total return of the S&P GSCI commodity index,[5] a commodity income return can be viewed as the sum of a collateral return (in this case, the three-month Treasury bill) and a roll return (the cost, or benefit, of staying invested in futures contracts over time). For example, from December 2004 to June 2015, the three-month T-bill had an annualized return of about 1.3% and the S&P GSCI had an

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Table 1. Decomposing Total Returns: Stocks, Bonds, and Commodities, December 2004–June 2015

Decomposition	S&P 500	Barclays US Aggregate	S&P GSCI	Bloomberg Commodity
Price return	5.20%	0.43%	3.39%	5.47%
Income return	2.22	4.04	–7.97	–7.39
Total return	7.41%	4.47%	–4.58%	–1.92%

Source: Bloomberg.

Table 2. The Drivers of Commodity Futures Index Returns

Component	In Sample, January 1970–December 2004		Out of Sample, December 2004–June 2015		Overall, January 1970–June 2015		Difference, Out of Sample – In Sample	
Treasury bill	6.78%		1.32%		5.39%		–5.47%	
Roll return	1.95%		–9.29%		–0.76%		–11.24%	
Income return		8.74%		–7.97%		4.64%		–16.71%
Inflation (CPI)	4.75%		2.07%		4.12%		–2.68%	
Real price return	–1.52%		1.32%		–0.85%		2.84%	
Price return		3.23%		3.39%		3.27%		0.16%
Total return		11.97%		–4.58%		7.91%		–16.55%

Source: Bloomberg (based on the S&P GSCI).

annualized roll return of about –9.3% (suggesting an income return of –8.0%). The commodity income return can be thought of informally as the "dividend return" of a collateralized commodity futures portfolio. From January 1970 to the end of 2004, its annual income return was 8.7%. Clearly, income returns, roll returns, and T-bill returns are not constant, and thus history can be a poor guide to the future.

Erb and Harvey (2006) offered an example of decomposing the total return of a commodity portfolio into three return drivers: a price return, a roll return, and a collateral return.[6] Although roll returns may be instructive for understanding commodity futures returns, roll returns are not unique to commodities or commodity futures.[7] Strategies that combine collateral with stock or bond futures also have the same three return drivers: a price return, a roll return, and a collateral return. The roll return is a characteristic of any collateralized futures strategy, not just a commodity futures strategy. For collateralized stock and bond futures portfolios, the roll return and the collateral return sum to the income return. Although stock and bond roll returns exist, they are generally ignored. If the roll return and the collateral return for collateralized stock and bond portfolios sum to the income return, the roll return and the collateral return of a collateralized commodity futures portfolio sum to the income return. This process of summing is not limited to the income return. As Table 2 shows, the price return can be thought of as the sum of the rate of inflation and a real price return (other decompositions are, of course, possible). Although it may seem obvious to some, stock, bond, and commodity investors cannot ordinarily invest separately in the building block returns of total return, such as price, income, and roll returns.

There are at least two ways to explore commodity price and income returns. The first is to look at the returns of traded commodity indexes, such as the S&P GSCI and the Bloomberg Commodity Index, which publish total return, excess return, and price return indexes as defined in substantial index methodology documents.[8] In addition, time series of these indexes are downloadable. The details of the construction of a total return index (excess return plus collateral return), an excess return index (price return plus roll yield, also known as roll return), and a price index (used to produce price returns)—all appropriately weighted by a well-defined portfolio construction scheme—are laid out in a way intended to promote trade and limit legal frictions.

There are many details in an index methodology, including the weighting of different contracts and the mechanics of rolling from one contract to the next. Index trading days can be divided into nonroll days and roll days. On nonroll days, the excess return of a commodity index, such as the S&P GSCI, equals its price return. On roll days, the index excess return equals the index price return plus an adjustment for rolling from one futures contract to another (the roll return, also called roll yield, is positive when two contracts are in backwardation, negative when two contracts are in contango, and zero when the term structure between two contracts is unchanged or flat).[9] "Rolling" from one contract to another does

not have any cash flow implications for investors, although it does trigger an accounting-like recognition of price and roll returns. Although some investors may focus on tracking "spot" commodity prices, there is no reason to expect a commodity futures price index to track spot prices given the way commodity futures indexes are constructed.

A second way to examine price and income returns is much more problematic. It entails researchers' selecting their own universe of commodities (which may or may not overlap with the universes that investors are exposed to in actually traded indexes), contract roll method, contract selection methodology, and portfolio-weighting scheme. Unlike the world of daily priced and updated professional indexes, these one-off research ("roll your own") commodity indexes are rarely supported by well-developed index methodology documents and may not have readily available and downloadable total return, excess return, and price indexes.

There are at least two schools of thought regarding the value of decomposing commodity index returns into their constituent returns. At least superficially, the differences in opinion can be attributed to dissatisfaction with or acceptance of what might ambitiously be called John Maynard Keynes's theory of "normal backwardation." Arnott, Chaves, Gunzberg, Hsu, and Tsui (2014, p. 54) found that decomposing commodity futures excess returns into price and roll returns "offers important insights into the characteristics and performance of commodity indexes." Focusing on perceived recent unattractive commodity performance and the reasons for that performance, they noted that "while Keynes may have predicted positive roll yields for the last quarter-century, they've been more the exception than the rule." Goldman Sachs (2016), which sold the GSCI to S&P in 2007, has a public webpage stating that S&P GSCI returns cannot be decomposed into their constituent returns. Goldman Sachs researchers Shemilt and Unsal (2004, p. 1) observed that the "GSCI historically has had high equity-like returns" and suggested that this performance might be driven by the "supply and demand for risk capital" and "the Keynes argument." Of course, investors often face situations in which differences of opinion exist. For instance, many investors have differing opinions about the efficiency or inefficiency of markets and the rationality or irrationality of investor behavior. Thus, it is not surprising that within the microcosm of commodity futures investment, differences of opinion exist and investors need to know which opinions matter for them and why. As Buffett (1983) noted, "Don't ask the barber whether you need a haircut."

What has been driving commodity portfolio returns? Focusing on the investable commodity index with the longest performance history, the S&P GSCI, **Table 3** reports correlations for the rolling 10-year returns of the drivers of the S&P GSCI. What has been driving commodity "total" returns? Interestingly, the first row shows that, historically, there has been little correlation between total return and price return (–0.07), a high correlation between total return and income return (0.73), and a positive correlation between total return and inflation (0.55). What has been driving commodity "price" returns? The third row shows that price returns have historically been negatively correlated with income returns (–0.73), roll returns (–0.71), collateral returns (–0.63), and inflation (–0.26). What has been driving "income" returns? The fourth row shows that income returns have historically been positively correlated with roll returns (0.97), collateral returns (0.87), and inflation (0.55). Finally, what are the commodity return components' correlations with inflation? The seventh row shows that inflation has been negatively correlated with price returns (–0.26) and positively correlated with income returns (0.55), roll returns (0.36), and collateral returns (0.83). In a broad sense, Table 3 suggests (1) a weak link between commodity price returns and commodity total returns, (2) a negative link between inflation and commodity price returns, (3) a positive link between commodity income returns and commodity total returns, (4) a positive link between inflation and commodity income returns, and (5) a negative link between income returns and price returns.

How representative, or misleading, a guide of historical returns is the S&P GSCI? Using the value of futures contract open interest,[10] Erb and Harvey (2006) noted that in 2004, as a measure of popularity and seeming familiarity, the S&P GSCI had 86%

Table 3. Correlations of 10-Year Returns with S&P GSCI Return Drivers, January 1970–June 2015

	Total Return	Excess Return	Price Return	Income Return	Roll Return	T-Bill	Inflation Rate
Total return	1.00	0.85	–0.07	0.73	0.71	0.64	0.55
Excess return	0.85	1.00	0.34	0.35	0.43	0.14	0.15
Price return	–0.07	0.34	1.00	–0.73	–0.71	–0.63	–0.26
Income return	0.73	0.35	–0.73	1.00	0.97	0.87	0.55
Roll return	0.71	0.43	–0.71	0.97	1.00	0.71	0.36
T-bill (collateral)	0.64	0.14	–0.63	0.87	0.71	1.00	0.83
Inflation rate	0.55	0.15	–0.26	0.55	0.36	0.83	1.00

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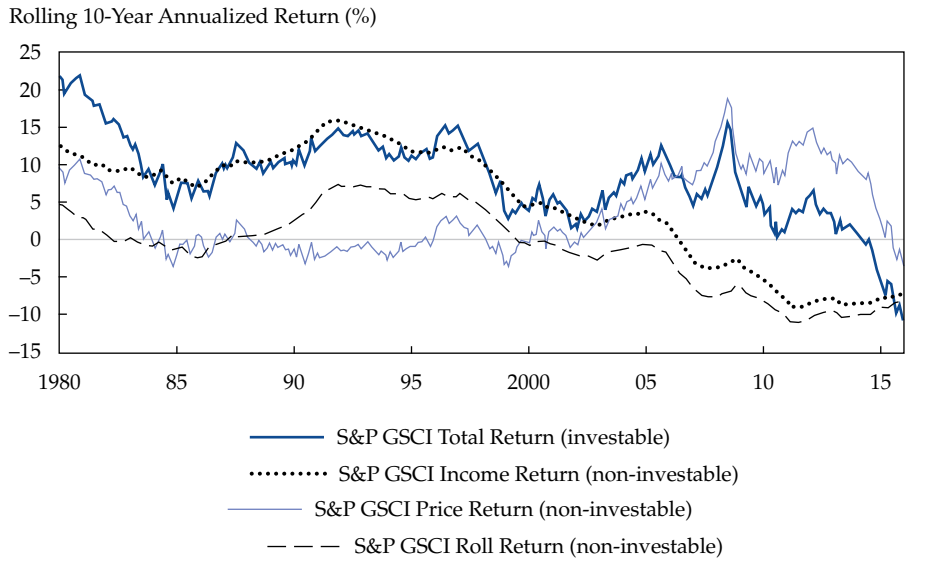
of combined commodity index futures open interest value, the Bloomberg Commodity Index accounted for 10% of open interest value, and the Commodity Research Bureau Index made up the remaining 4% of open interest value. **Figure 1** depicts the rolling 10-year total, price, income, and roll returns for one of the most popular commodity indexes in 2004, the S&P GSCI. Although not shown here in the interest of brevity, the results for the (shorter) history of the Bloomberg Commodity Index are essentially the same.[11] The difference between the income returns and the roll returns is simply the T-bill collateral return embedded in the calculation of the two income return time series. Rolling 10-year total, price, income, and roll returns for the two indexes are largely the same over the common sample.[12] Total, income, and roll returns declined over time. The fact that the performances of the return drivers of both the S&P GSCI and the Bloomberg Commodity Index have been similar suggests that if one of the indexes is a real or acceptable commodity index, so is the other.[13]

That the out-of-sample performance of the "newer" Bloomberg Commodity Index echoes the performance of the "older" S&P GSCI is consistent with the idea that there is no compelling out-of-sample evidence of a new investment product "free lunch"—that is, a newer commodity index with an inherent performance edge relative to an older commodity index.[14] Since 2004, many new commodity indexes have been launched—for example, the UBS Bloomberg CMCI (Constant Maturity Commodity Index), the Credit Suisse Commodity Benchmark, and the Dow Jones RAFI Commodity Index—turning in impressive backtested total and income return performances relative to older commodity indexes. Focusing on the possibility that "newer might be better," Brightman, Li, and Liu (2015, p. 2) constructed an exchange-traded fund (ETF) strategy "event study"; after chasing the performance of backtested investment strategies, they concluded that "disappointing subsequent performance is inevitable."[15]

There are at least two opposing views that attempt to explain the decline in both income and roll returns. The first view, offered by Bhardwaj, Gorton, and Rouwenhorst (2015), is that there is no difference between pre-2004 commodity performance and post-2004 commodity performance. Their view is illustrated by looking at the performance of a hypothetical, equally weighted paper portfolio created by Gorton and Rouwenhorst (2006). This paper portfolio embeds a common smart beta strategy: rebalancing an equally weighted portfolio every month.[16] Working with an intuition that commodity futures markets are risk-transfer insurance markets for commodity hedgers,[17] Bhardwaj et al. (2015) found no evidence that an influx of long-only financial commodity investors over the last decade has affected the historical or prospective returns of their hypothetical paper portfolio. Summing up the impact of the last decade, they found that "the risk premium has been comparable to its long-term historical average" (p. 22).

Arguing that the hypothetical paper portfolio of Gorton and Rouwenhorst (2006) "is not a viable option for most investors," Norrish (2015a, p. 2) offered an alternative view—namely, that over the last decade, an influx of long-only financial investors has lowered returns significantly for actual and tradable long-only commodity indexes.[18] Echoing the

Figure 1. Commodity Total, Income, Price, and Roll Returns Have Been Positive and Negative, January 1970–June 2015



view that commodity futures markets can be seen as price insurance markets, Norrish (2015a) observed that there has been too much long-only insurance capital chasing too few insurance opportunities. If too much insurance-inspired capital has lowered returns, a contraction in insurance-inspired capital might increase returns. It is also possible to see this as an example of "adaptive markets," reflecting "the evolutionary dynamics of financial markets and investor behavior across time and circumstances" (Lo 2012, p. 28). The debate over whether both income and roll returns have declined is a bit Rashomonesque—seemingly presenting contradictory interpretations of the same historical data. What matters for investors, however, is to learn from the performance of the investment choices they actually have and not from the performance of paper portfolios they never invested in.

Two Oracles

Consider the following thought experiment. Suppose that in January 1970, an investor wants to forecast the rolling 10-year total returns of the S&P GSCI and must choose between two oracles: a price return oracle and an income return oracle. The first oracle knows the future 10-year price returns of the S&P GSCI. The second oracle knows the future 10-year income returns of the S&P GSCI. Neither oracle knows what the future 10-year total returns will be, and each oracle acts independently of the other. Obviously, if the investor had access to both forecasts, it would be possible to forecast the S&P GSCI total returns perfectly.

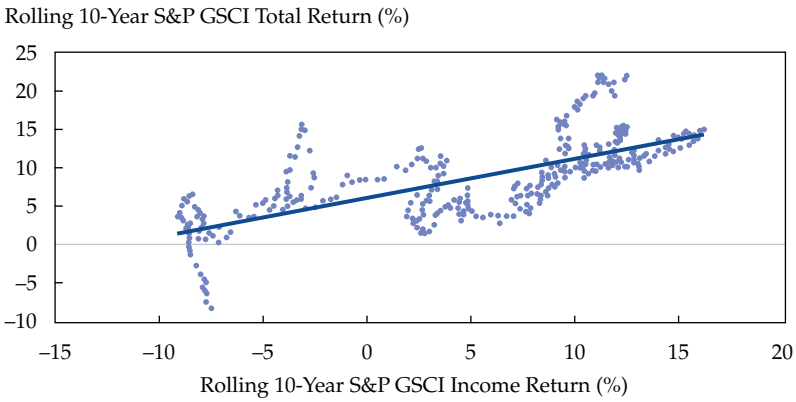
Suppose that the investor chooses the income return oracle and thus knows, month by month, all the 10-year income returns from January 1970 to the present. How well have these perfect forecasts of future income returns lined up with the actual 10-year *total* returns of the S&P GSCI? **Figure 2** provides an answer. The dots represent each possible pair of 10-year income returns and 10-year total returns. The solid line is a regression line showing the best-fit prediction of total return given a perfect forecast of income returns. Income returns explain about 54% of the time-series variability in total return.[19]

Figure 2 illustrates the seemingly obvious idea that having perfect foresight of future income returns, though they are impossible to achieve, should be of some value in predicting S&P GSCI total returns. Given that commodity futures investors are unlikely to have a clairvoyant oracle and at best have a limited understanding of commodity futures term structures and income returns, Figure 2 merely represents an unattainable ideal. If income returns explain 54% of S&P GSCI total return variability, do price returns explain the other 46%?

Let us return to our thought experiment with the two oracles. Now suppose that the investor chooses the oracle that foretells S&P GSCI price returns. As Ritholtz (2015) showed, going-nowhere or falling commodity prices are commonly believed to be one reason for disappointing historical commodity returns. **Figure 3** depicts the ability of clairvoyant 10-year S&P GSCI price return forecasts to explain the variability of 10-year S&P GSCI total returns.

The solid line and the R^2 of approximately 0% suggest the absence of a significant linear relationship between perfect price return forecasts and total returns for the S&P GSCI (this finding is robust to using nonoverlapping price and total returns).[20] For an investor who believes there should be a powerful relationship between the price return of a commodity futures portfolio and its total return, this result may seem unwelcome and preposterous. There is nothing

Figure 2. Historically Perfect Foresight of Commodity Income Returns Has Been Helpful, June 1970–June 2015



Note: Total return = 0.06 + 0.51 × Income return; R^2 = 0.54.

Source: Bloomberg (overlapping monthly observations).

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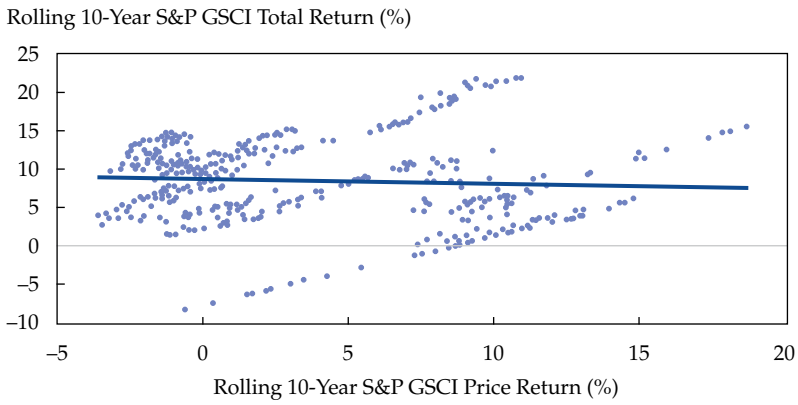
Figure 3. Historically Perfect Foresight of Commodity Price Returns Has Not Been Helpful, January 1970–June 2015



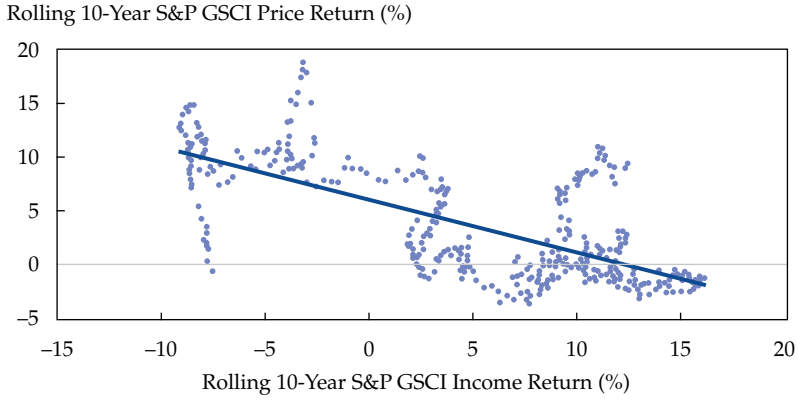
Note: Total return = 0.09 – 0.06 × Price return; R^2 = 0.004.
Source: Bloomberg (overlapping monthly observations).

wrong with rejecting the message of Figure 3 that there seems to be little historical connection between price returns and total returns. Figure 3 is simply an expression of what actually happened to the most widely used commodity index in the past.

One can look at Figure 3 and see vague clusters of returns that speak to the possible existence of two, three, or even more total return–price return correlation regimes. Possible regimes include the oil price shock of the 1970s, the Volcker inflation fix, and the period following the global financial crisis. One challenge in focusing on changing regimes is that this approach is prone to narrative fallacy because no one knew about the existence of, or the labels that would be applied to, these regimes before they happened. Of course, the existence of multiple total return–price return correlation regimes means that there is no single, stable total return–price return relationship and that precisely identifying future total return–price return correlation regimes is critical. Or perhaps the desire to reject historical evidence in favor of personal beliefs is a manifestation of cognitive dissonance. Taken as is, Figure 3 presents the message that the S&P GSCI was not a good way to capture S&P GSCI commodity price moves. If perfect forecasts of income returns explain 54% of total return variability and perfect forecasts of price returns explain about 0% of total return variability, what is the missing link that drives the other 46% of total return variability?

Figure 4 shows that S&P GSCI price returns and income returns have historically been negatively correlated. It illustrates what might be called the "Croesus problem," in which foresight does not mean what one hopes it means, and hints at why the relationship between S&P GSCI total returns and

Figure 4. Historically High Commodity Income Returns Associated with Low Price Returns, January 1970–June 2015



Note: Price return = 0.06 – 0.49 × Income return; R^2 = 0.52.
Source: Bloomberg (overlapping monthly observations).

S&P GSCI price returns has been so slight. Croesus was the king of Lydia who asked the Oracle of Delphi whether he should go to war with Persia. The oracle responded, "If Croesus goes to war, he will destroy a great empire." Unfortunately for Croesus, Lydia went to war with Persia and Lydia lost to Persia. The oracle was correct, but Croesus assumed that he understood the mutterings of the oracle. For the investor who received the oracular price return forecasts, the Croesus problem was the assumption that price returns by themselves mattered. The solid line shows that an income return of about 12% is associated with a price return of about 0% and an income return of –8% is associated with a price return of about 10%. Is Figure 4 an example of investors' behavioral errors, which could possibly be corrected in the future? If past behavioral errors are corrected, will they be replaced by different behavioral errors in the future or by some semblance of "the truth"? Could there be another explanation?

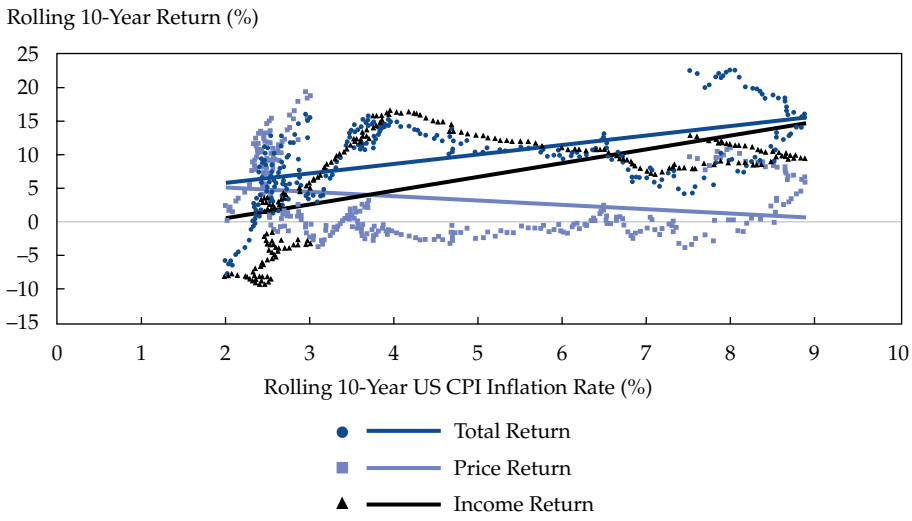
One question might be, "Other than odd investor behavior, why has there been a negative correlation between price returns and income returns?" A tentative answer might be found in the "carry" literature. The early carry literature focused on foreign exchange rates and their relationship to differences in interest rates between two countries. A concept called "uncovered interest rate parity" suggests that to avoid an economic free lunch, the difference in interest rates between two countries—the carry—should be offset by an opposite change in the value of an exchange rate. For instance, if country A's interest rate is 10% and country B's interest rate is 5%, the idea of no free lunch suggests that country A's currency should be devalued by 5% relative to country B (uncovered interest rate parity holds that the correlation between income returns and price returns should be –1.0). Koijen et al. (2015) found evidence that for many investments (e.g., equities, bonds, and commodities), there seems to be a free lunch in that income return differences are not offset completely by price return differences. Figure 4 shows that for the S&P GSCI, the trade-off between income returns and price returns is close to the trade-off suggested by uncovered interest rate parity. From a carry perspective, the income return can be viewed broadly as a risk premium, albeit a risk premium subject to a possibly offsetting price return.

Commodities and Inflation

A frequently advanced reason for investing in commodities is that commodity total returns are supposed to be an inflation hedge.[21] But what does that mean? For example, Treasury Inflation-Protected Securities (TIPS) are viewed as an inflation hedge because they pass through realized and "unexpected" inflation; nominal bonds are not an inflation hedge because they do not pass through realized and unexpected inflation. If one characteristic of an inflation hedge is that it passes through realized inflation, how well have commodities passed through realized inflation?[22]

Figure 5 depicts the source of the historical link between rolling 10-year realized inflation and S&P GSCI total returns. It shows that S&P GSCI price returns are negatively correlated with realized

Figure 5. Historically Perfect Foresight of Inflation Has Been a Mixed Bag, January 1970–June 2015



Notes: Total return = –0.03 + 2.0 × Inflation rate; R^2 = 0.31. Income return = 0.03 + 1.36 × Inflation rate; R^2 = 0.30. Price return = 0.06 – 0.63 × Inflation rate; R^2 = 0.07.

Source: Bloomberg (overlapping monthly observations).

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inflation and that both income returns and total returns are positively correlated with realized inflation. Table 3 shows that inflation is positively correlated with the constituents of income returns (the collateral returns and roll returns). If an investor expects commodity price returns to be the driver of a positive correlation between commodity total returns and inflation, Figure 5 is probably disconcerting. It is unlikely that many investors have tied their "commodities are an inflation hedge" bet to the existence of a positive correlation between income returns and inflation. Viewing commodity income returns as a carry-inspired proxy for a commodity risk premium, the observed positive correlation between inflation and income returns suggests that the higher the rate of inflation, the higher the commodity risk premium and that the lower the rate of inflation, the lower the commodity risk premium.

This negative relationship between realized inflation and commodity price returns echoes a finding by Erb and Harvey (2013) that historically, the 10-year total return of gold, sometimes viewed as a commodity and sometimes as a currency, has largely been driven by the 10-year real price return of gold and not the 10-year rate of inflation. Thus, gold has been a poor hedge of 10-year inflation. The strongest support for the idea that commodities, in general, and gold, in particular, are inflation hedges comes from a belief that reported measures of inflation are seriously flawed and that the flawed inflation measures do not capture the true covariation of commodity returns with inflation.

Commodity Asset Allocation

How much should be invested in commodities? There is no one answer because an answer depends on investor perspective. Some argue for a tactical approach, and others suggest a strategic, permanent allocation. Erb and Harvey (2006) viewed commodities as a tactical opportunity that made sense if commodities had attractive prospective returns relative to other investments. Bhardwaj and Janardanan (2014, p. 128) suggested that for long-only portfolios, a "5%–10% allocation is commonly used by practitioners" and that the optimal allocation to commodities in a risk parity portfolio is 18%.[23] Gorton (as quoted in Authers and Meyer 2015) also took a strategic approach, noting that "I think you should always have exposure to commodity futures if you're a large investor." Idzorek (2006) focused on strategic asset allocation and, using a number of ways to estimate capital market returns, found that "optimal" allocations to commodities are about 10% for "conservative" portfolios, 25% for "moderate" portfolios, and 19% for "aggressive" portfolios.

It is possible that all assets are owned by someone, somewhere. Sharpe (2010) looked at "adaptive asset allocation" and noted that the tactical and strategic asset allocations of all asset owners must add up to the value of all the assets available to all asset owners. This concept, which Sharpe called "macro-consistency," poses a challenge for commodity investments. **Table 4** suggests that the total value of stock, bond, and commodity investments is about $110 trillion (as of October 2015). Stocks account for a little more than 58% of the total. The Barclays Multiverse, which includes the value of the Barclays Global Aggregate Bond Index and global high-yield bonds, accounts for more than 41% of the total.[24] Commodities account for 0.22% of the total, or about $240 billion.[25] Note that the total market value of commodity investments is less than the market capitalization of Facebook. Interestingly, from the perspective of trend-following managed futures investors, Hurst, Ooi, and Pedersen (2014) estimated the "size" of the commodity market to be $2.3 trillion. This estimate highlights that the "size" of an investment market may or may not be similar to the amount of money actually "invested" in that market. A 10% allocation to commodities would require shifting about $10 trillion into commodities, and a 20% commodity allocation would require about a $20 trillion exposure. Currently, the total investment in commodities is an asset allocation rounding error. In terms of macro-consistency, it is impossible for investors large and small to collectively allocate 5%, 10%, or 20% to commodities.

Conclusion

Price returns and income returns drive the total returns of commodities, stocks, and bonds. Knowing this decomposition does not make it easy to forecast price returns and income returns. Buffett (1997) expressed his view that knowing one's investing "circle of competence" is important—that is, investing in what one understands and avoiding what one does not understand. Commodities are within the circle of competence of some investors and outside the circle of competence of others. For instance, some investors have a good idea of what commodity income and price returns will be over the next 10 years. The

Table 4. Macro-Consistency and Asset Allocation

	Market Value ($ trillions)	Share
Bloomberg Global Equity	64.80	58.46%
Barclays Multiverse	45.80	41.32
Commodities	0.24	0.22
Total	110.84	100.00%
Facebook market capitalization	0.29	

Sources: Bloomberg; Norrish (2015a).

appeal of commodities for investors is unlikely to reside in easy misperceptions that commodities are an inflation hedge, a portfolio diversifier, or a source of a "risk-transfer" risk premium. As Charlie Munger observed to Howard Marks (2015) on the subject of being a successful investor, "It's not supposed to be easy. Anyone who thinks so is stupid." The last decade's poor commodity performance has not changed the fact that commodity total returns are driven by both price returns and income returns. We hope that our research helps investors conquer key misperceptions about investing in commodities and thereby avoid the mistakes of the past.

We appreciate the comments of Stephen Brown, Barbara Petitt, and two anonymous referees.

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Notes

1. For many investors, "investing in commodities" often means "investing in a portfolio of collateralized commodity futures." A collateralized commodity portfolio could consist of commodity futures or swaps and collateral (T-bills, notes, and bonds are common choices).
2. The Bloomberg Commodity Index (Bloomberg Commodity Index Total Return ticker: BCOMTR) was originally called the Dow Jones-AIG Commodity Index and was later renamed the Dow Jones-UBS Commodity Index.
3. See endnote iii in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
4. See also Bhansali, Davis, Dorsten, and Rennison (2015). Asness, Ilmanen, Israel, and Moskowitz (2015) defined a carry return as "the return achieved if prices do not change."
5. The total return of the S&P GSCI is the return on a collateralized (with an embedded three-month T-bill return) futures portfolio. The Bloomberg tickers for the various S&P GSCI indexes that we used in our study are SPGSCITR (S&P GSCI Total Return Index), SPGSCIP (S&P GSCI Excess Return Index), and SPGSCI (S&P GSCI Spot Index). The Bloomberg tickers for the various Bloomberg commodity indexes we used are BCOMTR (Bloomberg Commodity Index Total Return), BCOM (Bloomberg Commodity Index Excess Return), and BCOMSP (Bloomberg Commodity Spot Index).
6. See endnote vi in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
7. See endnote vii in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
8. The S&P GSCI methodology document is about 70 pages long, and the Bloomberg Commodity Index methodology document is around 100 pages. See S&P GSCI Index Methodology (2016) and Bloomberg Commodity Index Methodology (2016).
9. The price return is the return of a published price index, which is not an investable index. Depending on the index, the price return may be a "spot" price return or some other price return. In a commodity futures index, price return may be well defined but there is typically no well-defined spot price.
10. Open interest is the number of derivative contracts (futures, options, etc.) outstanding at any given time. The value of open interest is the number of open derivative contracts times the price of the contracts.
11. For the two indexes, the correlation of rolling 10-year total returns was about 0.95, the correlation of rolling 10-year price returns was about 0.97, the correlation of rolling income returns was around 0.99, and the correlation of rolling roll returns was about 0.99.
12. The Bloomberg Commodity Index may benefit from a rebalancing return (see Erb and Harvey 2006), though "may" does not mean "did" or "will." For some perspective on the nuances and possible impact of rebalancing returns, see Greer (2000); Granger, Greenig, Harvey, Rattray, and Zou (2014); Ilmanen and Maloney (2015).
13. Arnott et al. (2014) examined the performance of three commodity indexes (the S&P GSCI, the Bloomberg Commodity Index, and a Research Affiliates commodity index) and found that although price returns were fairly similar, roll and income returns varied among the indexes.
14. One challenge in comparing the out-of-sample/since-going-live performances of many commodity indexes is that the common time span for "old" and "new" commodity indexes is dictated by the start date of the index with the shortest live performance history. Brightman, Li, and Liu (2015) expressed the view that "new" ETFs have "above average" backtested returns that look attractive but that have average out-of-sample performance.
15. See also Harvey and Liu (2015).
16. Erb and Harvey (2006) suggested that the rebalancing return of an equally weighted, monthly rebalanced commodity portfolio might be as high as 4% a year, which implies that it is important to distinguish between the possible payoff to a rebalancing strategy and the possible false discovery of a "risk premium." Greer (2016) argued that the Bloomberg Commodity Index might have a rebalancing return of roughly 3% a year. See also endnote xvi in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
17. See endnote xvii in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
18. Norrish (2015a) noted that the Gorton and Rouwenhorst (2006) paper portfolio allocates as much to butter as to crude oil, though the butter futures market is minuscule compared with the oil futures market. Another nuance is that when investors interact with markets, they affect prices. When a paper portfolio pretends to interact with markets, it does not affect prices.
19. See endnote xviiii in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
20. See endnote xx in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
21. Actual inflation = Expected inflation + Unexpected inflation.
22. See endnote xxii in the unabridged version of this article at http://papers.ssrn.com/abstract=2645444.
23. Chaves (2014, p. 1) took a strategic approach, noting that "commodities have special characteristics that make them ideal candidates to receive at least a small allocation in every investor's portfolio."
24. Although macro-consistency is an interesting idea, it may not be easy to agree on the size of an investment opportunity. For instance, PIMCO (2015) observed that "bonds have evolved into a $100 trillion global marketplace," twice the size of the Barclays Multiverse.
25. See Norrish (2015b). See also data from the Commodity Futures Trading Commission (http://www.cftc.gov/marketreports/indexinvestmentdata/index.htm).

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References

Arnott, Robert, Denis Chaves, Jodie Gunzberg, Jason Hsu, and Peter Tsui. 2014. "Getting Smarter about Commodities." *Journal of Indexes* (November/December): 52–60.

Asness, Clifford S., Antti Ilmanen, Ronen Israel, and Tobias Moskowitz. 2015. "Investing with Style." *Journal of Investment Management*, vol. 13, no. 1 (First Quarter): 27–63.

Authers, John, and Gregory Meyer. 2015. "Investment: Revaluing Commodities." *Financial Times* (3 June): http://www.ft.com/intl/cms/s/0/a6ff2818-094c-11e5-8534-00144feabdc0.html#slide0.

Bhansali, Vineer, Josh Davis, Matt Dorsten, and Graham Rennison. 2015. "Carry and Trend in Lots of Places." *Journal of Portfolio Management*, vol. 41, no. 4 (Summer): 82–90.

Bhardwaj, Geetesh, Gary B. Gorton, and K. Geert Rouwenhorst. 2015. "Facts and Fantasies about Commodity Futures Ten Years Later." Working paper (25 May).

Bhardwaj, Geetesh, and Rajkumar Janardanan. 2014. "Commodities in a Risk-Parity Portfolio." *Journal of Indexes* (November/December): 58–61.

Bloomberg Commodity Index Methodology. 2016. Bloomberg (April): http://www.bloombergindices.com/content/uploads/sites/2/2016/05/BCOM-Methodology-April-2016.pdf.

Brightman, Chris, Feifei Li, and Xi Liu. 2015. "Chasing Performance with ETFs." Research Affiliates (November).

Buffett, Warren. 1983. "Chairman's Letter, 1982." Berkshire Hathaway (3 March): http://www.berkshirehathaway.com/letters/1982.html.

———. 1988. "Chairman's Letter, 1987." Berkshire Hathaway (29 February): http://www.berkshirehathaway.com/letters/1987.html.

———. 1997. "Chairman's Letter, 1996." Berkshire Hathaway (28 February): http://www.berkshirehathaway.com/letters/1996.html.

Chaves, Denis. 2014. "Go for the Gold: Commodities and Inflation." Research Affiliates (October).

Erb, Claude B., and Campbell R. Harvey. 2006. "The Strategic and Tactical Value of Commodity Futures." *Financial Analysts Journal*, vol. 62, no. 2 (March/April): 69–97.

———. 2013. "The Golden Dilemma." *Financial Analysts Journal*, vol. 69, no. 4 (July/August): 10–42.

Goldman Sachs. 2016. "S&P GSCI Components and Weights." Goldman Sachs (http://www.goldmansachs.com/what-we-do/securities/products-and-business-groups/products/gsci/components-weights-index-levels.html).

Gorton, Gary B., and K. Geert Rouwenhorst. 2006. "Facts and Fantasies about Commodity Futures." *Financial Analysts Journal*, vol. 62, no. 2 (March/April): 47–68.

Granger, Nicholas M., Douglas Greenig, Campbell R. Harvey, Sandy Rattray, and David Zou. 2014. "Rebalancing Risk." Working paper (3 October).

Greer, Robert J. 2000. "The Nature of Commodity Index Returns." *Journal of Alternative Investments*, vol. 3, no. 1 (Summer): 45–52.

———. 2016. "Portfolio Rebalancing and Commodities: The Whole Is Greater Than the Sum of Its Parts." J.P. Morgan Center for Commodities (http://jpmcc-gcard.org/wp-content/uploads/2016/02/GCARD_Scholar_Section_Spring_2016_v2.pdf).

Harvey, Campbell R., and Yan Liu. 2015. "Backtesting." *Journal of Portfolio Management*, vol. 42, no. 1 (Fall): 13–28.

Hurst, Brian, Yao Hua Ooi, and Lasse H. Pedersen. 2014. "A Century of Evidence on Trend-Following Investing." AQR (Fall): https://www.aqr.com/~/media/files/papers/aqr-a-century-of-trend-following-investing.pdf.

Idzorek, Thomas M. 2006. "Strategic Asset Allocation and Commodities." Ibbotson Associates, commissioned by PIMCO (27 March).

Ilmanen, Antti, and Thomas Maloney. 2015. "Portfolio Rebalancing: Strategic Asset Allocation (Part 1 of 2)." AQR (December).

Koijen, Ralph S.J., Tobias J. Moskowitz, Lasse Heje Pedersen, and Evert B. Vrugt. 2015. "Carry." Working paper (4 August).

Lo, Andrew W. 2012. "Adaptive Markets and the New World Order." *Financial Analysts Journal*, vol. 68, no. 2 (March/April): 18–29.

Marks, Howard. 2015. "It's Not Easy." Oaktree Capital Management memo (9 September).

Norrish, Kevin. 2015a. "Numbers and Nightmares." Barclays Commodities Research (15 June).

———. 2015b. "Commodity Investor." Barclays Commodities Research (2 October).

PIMCO. 2015. "Everything You Need to Know about Bonds." PIMCO (www.pimco.com/en-us/resources/education/everything-you-need-to-know-about-bonds).

Ritholtz, Barry. 2015. "Why Commodities Are Back in the 1990s." *BloombergView* (1 October).

Sharpe, William F. 2010. "Adaptive Asset Allocation Policies." *Financial Analysts Journal*, vol. 66, no. 3 (May/June): 45–59.

Shemilt, H., and S. Unsal. 2004. "The Case for Commodities as an Asset Class." Goldman Sachs (http://faculty.fuqua.duke.edu/~charvey/Teaching/BA453_2006/GSCI_Strategic_June_2004.ppt).

S&P GSCI Index Methodology. 2016. Standard & Poor's (http://us.spindices.com/documents/methodologies/methodology-sp-gsci.pdf).