

Commodity Insights

When the trend is your friend: Momentum in commodities

- Recent years have seen rising interest in factor investing among portfolio managers (Exhibit 1). Given the robust empirical evidence shown in academic literature on the momentum factor, we look into momentum investing in commodities with a focus on when and why such strategies work.
- We find that trend following, a simple time-series momentum strategy, can improve the Sharpe Ratio for a wide range of assets and commodities by increasing average returns and/or reducing return volatility. Different securities benefit from trend following to different degrees and from different sources. The gain for commodities is mainly from increased average returns and the gain for credit is mainly from reduced volatility.
- Researchers are not certain why momentum strategies work and the most common explanations relate to behavioral biases such as herding and under-reaction. For commodities, we think curve shapes play an important role. Commodities in persistent contango benefit the most from trend following by avoiding the negative carry. We also highlight the time-varying nature of momentum investing and the risk of crowding.

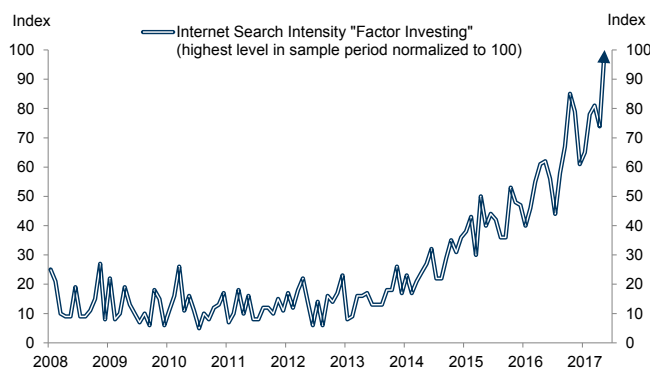
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Exhibit 1: Factor investing is trending



Source: Google, Goldman Sachs Global Investment Research

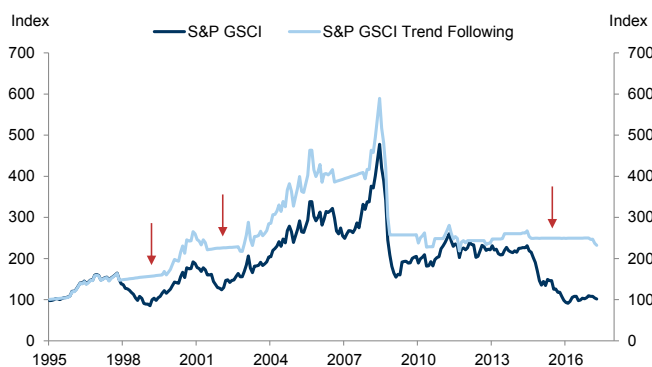
Momentum strategies—typically featuring being long the past “winners” and/or being short the past “losers”—have been shown to be profitable strategies across assets and regions.¹ In a world of rising interest in factor investing, momentum strategies have withstood the test of time and scrutiny. For example, in a recently released working paper, the entire anomalies literature in finance was replicated and 286 (65%) of the 447 anomaly variables were found to be insignificant.² However, momentum strategies survived the test. Given its empirical robustness, we take a close look at momentum in commodities in this *Commodity Insights*. Our analysis shows that commodities can benefit significantly from momentum investing although the gains are neither uniform across commodities nor constant over time.

Before diving into the analysis, it is first worth clarifying our methodology. While there are many ways to capture momentum, the strategy that we examine here is a simple “time-series” momentum that relies on a security’s own past returns rather than relative performance in a “cross-section”: trend following. Specifically, the rule is that the investor goes long the security in month t if the cumulative total returns from month $t-12$ to month $t-2$ are above cash (3-month Treasury bills). Otherwise, the investor holds cash in month t instead. Note that we follow the literature and skip the most recent month’s return to avoid potential microstructure and liquidity biases.³ We also restrict our sample period to January 1995-April 2017 for all assets to ensure that the findings for different securities are not driven by different sample periods.

Visualizing trend following

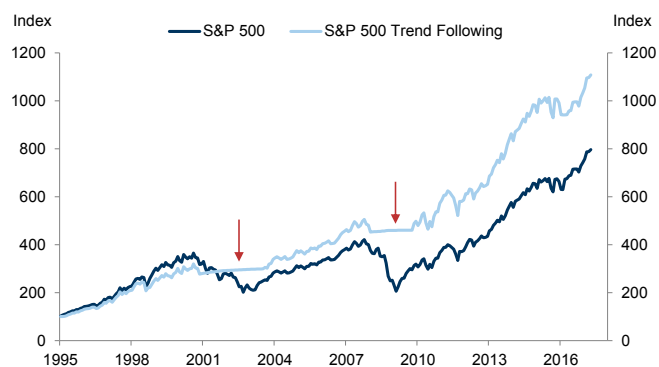
We first illustrate how exactly the momentum strategy described above improves returns. Exhibits 2 and 3 compare the total return indices when trend following is and is not employed for commodities (S&P GSCI) and equities (S&P 500) respectively. As highlighted by the arrows in these exhibits, the outperformance takes place when the index is moving down and the trend following strategy dictates holding cash.

Exhibit 2: Trend following increases returns of S&P GSCI



Source: Goldman Sachs Global Investment Research

Exhibit 3: Trend following increases returns of S&P 500



Source: Haver Analytics, Goldman Sachs Global Investment Research

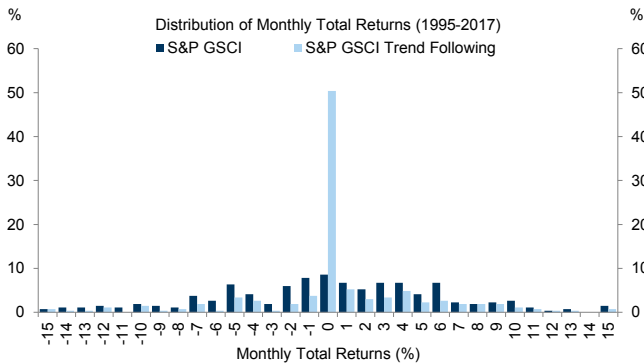
¹ See Moskowitz, Ooi and Pedersen, “Time series momentum,” *Journal of Financial Economics* 104(2), May 2012 for example.

² Hou, Xue and Zhang, “Replicating Anomalies,” NBER Working Paper #23394, May 2017.

³ See Asness, Frazzini, Israel and Moskowitz, “Fact, Fiction and Momentum Investing,” *Journal of Portfolio Management*, Fall 2014 for example.

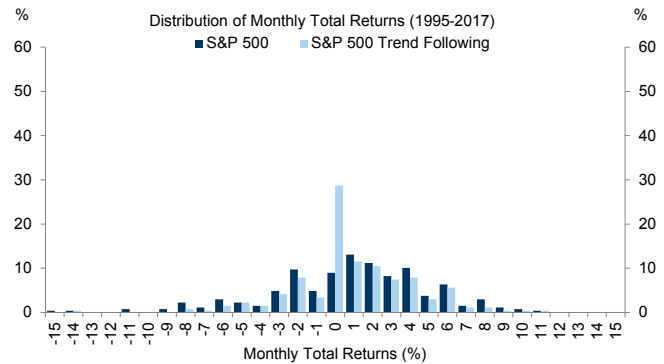
Another way to visualize the effect of trend following is to compare the distribution of monthly returns when trend following is and is not used (Exhibits 4 and 5). Two differences stand out: First, similar to the pattern shown in Exhibits 2 and 3 earlier, trend following results in a cluster of returns around 0% due to cash holding during downturns. Second, monthly returns have a narrower distribution when using trend following strategies. Less frequent negative returns come from avoiding continuation of declines in the index, while less frequent positive returns come from missing the rebound after a downturn since trend following is by definition backward looking.

Exhibit 4: A narrower distribution by trend following in commodities...



Source: Goldman Sachs Global Investment Research

Exhibit 5: ...and in equities



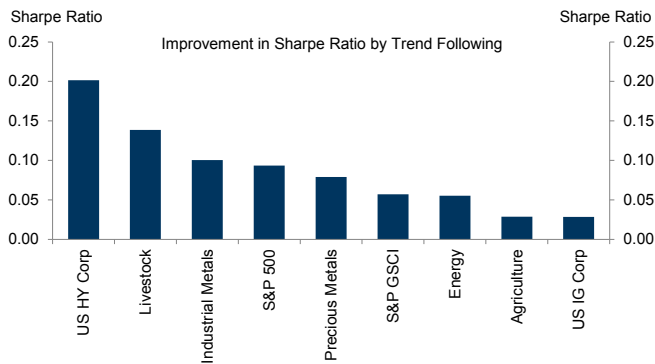
Source: Goldman Sachs Global Investment Research

When do momentum strategies work?

We next expand our analysis to a range of assets and commodities to explore what makes trend following work better in some securities than others. Exhibit 6 shows the improvement in the Sharpe Ratio by trend following for equity, credit, and commodities. While the ranking may not be intuitive—high-yield corporate bonds appear to benefit the most from trend following but investment-grade corporate bonds the least, the message here is that assets across a broad spectrum can achieve higher Sharpe Ratios with momentum strategies.

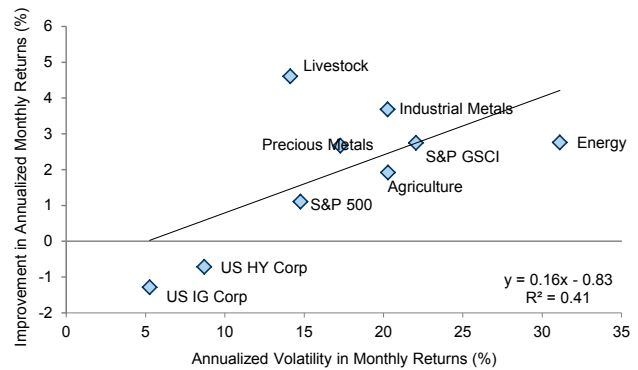
A higher Sharpe Ratio originates from higher monthly returns and/or lower volatility. Exhibit 7 looks at the impact of trend following on the numerator—monthly returns—across different assets. There is a positive correlation between the volatility of the asset and the change in monthly returns: S&P GSCI has higher volatility than S&P 500 and seems to experience a larger increase in monthly returns by trend following. Corporate bonds have the lowest volatility and actually see declines in average monthly returns. But the denominator—volatility in monthly returns—matters too. Because trend following reduces return volatility for high-yield corporate bonds significantly, Sharpe Ratio actually rises the most for high-yield corporate bonds as shown in Exhibit 6.

Exhibit 6: Trend following improves Sharpe Ratio for a wide range of assets



Source: Goldman Sachs Global Investment Research

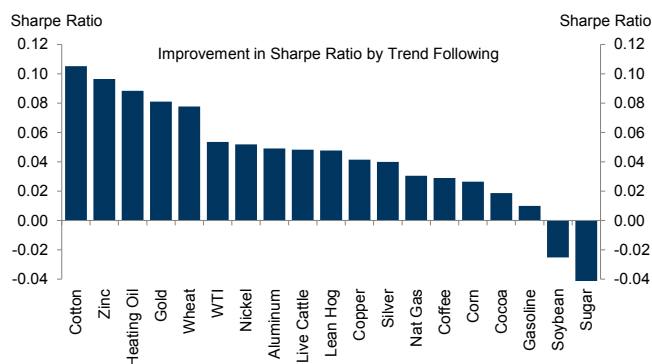
Exhibit 7: Assets with higher volatility appear to gain higher returns from trend following



Source: Goldman Sachs Global Investment Research

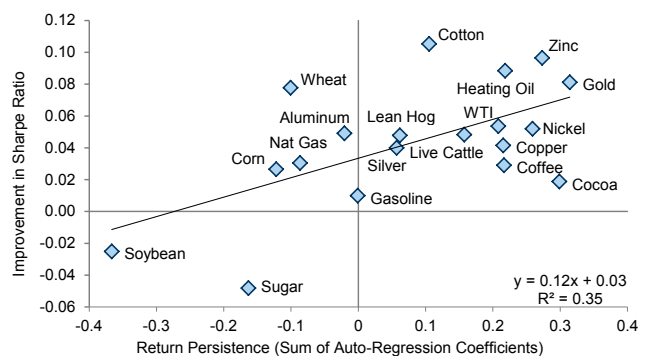
Exhibit 8 focuses on the 19 GSCI commodities whose total return indices begin before 1995. With the exception of Soybean and Sugar, all commodities see improved Sharpe Ratios using the trend following strategy. At the end of day, trend following works the best when returns are persistent, meaning past winners continue to be winners and past losers continue to be losers. We regress monthly returns on their own lags from month $t-2$ to month $t-12$ and sum the estimated coefficients as a measure of return persistence. Exhibit 9 shows that commodities with more persistent returns experience larger increases in the Sharpe Ratio by trend following. In contrast, returns display more mean-reversion than persistence for commodities such as Soybean and Sugar, rendering a trend following strategy ineffective in boosting performance for these commodities.

Exhibit 8: Some commodities benefit from trend following more than others



Source: Goldman Sachs Global Investment Research

Exhibit 9: Sharpe Ratio rises more for commodities with persistent returns when trend following

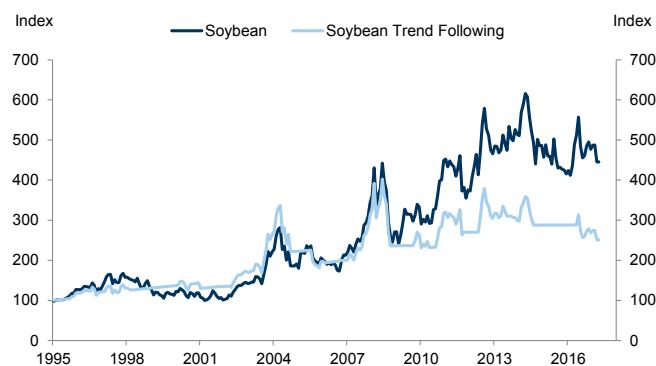


Source: Goldman Sachs Global Investment Research

One intuitive way to show when trend following works the best is to look at two concrete examples: Gold and Soybean. Exhibit 10 shows that the gold total return index declined in the late 1990s gradually, allowing the trend following strategy to switch to cash in time to avoid losses. On the other hand, the soybean total return index tends to rebound quickly after sharp declines, leaving limited room for the trend following strategy to avoid drawdowns or to catch the subsequent rallies (Exhibit 11).

Exhibit 10: Trend following works well when there is a trend in the underlying security

Source: Goldman Sachs Global Investment Research

Exhibit 11: Trend following works poorly when sharp rebounds follow drawdowns

Source: Goldman Sachs Global Investment Research

Why do momentum strategies work?

The analysis above shows that momentum strategies can improve returns for a wide range of assets, especially those with persistent returns. However, the academic literature has not agreed on why momentum strategies work in the first place. Canonical models based on rationality and market efficiency such as APT and CAPM clearly cannot explain the excess returns generated by momentum strategies. In fact, Fama and French (1996) remark that the continuation of short-term returns documented by Jegadeesh and Titman (1993) and Asness (1994) constitute the “main embarrassment” of their three-factor model.⁴

There is a literature attempting to link return continuation to microstructure issues such as liquidity and transaction costs. But the fact that momentum strategies work in vastly different markets and regions with varying liquidity conditions and transaction costs suggests this is unlikely the main explanation. A more convincing line of research relies on slow information diffusion and bounded rationality. One example is Hong and Stein (1999) where the authors model the market with “news watchers” who under-react and “momentum traders” who herd, neither of which is fully rational.⁵

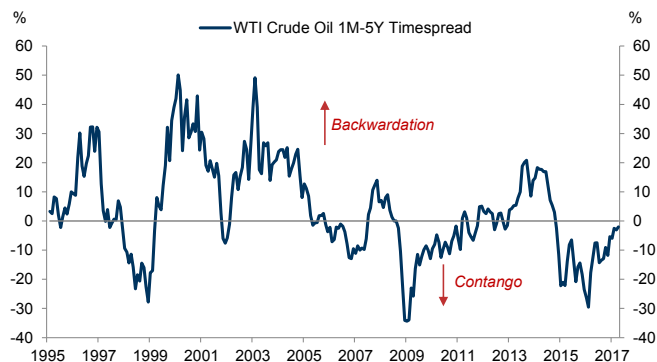
While behavioral biases such as herding and under-reaction apply to both commodity and other markets, the commodity market is unique in the “physical constraints” that it faces. This could make momentum strategies more attractive for commodities. For example, it can take 5-10 years of investment to bring new mines online. Producers often continue to produce even if there is already too much supply given the large upfront costs. As a result, once the market enters deficit or surplus, it takes a long time for the market to balance again. Exhibit 12 shows that oil tends to stay in backwardation (when inventory is low) or contango (when inventory is high) for an extended period of time.

⁴ Fama and French, “Multifactor explanations of asset pricing anomalies,” *Journal of Finance* 51, 1996, Jegadeesh and Titman, “Returns to buying winners and selling losers,” *Journal of Finance* 48, 1993, and Asness, “The power of past stock returns to explain future stock returns,” Manuscript, June 1994.

⁵ Hong and Stein, “A unified theory of underreaction, momentum trading, and overreaction in asset markets,” *Journal of Finance* 54(6), March 1999.

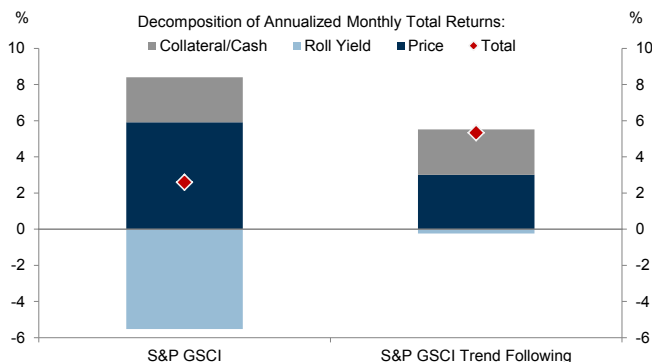
We think that differences in curve shapes help explain why the trend following strategy works better for some commodities than for others. Indeed, exhibit 13 shows that the gains in returns are mostly driven by the reduction in negative roll yields. This makes intuitive sense because contango curve shapes and negative roll yields tend to be persistent, and investors under trend following hold cash in periods of contango and avoid the negative carry. Some momentum strategies are implemented precisely by “buying backwardated contracts and selling contangoed contracts.”⁶

Exhibit 12: Commodities tend to stay in backwardation or contango for an extended period of time



Source: Goldman Sachs Global Investment Research

Exhibit 13: Trend following strategy manages to avoid negative roll yield and to improve performance



Source: Goldman Sachs Global Investment Research

To shed more light on the link between contango and trend following, we break the sample period into six segments (1995-98, 1999-2002, 2003-06, 2007-10, 2011-13 and 2014-17) and construct a panel dataset where each observation is a “commodity and time period” combination (e.g., Copper in 1995-98 would be one observation). We then regress the improvement in the Sharpe Ratio on contango measures after controlling for commodity fixed effects and time period fixed effects. One benefit of this approach is that the commodity fixed effects control for commodity-specific idiosyncrasies (e.g., sensitivity to weather shocks) that might influence the return persistence of that commodity and the gains from trend following.

Exhibit 14 shows the estimation results. For any given commodity, trend following improves the Sharp Ratio more when the futures curve is more contangoed. The result holds whether we measure contango by the share of days in contango, the average curve shape or the median curve shape. This result helps explain why trend following works well for gold and why heating oil benefits more from trend following than gasoline as shown in Exhibit 8.

⁶ See Miffre and Rallis, “Momentum strategies in commodity futures markets,” EDHEC Risk and Asset Management Research Center for example.

Exhibit 14: Panel regressions show the link between contango and improvement in Sharpe Ratio by trend following

Dep Var = Improvement in Sharpe Ratio	(1)	(2)	(3)
Share of days in contango	0.14 (1.18)		
Average curve shape (positive = backwardation, negative = contango)		-1.33 (2.48)	
Median curve shape (positive = backwardation, negative = contango)			-1.36 (2.46)
Commodity fixed effects	Y	Y	Y
Time period fixed effects	Y	Y	Y
R2	0.30	0.35	0.34
N	99	99	99

Note: Each observation is one commodity in one time period. There are 18 commodities and 6 time periods in sample. t-stats are shown in parenthesis.

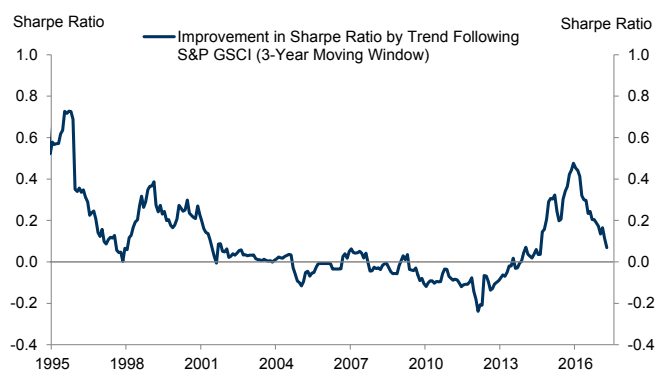
Source: Goldman Sachs Global Investment Research

A few caveats

We conclude our analysis by highlighting three caveats. First, there are many types of momentum strategies: time series momentum, cross-sectional momentum, and momentum with different lookback periods and holding periods. We focus only on one simple trend following strategy here. To the extent that different strategies generate different levels of gains in the Sharpe Ratio, the rankings shown in Exhibits 6 and 8 are likely to be different. Investors may want to tailor momentum strategies for the assets at hand accordingly.

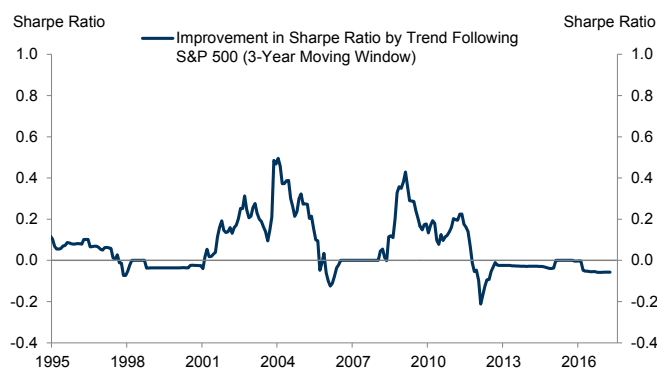
Second, even for the same strategy, the efficacy of momentum investing can change considerably over time. Exhibits 15 and 16 show that trend following has boosted returns notably for commodities over the past few years but has failed to do so for equities. While it goes without saying that past performance is no indication of future returns, it is important for investors to understand when certain strategies work the best and to potentially alter strategies in different macro environments.

Exhibit 15: Trend following has increased Sharpe Ratio for commodities over the past few years...



Source: Goldman Sachs Global Investment Research

Exhibit 16: ...but not for equities



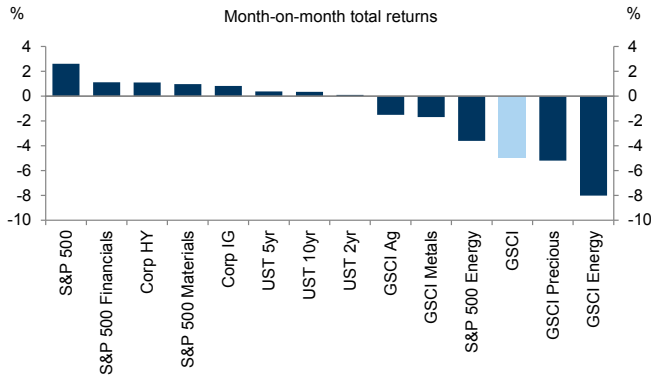
Source: Goldman Sachs Global Investment Research

Lastly, there is a risk of crowding. As illustrated by Hong and Stein (1999), when momentum traders push up prices and lead to more momentum traders piling in, prices can rise above fair value and result in subsequent reversals. That said, even researchers who have questioned the strategic value of commodity futures acknowledge the case of momentum strategies and tactical asset allocation using commodity futures.⁷

⁷ See Erb and Harvey, "The strategic and tactical value of commodity futures," *Financial Analysts Journal* 62(2), 2006 for example.

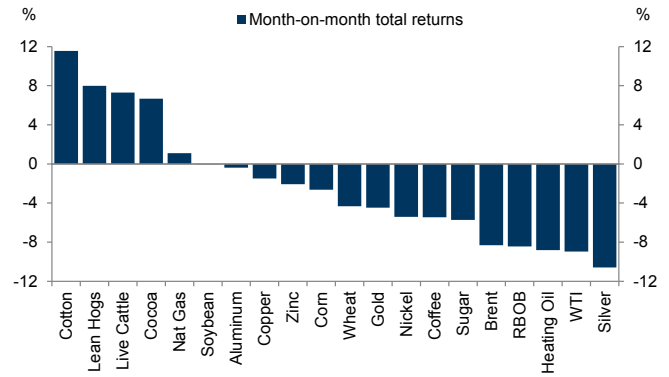
Commodities Monitor

Exhibit 17: Cross-asset performance



Source: Haver Analytics, Goldman Sachs Global Investment Research

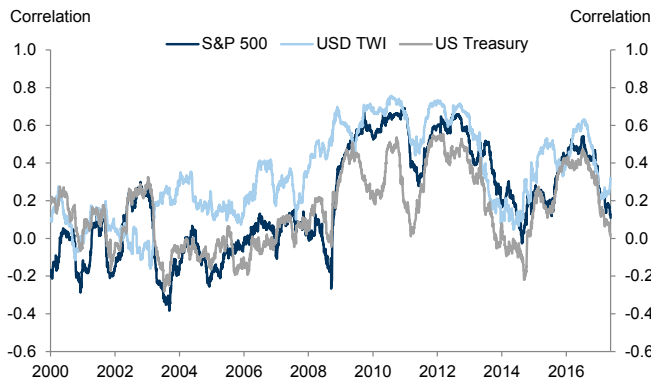
Exhibit 18: Commodity performance



Source: Goldman Sachs Global Investment Research

Exhibit 19: Cross-asset correlations

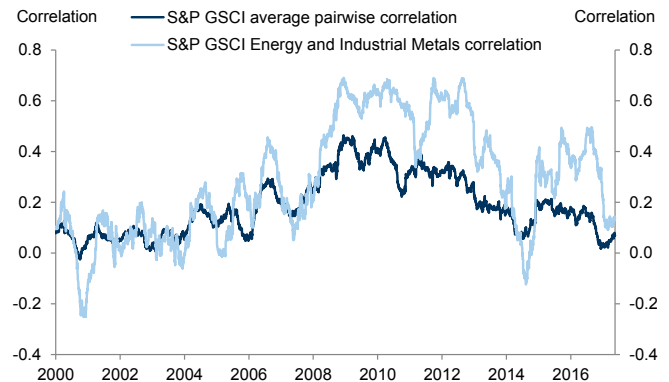
Time-varying correlation between S&P GSCI daily total returns and other assets



Source: Haver Analytics, Goldman Sachs Global Investment Research

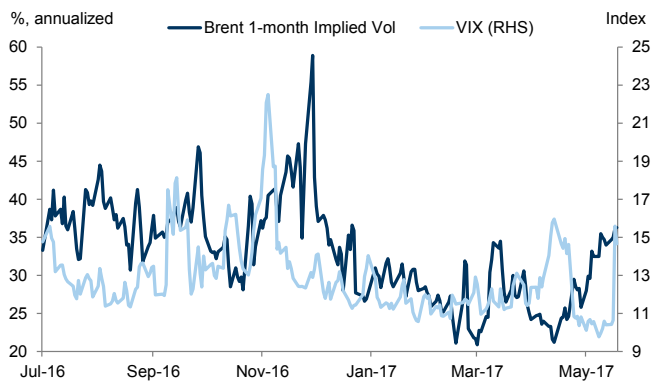
Exhibit 20: Commodity correlations

Time-varying correlation of S&P GSCI commodity daily total returns



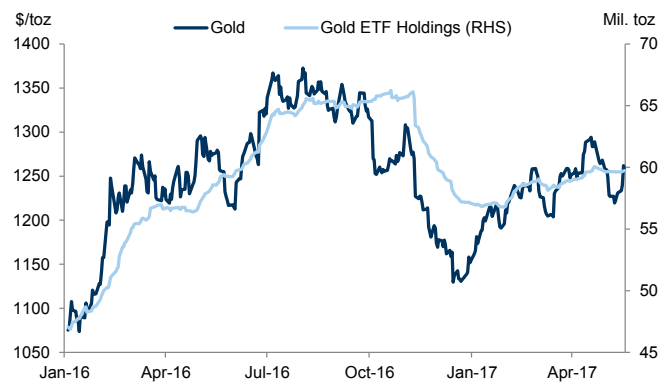
Source: Goldman Sachs Global Investment Research

Exhibit 21: Oil and equity volatility



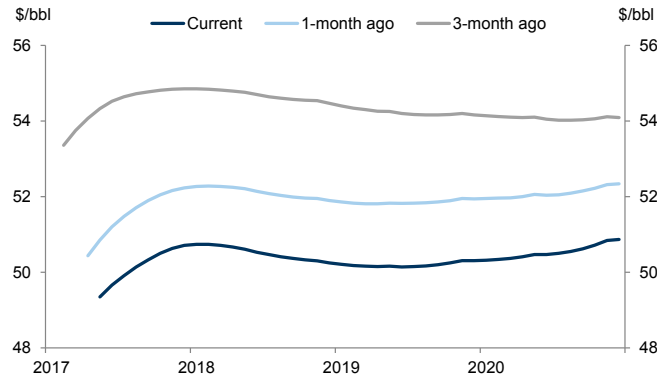
Source: Goldman Sachs Global Investment Research

Exhibit 22: Gold price and total known gold ETF holdings



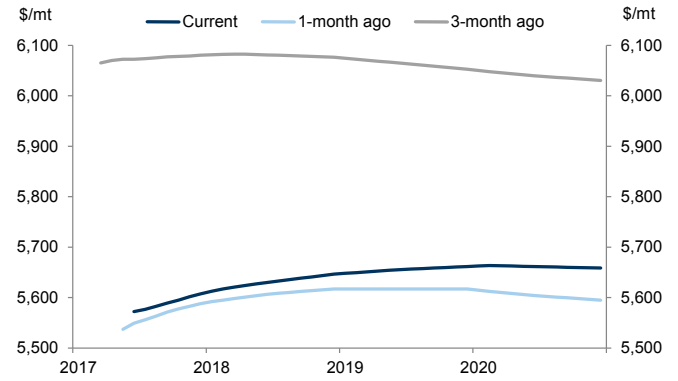
Source: Bloomberg

Exhibit 23: Brent crude oil futures curve



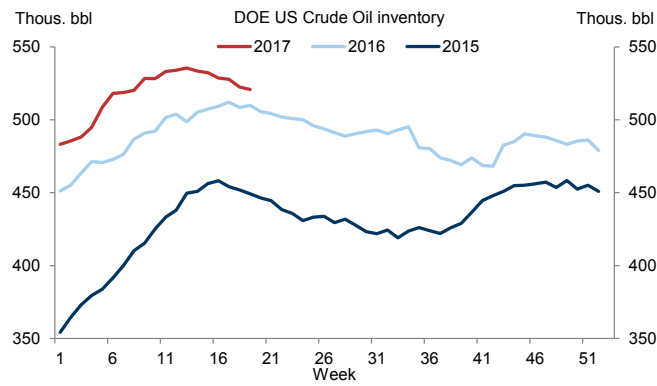
Source: Goldman Sachs Global Investment Research

Exhibit 24: Copper futures curve



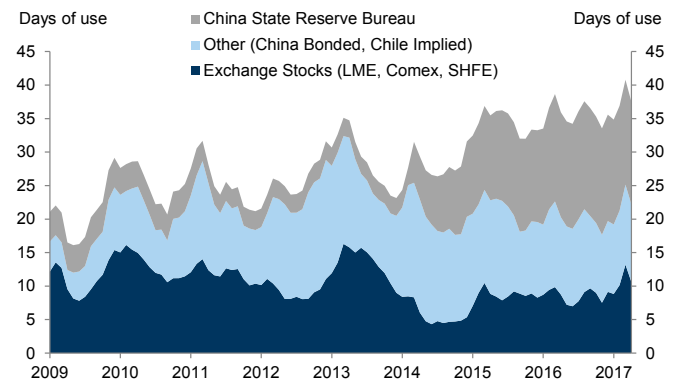
Source: Goldman Sachs Global Investment Research

Exhibit 25: Oil inventory



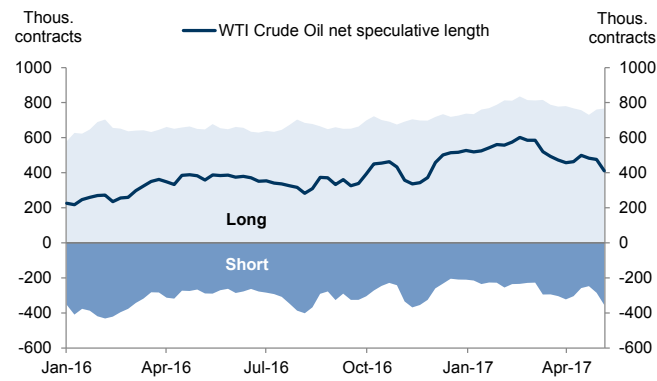
Source: Bloomberg, Goldman Sachs Global Investment Research

Exhibit 26: Copper inventory



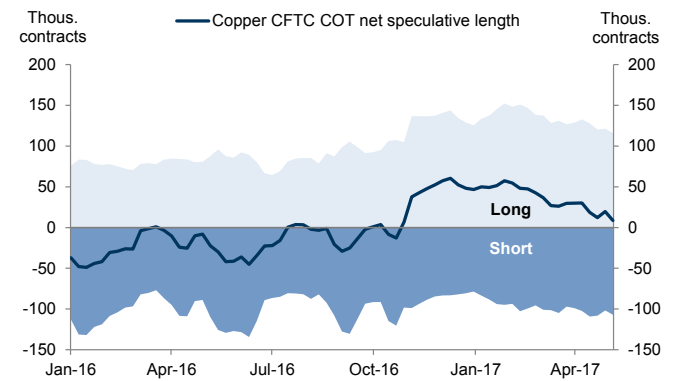
Source: Goldman Sachs Global Investment Research

Exhibit 27: Oil positions



Source: Goldman Sachs Global Investment Research

Exhibit 28: Copper positions



Source: Goldman Sachs Global Investment Research

Exhibit 29: Macro forecast summary

	2017				2016	2017	2018	2019
	Q1	Q2	Q3	Q4				
Real GDP (% Chg, yoy)								
US	1.9	2.3	2.1	2.1	1.6	2.1	2.2	1.7
Euro Area	1.6	1.7	1.6	1.4	1.7	1.6	1.4	1.5
Japan	1.6	1.6	1.3	1.3	1.0	1.4	1.1	1.3
China	6.9	6.8	6.7	6.7	6.7	6.8	6.3	6.1
DM	2.0	2.1	2.0	1.9	1.7	2.0	1.9	1.8
EM	4.8	5.1	5.3	5.4	4.6	5.2	5.4	5.5
World	3.5	3.7	3.7	3.7	3.2	3.6	3.8	3.8
Asset Markets (EOP)								
FF Target Range (%)	0.75-1.0	1.0-1.25	1.25-1.5	1.25-1.5	0.5-0.75	1.25-1.5	2.25-2.5	3.25-3.5
10 Year Treasury Note (%)	2.40	2.75	2.90	3.00	2.45	3.00	3.50	3.70
S&P 500 (index level)	2400	2375	2350	2300	2200	2300	2400	2500
Euro (€/\$)	1.07	1.08	1.08	1.07	1.06	1.05	--	--
Yen (\$/¥)	111	114	115	116	117	125	--	--
CNY (\$/CNY)	6.95	7.00	7.10	7.20	6.94	7.20	--	--

Source: Goldman Sachs Global Investment Research

Exhibit 30: Commodities forecast summary

	Prices and monthly changes			Historical Prices						Price Forecasts ³		
	units	16 May	Change ¹	4Q 15	1Q 16	2Q 16	3Q 16	4Q 16	1Q 17	3m	6m	12m
Energy												
CME WTI Crude Oil	\$/bbl	49.00	↓ -4.60	42.16	33.63	45.64	44.94	49.29	51.78	57.50	55.00	55.00
ICE Brent Crude Oil	\$/bbl	51.65	↓ -4.24	44.69	35.21	47.03	46.99	51.06	54.57	59.00	57.00	58.00
Industrial Metals⁴												
LME Copper	\$/mt	5,611	↓ -81	4,882	4,669	4,728	4,793	5,291	5,855	6,200	5,600	5,500
LME Aluminum	\$/mt	1,923	↑ 14	1,507	1,515	1,583	1,633	1,709	1,858	1,950	2,000	2,100
Precious Metals												
COMEX Gold	\$/troy oz	1,240	↓ -49	1,105	1,185	1,260	1,335	1,218	1,220	1,200	1,200	1,250
COMEX Silver	\$/troy oz	16.7	↓ -1.8	14.8	14.9	16.8	19.6	17.1	17.5	16.5	16.5	17.2
Agriculture												
CBOT Soybean	cent/bu	976	↑ 10	880	881	1,057	1,012	1,000	1,021	950	925	885
CBOT Corn	cent/bu	368	↓ -10	373	363	391	331	348	364	350	350	335

¹ Monthly change is difference of close on last business day and close a month ago.² Price forecasts refer to prompt contract price forecasts in 3-, 6-, and 12-months time.³ Based on LME three month prices.

Source: Goldman Sachs Global Investment Research

Disclosure Appendix

Reg AC

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