J.P.Morgan

Rule-based Investment Strategies
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Commodity equities or futures?

- **Measures of relative value/carry of commodity equities and commodity futures are reliable signals when deciding whether to be long commodity equities or futures.**
- **Relative carry is determined by the shape of the futures curves and yield measures of commodity equities.**
- **Relative carry is a profitable signal for both long-only or long-short strategies on commodity equities and futures with return-to-risk ratios above 1.**
- **Results are robust to various specifications and underlying indices.**
- **Commodity equities provide both diversification and inflation hedging benefits. A strategy that hedges the excess equity exposure has even better diversification characteristics.**
- **Relative value opportunities are due to mispricing in the commodity curves and market segmentation between commodities and equity markets.**

Investors who require a strategic exposure to commodities typically gain this through commodity futures. However, there are frequently significant costs involved in rolling over these futures contracts. One could instead gain similar exposures by buying the equities issued by companies exposed to commodity markets, such as the major oil companies. These commodity stocks generally pay dividends, grow and have no roll-over costs. But they are not as closely linked to commodity prices as futures are. We show below that **dynamically switching between commodity futures and equities on the basis of their relative yield adds significant returns** to commodity investors without giving up much exposure to underlying spot commodity prices. It retains a low correlation to equities and similar inflation hedging characteristics as a pure passive investment in commodity futures.

The base-case rule chooses on a monthly basis and for each commodity the exposure that provides the highest carry or yield. For a long-short strategy, this produced a Sharpe ratio of 1.75 since 2002 (Chart 1), and 1.02 for a long-only strategy (Chart 2), while S&P GSCI delivered a Sharpe ratio of 0.05 over the same period. Using longer samples since mid-80's and other indices, we find similar outperformance with respect to commodity benchmarks. This relative carry signal is driven by the **difference between the slope of the commodity futures curves** (futures carry/slide) **and yield measures of commodity equities** (equities carry/value) on an individual commodity basis.

One potential criticism to using commodity equities is that they are more exposed to the overall equity market than to spot commodity prices. That is correct. We show that the **optimal commodity exposure via commodity equities indeed requires hedging this excess equity risk**. We trade a hedged portfolio of commodity equities, i.e., this portfolio is long commodity equities and partially short a broad global equity index on a dynamic basis, in order to reduce the beta to equities and make this a pure commodities strategy (Chart 3). We also analyze the performance without hedging, this also produced good results.

In the following sections, we show how we gauge relative value; what indices we use; how we hedge excess equity risk, and what returns we achieve. We also show that the **results are robust** across various sample periods, sectors, equity and commodity indices, definitions of slope, methodologies for equity hedging, etc.

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How to gauge relative yield/value?

We apply a **relative value methodology that evaluates the carry/value/slide of each alternative position**. On a monthly basis, the relative value strategy decides for every single commodity if it is better to be long a commodity futures index or a commodity equity index (with or without hedging its excess equity exposure).

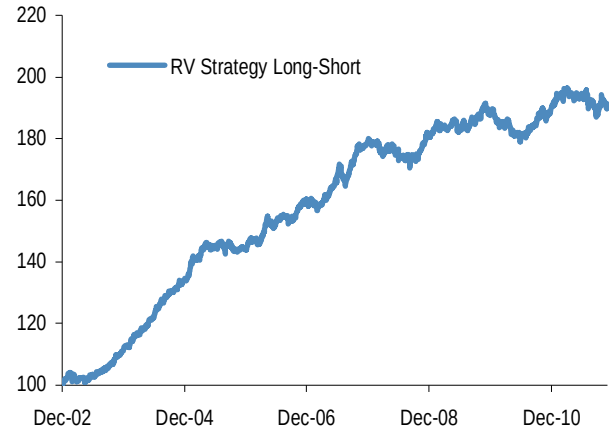
In the case of **commodity futures**, we defined carry (or, in this case, slide) in the same way we defined it in Ribeiro, R.M., *Profiting from slide in commodity curves*, 2009. In that paper, we used the concept of **local slope**, which is the slope of the curve measured at each point relative to the nearby closer-to-expiry contract. To make it comparable to the equity equivalent, this slope is annualized.

In the case of **commodity equities**, we defined carry (or value) in multiple ways to make sure results are robust. We considered both **dividend yields and earnings yields using both historical and forward-looking measures** based on analyst forecasts. We should note that investments in commodity futures are unfunded (do not require capital upfront, except for margins), while equities are funded investments. Therefore, we need to subtract a funding rate from the yield measure to make it comparable to futures. We considered both 1-month Libor and 10-year swap rates.

For **hedged commodity equities**, where we take out the overall exposure to global equities, we make sure this position is accounted for in the carry definition. As explained later on, the short position depends on the betas of both commodity futures and equities to global equities. So carry is the difference between the net yield of commodity equities and the beta-adjusted net yield of global equities (i.e., for earning yields, $(E_{ce}/P_{ce} - r) - (\beta_{ce,e} - \beta_{cf,e}) * (E_e/P_e - r)$, where $\beta_{y,x}$ is beta of y to x, *ce* is commodity equities, *e* is global equities and *cf* is commodity futures).

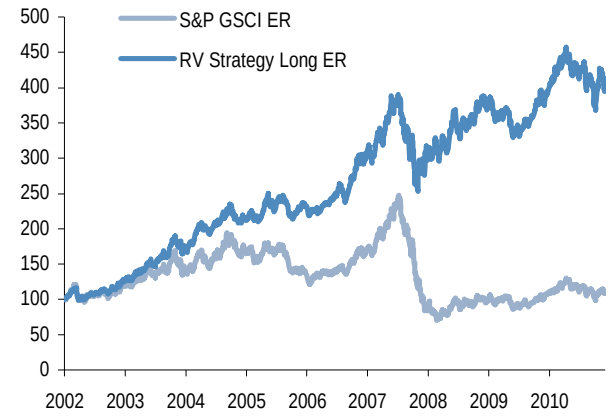
For example, we compare the shape of the WTI forward curve to the yield (net of funding rate) of the Energy equity index (hedged or not). Let us ignore hedging for a moment. On December 31, 2010, the ratio of the WTI May 11 futures price (the selected contract by our chosen index) to the April 11 futures price (preceding contract) was 1.00538, which produced a 6.65% annual negative roll. That month, the index of oil producer companies was expected to have earnings of 10.53% of their then current price over the following 12 months, while 10-year swap rates were 3.38%, so the net yield was 7.15%. Hence, the yield gap between the two, ignoring hedging, was 13.8% in favor of equities, indicating that one should hold Energy equities instead of WTI futures.

Chart 1: Commodity Equities-Futures RV Strategy - long-short version
excess return index



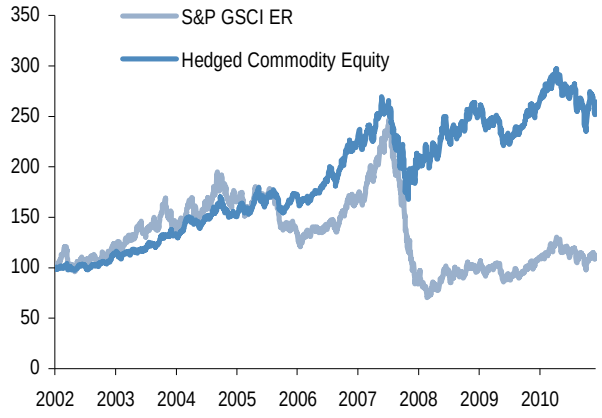
Source: J.P. Morgan, S&P, Bloomberg.

Chart 2: Commodity Equities-Futures RV Strategy - long-only version
excess return index, compared to S&P GSCI Excess Return Index



Source: J.P. Morgan, S&P, Bloomberg.

Chart 3: Hedged Commodity Equities
excess return index, compared to S&P GSCI Excess Return Index



Source: J.P. Morgan, S&P, Bloomberg.

Which equities and futures? What weight?

We implement the relative value strategy using **third-party indices with transparent methodologies**. The base-case strategy trades S&P GSCI F3 indices on a single commodity basis and S&P Global Natural Resources indices on a sector-level basis (see Appendix 1). One of the advantages of the S&P Global Natural Resources index family is that it is a global index.

Commodity-sector equity indices are the best feasible option due to the unavailability of single-commodity equity indices. While there are plenty of Industrial Metals and Agriculture equity indices, there are no Copper or Soybean equity indices. Hence, the strategy replaces the single-commodity futures index with the respective equity sector index whenever the signal selects the equity underlying. We use sector data for agriculture, energy and base metals[1].

The **weight of each one of the positions will depend on the chosen commodity benchmark**. In most cases reported here, these weights depend on the composition of the S&P GSCI Full Energy index. Therefore, the version of the strategy shown here is a potential alternative to investors using the S&P GSCI Full Energy index as a benchmark. A wide range of benchmarks have been considered with robust performance.

Results are robust across other indices, as we see in a later section. On the commodity side, we tested the strategy with a variety of other single-commodity indices (S&P GSCI, J.P. Morgan Commodity Curve Index, J.P.Morgan CONTAG and others). On the equities side, our preference was to use indices whose methodology is driven by exposure to commodity activities such as the CRB-EQ, but other broader indices were also considered.

Hedging excess equity exposure in commodity equities

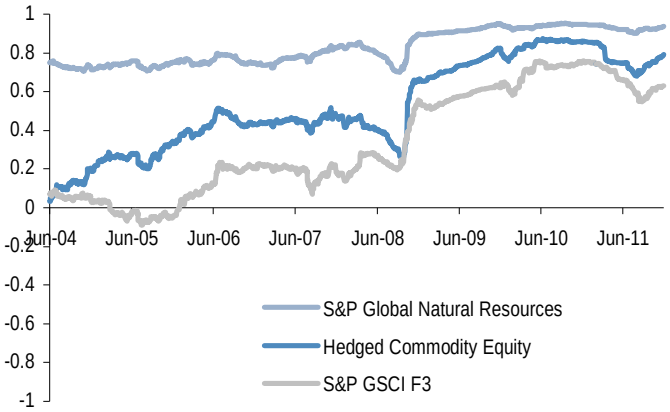
One of the main concerns investors have about commodity equities is that **commodity equities are sometimes more correlated to equity markets than to commodities**. Even though cash flows should rise when commodity prices rally, changes in equity risk premia (i.e. an increase in the discount factor) can potentially offset those gains. On the positive side, commodity equities provide a positive risk premium, while we do not believe in a positive long-term premium in commodity futures.

In order to address this concern, we considered a version of the strategy that invests in a **hedged commodity equity index**. The hedged index is the combination of a long position in the selected commodity equity index and a short position in a basket of equity index futures that is designed to track the MSCI World Index (only developed markets, to be clear).

By hedging the excess equity exposure, we achieve four goals as we create a commodity equity index that has:

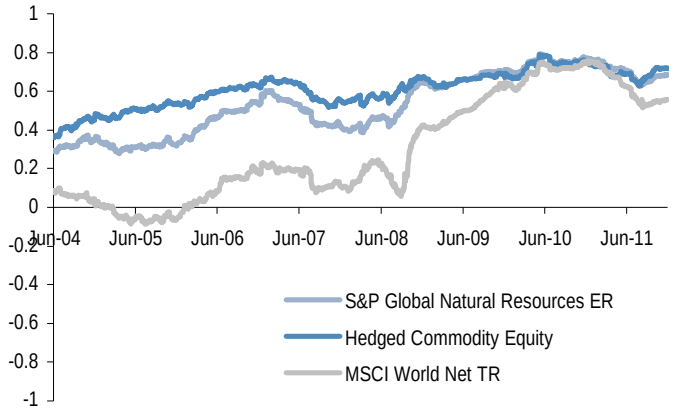
- **correlation to equities that is similar to the one commodity futures indices have** (Chart 4) ;
- **a higher correlation to commodity spot prices** than other commodity equity indices (Chart 5); and
- **a better risk-adjusted performance and lower volatility** (Chart 3 and 6).

Chart 4: Correlation of Hedged Commodity Equity to MSCI World
rolling 126-day, compared to S&P Global Natural Resources and S&P GSCI F3



Source: J.P. Morgan, S&P, Bloomberg. MSCI World is proxied by the same futures basket. we use for hedging.

Chart 5: Correlation of Hedged Commodity Equity to S&P GSCI
rolling 252-day, volatility-matched investments, compared to S&P Global Natural Resources and MSCI World



Source: J.P. Morgan, S&P, Bloomberg.

1 In the case of precious metals, we assume that it is always optimal to hold futures. The exclusion of precious metals is economically motivated, as the futures curve is mostly determined by storage arbitrage (physical storage plues interest cost) and therefore it does not provide useful information (see Ribeiro, R.M., *Profiting from slide in commodity curves*, 2009). The slope is determined by storage cost. Note that the equities side could still provide profitable information, but we did not find significant empirical evidence. We leave the precious metals case for a later paper.

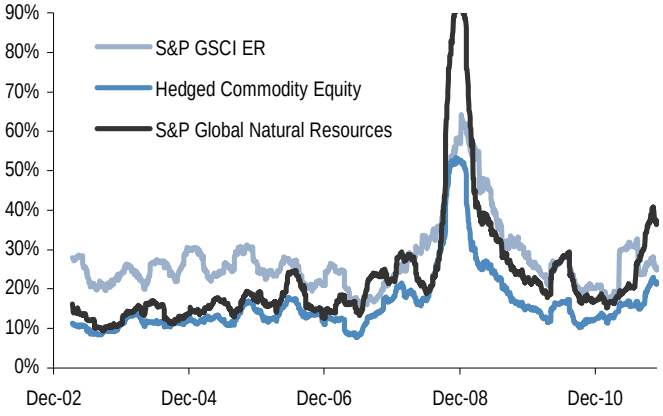
The **sizing of the short position is based on the betas of both commodity equities and commodity futures** to this global futures basket. In the base-case strategy, the objective is to construct a hedged commodity equity index that has the same low sensitivity to global equities that a commodities futures index has at each point in time. So if the sensitivity of commodity futures to global equities is $\beta_{cf,e}$ and sensitivity of commodity equities to global equities is $\beta_{ce,e}$, then we go short $\beta_{ce,e} - \beta_{cf,e}$ of global equities, as this is excess beta to global equities (see diagram in Chart 7). We considered caps and floors to minimize the effect of estimation error. Other methods were considered with similar qualitative results.

As the risk profile of commodity futures and equities changes over time, we **estimate betas on a daily basis using a rolling window**. We tested a range from 21 to 126 days with similar performance. Our reported numbers are based on exponentially-weighted betas, where 50% of the weight is given to the past month data. Using dynamic estimates of beta has been particularly important in the recent past as we have seen a significant change in the correlation and beta between commodity prices and equity prices, possibly a structural change, in the view of some market participants.

For the sake of completeness, we present strategy results for **versions with and without global equity hedging**. By hedging part of the equity risk, the two investment options become more comparable, as the hedged equity index provides exposure to the commodity-driven performance of the commodity equity index. An alternative is to compare the investment in commodity equities to an investment in a basket of commodity futures and global equities. In this case, investors compare an investment in commodity equities to an allocation to global equities with a commodity overlay.

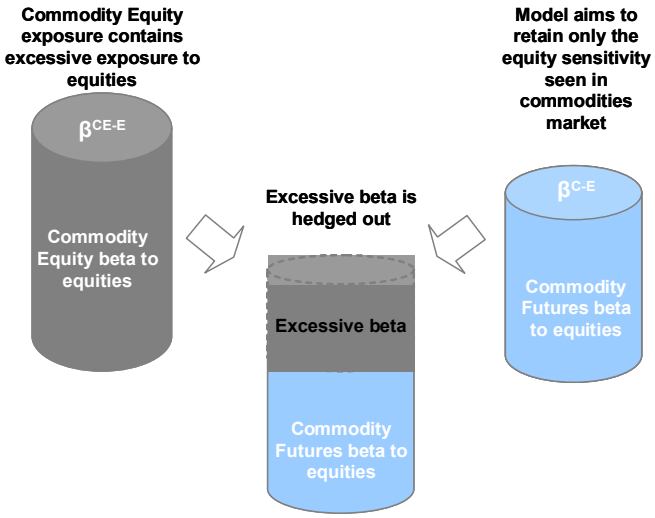
Hedging increases the correlation to commodity spot prices, but that does not imply that correlation is now 1. In fact, we would not expect that to happen as commodity equities provide an alternative exposure to the commodity story. Commodity equity returns reflect changes in current spot prices but should also anticipate changes in expected future spot prices as they affect the present value of all future profits. Moreover, commodity firms may (efficiently or not) implement hedging strategies. Commodity firms can also be jointly exposed to multiple commodity sectors as costs of running the business are related to commodity prices (particularly energy costs). Another interesting characteristic is that hedged commodity equities are less volatile that commodity futures.

Chart 6: Volatility of hedged commodity equities and other indices
rolling 252-day annualized standard deviation



Source: J.P. Morgan, S&P, Bloomberg.

Chart 7: Hedging the excessive equity beta



Source: J.P. Morgan.

Commodity future returns are related to spot performance but also **affected by the shape of the curve**. If the curve is in contango, i.e., positively sloped, the negative roll cost (more precisely, the negative slide) will make actual returns lower than spot returns. If the curve is in backwardation, returns are higher than spot returns. As most indices pick only one point of the curve, they do not necessarily benefit from bullish steepenings (increase in longer-dated prices without increase in short-dated ones)

Why relative value between equities and futures?

There are multiple reasons why a relative value strategy with commodity equities and commodity futures makes sense. The source of the excess return produced by our switching strategy could be due to **distortions in commodity futures markets** or also be explained by a **degree of market segmentation between futures and equities**.

Some of the explanations could be commodity futures specific in the sense that this **relative value measure is only identifying risk premia in commodity curves**. In *Profiting from slide in commodity curves*, Ribeiro, J.P.Morgan, 2009, we argued that the relation between the shape of a commodities futures curve and future commodity spot price developments is weak due to the presence of risk premia and/or mispricing (sometimes negative or positive). There we tested many strategies based on the slope of the futures curves and discussed the reasons why risk premium was present in futures curves and varied over time. In this case, commodities equities would not necessarily suffer from the biases in commodity curves we identified in our previous paper and be an investment alternative whenever risk premium is negative for futures.

Another explanation for the performance of this strategy is **market segmentation**. In this case, part of the inefficiency would be explained by mispricing in commodity equities. Hence, **equity markets would not price all the information available on the commodities futures curves, and vice versa**. One hypothesis is that equity markets do not fully incorporate the information on expected spot prices embedded in the futures curves.

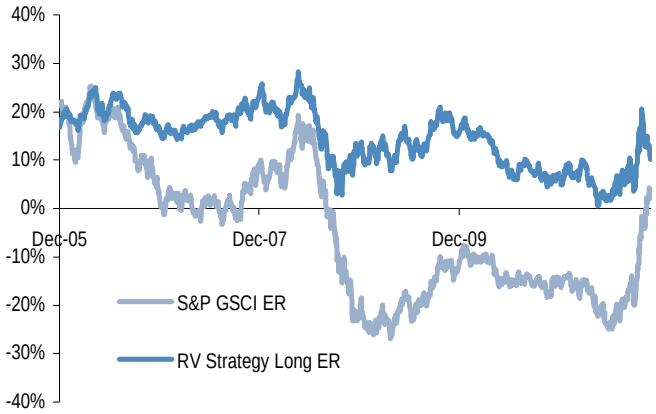
Performance

In this section, we show that our base-case **relative value strategy has outperformed in a consistent manner both a static allocation into commodities futures and a static allocation into commodity equities**. Most results are based on a sample since 2002 due to index data availability, but we later extend some of the results to longer data with other indices. Our sample ends in November 2011. Allocations are rebalanced on the first business day of every month based on information available on the last business day of the previous month.

The strategy has posted **higher excess returns with lower volatility** than our commodity benchmark for the purpose of this paper, the S&P GSCI Index (Chart 1, second page and Table 1). Both average drawdown and maximum drawdown

3 More detailed methodology and additional robustness tests not reported here are available upon request. In the base-case strategy, we considered a model where we hedge the excess equity exposure. The equity signal uses 12-month forward I/B/E/S earnings yields and 10-year swap rates. Additionally, we split the position between equities and futures, whenever the relative value measure is within -2.5% and 2.5% to avoid excessive trading (robust to changes).

Chart 8: Rolling 36-month returns of RV Strategy Long and S&P GSCI excess return indices



Source: J.P. Morgan, S&P, Bloomberg.

Table 1: Performance statistics of long RV strategy and other indices
Sample: 2002-2011

	RV Strategy Long ER	Hedged Commodity Equity	S&P Global Natural Resources	S&P GSCI F3	S&P GSCI ER
Avg Exc Return	19.8%	13.2%	16.2%	12.0%	1.5%
Std Deviation	19.5%	18.0%	27.0%	26.3%	28.8%
Sharpe Ratio	1.02	0.73	0.60	0.46	0.05
Skewness	-0.05	-0.05	0.07	-0.13	-0.05
Kurtosis	5.23	8.25	12.81	4.50	4.16
Max Drawdown	-35.3%	-37.8%	-56.4%	-66.8%	-71.6%
Ave Drawdown	-6.7%	-6.7%	-13.7%	-22.8%	-29.1%
Alpha (GSCI)	17.7%	11.5%	14.1%	10.1%	0.0%
t-stat	4.13	2.27	1.79	7.35	0.00
Alpha (MSCI)	15.2%	8.9%	7.6%	9.5%	0.1%
t-stat	2.58	1.75	1.67	1.12	0.01
Alpha (Both)	15.1%	8.9%	7.5%	9.4%	0.0%
t-stat	3.80	2.03	1.92	6.97	0.00

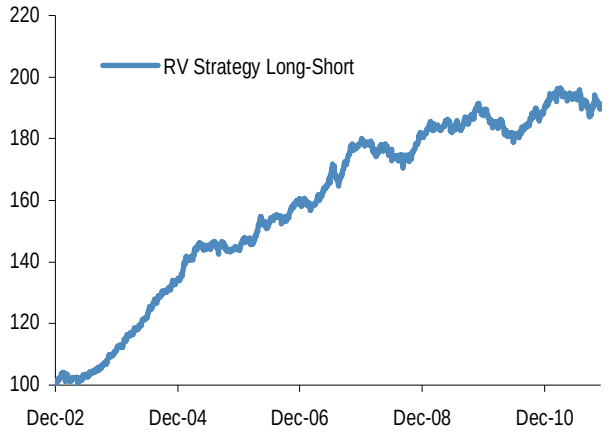
Source: J.P. Morgan, S&P, Bloomberg.

are lower for the strategy. The rolling 12-month return is almost always higher than the one delivered by commodities futures exposure (Chart 8).

Risk-adjusted performance is robust to the choice of the asset pricing model used in the analysis. In a regression on the S&P GSCI, the slope coefficient (Jensen's alpha) is statistically significant. It remains significant even if we include MSCI World as a pricing factor or only use equities as a pricing factor (Table 1).

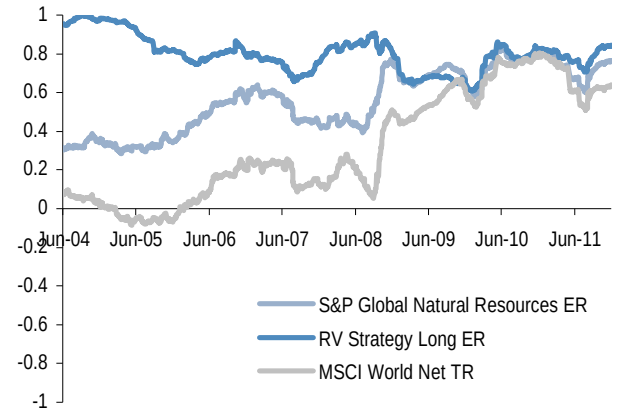
The **performance of alpha-based long-short strategies is also strong** (Chart 9). In these versions, we also go short commodity futures indices and/or equities indices based on

Chart 9: Alpha strategy with short positions based on rolling betas
excess return indices, short positons based on rolling betas, volatility control 5%



Source: J.P. Morgan, S&P, Bloomberg.

Chart 10: Correlation of RV Strategy Long to S&P GSCI ER
rolling 252-day correlation, compared to S&P Global Natural Resources and MSCI World

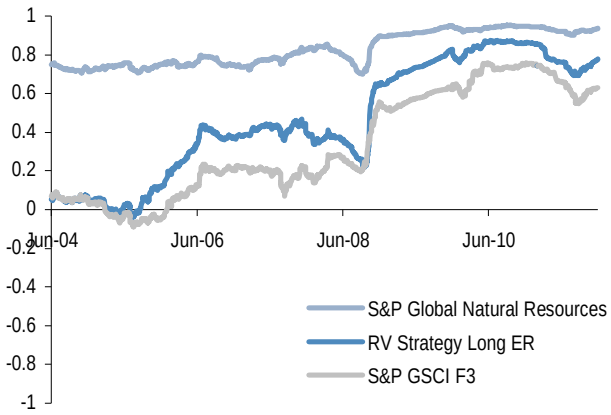


Source: J.P. Morgan, S&P, Bloomberg.

rolling beta estimates. For example, every end of the month, we estimate the rolling beta of the relative value strategy to the commodity futures benchmark and go short that amount of the commodity future index (S&P GSCI) for the following month. By doing so, we hedge the exposure to commodity futures, making this strategy uncorrelated to this benchmark. We apply a risk-control mechanism to make sure the risk capital allocated to the strategy is stable over time.

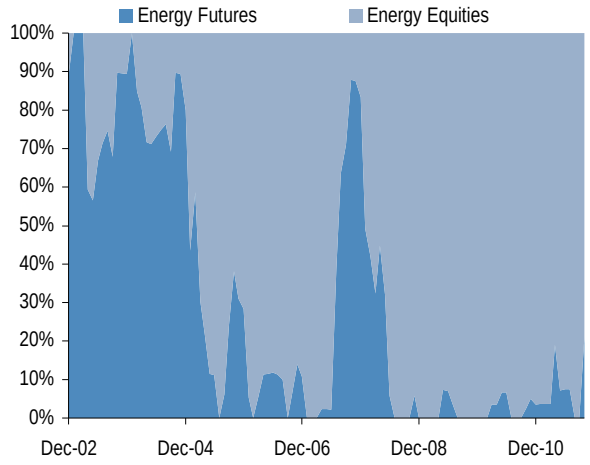
The **correlation of the long strategy to commodities is high** as expected (Chart 10) and the correlation to equities tracks the variation followed by standard commodity indices (Chart 11). In the full sample, the correlation to the S&P GSCI index was 0.78. Note that correlation to equities has been a lot higher since the onset of the financial crisis.

Chart 11: Correlation to MSCI World
rolling 252-day correlation, compared to S&P Global Natural Resources and S&P GSCI F3



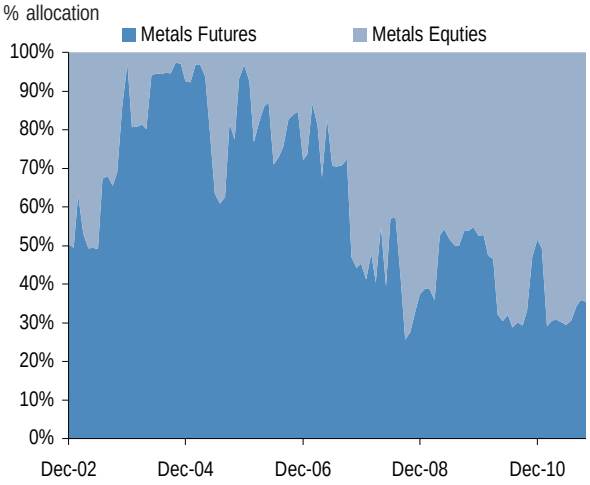
Source: J.P. Morgan, S&P, Bloomberg.

Chart 12.A: Equity-futures allocation within the energy sector
% allocation



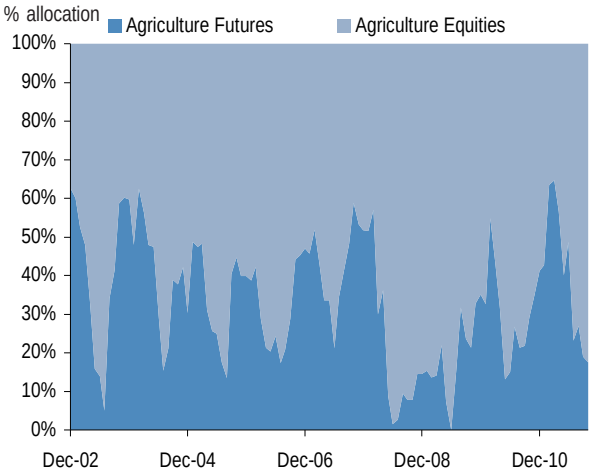
Source: J.P. Morgan, S&P, Bloomberg.

Chart 12.B: Equity-futures allocation within the metals sector
% allocation



Source: J.P. Morgan, S&P, Bloomberg.

Chart 12.C: Equity-futures allocation within the agricultural sector



Source: J.P. Morgan, S&P, Bloomberg.

The base-case strategy provides a **diversified exposure to both commodity futures and commodity equities**. Charts 12.A to 12.C show the composition of the portfolio for each of the commodity sectors. The composition has never been concentrated in only futures or equities. On average, the allocation has been roughly even into futures and equities. While we ignore transaction costs in the reported results, we also evaluated the profitability of cost-adjusted versions. On the conservative side, an overall cost of 50-70bps per year would be sufficient to cover all the necessary expenses/ trading costs to run the strategy, assuming the appropriate infrastructure.

No equity hedging

The **relative value strategy has performed well even without the use of the equity hedging feature.** The objective of equity hedging is to make the two investment alternatives more comparable as we choose between assets that have a similar correlation to equities[3]. Table 2 shows that performance statistics remain attractive without hedging.

For the sake of completeness, we also analyze another version where we choose between commodity equities and a basket of commodity futures and equities, a solution that also makes the two alternatives more comparable. This version (not reported here) is suitable to investors that prefer no short positions and are also happy with equity exposure (due to their positive risk premia).

Alpha strategies

Long-short versions of this strategy provide strong and uncorrelated performance. This is an interesting solution for investors that are not interested in commodity beta. This long-short strategy also has low correlation to other long-short strategies in commodities. Thus, it can be combined with other commodity-based strategies to deliver even higher risk-adjusted returns.

Table 2: Performance statistics - No global equity hedging
Sample: 2002-2011

	RV Strategy Long ER		S&P Global Natural
	No Hedging	RV Strategy Long ER	Resources ER
Avg Exc Return	18.6%	19.8%	13.3%
Std Deviation	26.2%	19.5%	27.0%
Sharpe Ratio	0.71	1.02	0.49
Skewness	0.00	-0.05	0.06
Kurtosis	12.21	5.23	12.78
Max Drawdown	-55.0%	-35.3%	-57.0%
Ave Drawdown	-12.7%	-6.7%	-14.5%
Alpha (GSCI)	16.4%	17.7%	11.2%
t-stat	2.53	4.13	1.42
Alpha (MSCI)	10.9%	15.2%	5.0%
t-stat	1.89	2.58	1.10
Alpha (Both)	10.8%	15.1%	5.0%
t-stat	2.67	3.80	1.26

Source: J.P. Morgan, S&P, Bloomberg.

Table 3: Alpha strategies
Sample: 2002-2011

	RV Strategy Long-Short ER	RV Strategy Pure LS ER	RV Strategy Long ER
Avg Exc Return	8.6%	5.7%	19.8%
Std Deviation	4.9%	5.0%	19.5%
Sharpe Ratio	1.75	1.13	1.02
Skewness	-0.09	-0.06	-0.05
Kurtosis	1.62	2.05	5.23
Max Drawdown	-6.4%	-6.5%	-35.3%
Ave Drawdown	-1.3%	-1.5%	-6.7%
Alpha (GSCI)	8.6%	5.5%	17.7%
t-stat	4.90	3.12	4.13
Alpha (MSCI)	7.7%	5.0%	15.2%
t-stat	4.59	2.91	2.58
Alpha (Both)	7.7%	5.0%	15.1%
t-stat	4.64	2.91	3.80

Source: J.P. Morgan, S&P, Bloomberg.

We considered a few long-short strategies. The **first version goes long the base-case strategy and short S&P GSCI**. The advantage of this version is that it is easier to implement. Due to the difference in the risk profiles of the long and short positions, we match the volatility of these two positions. We also apply a risk control mechanism that caps the volatility at 5%. (Chart 9)

3 While we do not report results here due to its technical nature, we also considered other choices of hedging ratios. In the base case strategy, we match the beta to global equities, which seems a reasonable assumption. We also considered a case where beta to equities is set to zero and that betas are estimated in two-step regressions or multiple regressions.

The **second version goes long the base-case strategy and short the underlyings that were not selected** by the base-case strategy, using the same weighting scheme for both long and short positions. Even though this is a better measure of the alpha of the strategy, this version is more costly to replicate as it may require going short cash equities (or impossible in the presence of short selling constraints).

The **alpha of these two versions is statistically significant**. Table 3 shows that the intercept of the regression of the long-short strategy returns on the S&P GSCI excess return indices is statistically significant at a 5% significance level.

The **correlation to other alpha strategies in commodities is low**, thus providing diversified source of returns (Table 3). The correlation to a commodity slide long-short strategy is 0.29 (see Ribeiro, R.M., *Profiting from slide in commodity curves*, 2008). The Sharpe ratio of a 50-50 risk-weight strategy since 2002 around 2.70, which is higher than the Sharpe ratio of the individual strategies. The correlation to a momentum strategy is only 0.09, providing once again good diversification (see Ribeiro, R.M. et all, *Momentum in Commodities*, 2006 and Ribeiro, R.M. et all, *Optimizing Commodities Momentum*, 2008).

Other samples, definitions or underlyings

In this section, we test the robustness of this strategy to other samples, definitions and underlyings. Overall, results were robust to these changes.

Changing equity signals

While the equity signals are relevant for a relative value strategy, **performance remains strong even if we do not use equity valuation ratios**. A simpler strategy that selects the allocation based on the shape of the commodity futures curves has delivered a Sharpe ratio also above 1. The relative value strategy is also **robust to other equity signals**. We considered both 12-month historical dividend yield and 12-month historical earnings yield. Table 4 shows that the performance of the strategy based on historical dividend yields is even slightly better in risk-adjusted terms. Results are also strong with forward-looking dividends.

Using other commodity futures indices

The relative value strategy **also works well with other commodity future indices**. We considered the following alternative indices: a) J.P. Morgan Contag; and b) J.P. Morgan Commodity Curve Index (JPMCCI). In the main analysis, we assume that the benchmark weights were based on the S&P GSCI index. We also tested variations with other weighting schemes, such as the weights of S&P GSCI Light Energy or equal-weights. Results remained robust to these variations and are available upon request.

Table 4: Using historical dividend yields as signals
Performance statistics

	RV Strategy Long ER	RV Strategy Long ER (Using dividend yield)
Avg Exc Return	19.8%	21.4%
Std Deviation	19.5%	20.2%
Sharpe Ratio	1.02	1.06
Skewness	-0.05	-0.01
Kurtosis	5.23	5.03
Max Drawdown	-35.3%	-35.0%
Ave Drawdown	-6.7%	-7.0%
Alpha (GSCI)	17.7%	19.1%
t-stat	4.13	4.55
Alpha (MSCI)	15.2%	16.6%
t-stat	2.58	2.67
Alpha (Both)	15.1%	16.5%
t-stat	3.80	4.18

Source: J.P. Morgan, S&P, Bloomberg.

Using other hedging positions

The base-case strategy uses a MSCI World-weighted basket of rolling futures strategies. Results are **robust to other hedging strategies**, as performance is nearly the same if we use MSCI World AC and S&P500 for the short position.

Using other commodity equity indices and longer samples

There are other sector equity indices that provide access to commodity exposure. Our conclusion is that outperformance has been independent of the choice of the underlying commodity equities. For example, performance remained very similar when using the CRBEQ indices (Table 5). Using the CRB sample since Dec 1999, we find that the long strategy had a Sharpe ratio of 0.90 vs 0.11 for the S&P GSCI Index.

Performance is not as strong when using other less specific indices, but **results with other equity indices are still better than following a static commodity allocation**. We also tested the strategy using sector/industry groups of standard indices, such as the S&P 500. As an advantage, some of these indices are available in ETF format.

We also tested the model with broader US equity indices. We considered the **S&P 500 Select Industry indices**, which are designed to measure the performance narrow GICS sub-industries: Oil Production and Exploration (SPSIOPTR Index) and Metals and Mining (SPSIMMTR Index). Data are available since December 1999. Results are not comparable to the base case strategy as we trade only energy and metals. In this analysis, we assume that both precious metals and agriculture weights are allocated into commodity futures.

Table 5: Using CRB commodity equity indices
Performance statistics

	RV Strategy Long ER	RV Strategy Long CRB ER
Avg Exc Return	19.8%	20.7%
Std Deviation	19.5%	20.9%
Sharpe Ratio	1.02	0.99
Skewness	-0.05	-0.26
Kurtosis	5.23	4.01
Max Drawdown	-35.3%	-40.1%
Ave Drawdown	-6.7%	-8.7%
Alpha (GSCI)	17.7%	18.5%
t-stat	4.13	4.45
Alpha (MSCI)	15.2%	15.8%
t-stat	2.58	2.51
Alpha (Both)	15.1%	15.8%
t-stat	3.80	4.11

Source: J.P. Morgan, S&P, Bloomberg.

As narrow indices do not have long history, we also use **broder indices that correspond to the top level of the GICS industry classification** and include only S&P 500 stocks. The indices are: Energy (SPTRENRS Index) and Materials (SPTRMATR Index). We also considered an Agriculture sub-index (S5AGRI Index) as a proxy for total returns in the Agriculture sector. We should note that these indices are broad and may include companies that do not belong to the targeted commodity sectors. In this analysis, we assumed that precious metals weights are allocated into commodity futures.

A version of the strategy that uses the S&P Global Natural Resources indice and, before their base date, the S&P 500 sub-indices has delivered a Sharpe ratio of 0.77 vs 0.08 for the S&P GSCI since Dec 1994. Note that some of the information used in this model is not available in 1994, so, in this version, information is added as it becomes available.

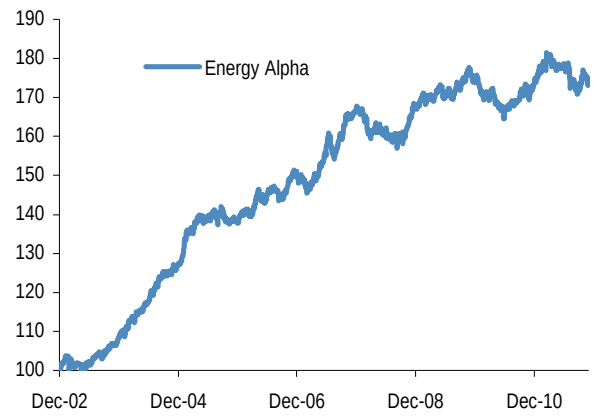
We find that the **relative value strategy has paid off since the mid 80's**. As discussed previously, we lack long historical data on commodity equity indices. In order to evaluate the robustness of this concept with longer data, we tested a simpler version that trades one commodity futures index (S&P GSCI WTI Crude Oil) and one broad sector index (Datastream US Energy). In this version, we hedge the equity exposure using the Datastream US equity index. This simpler relative value strategy had a Sharpe ratio of 0.68, while a long only positiong in the Crude Oil index delivered only 0.36, which is economically significant since we are trading only one commodity.

Table 6: Sector Long-Short Strategies
Performance statistics

	Energy Alpha	Metals Alpha	Agriculture Alpha
Avg Exc Return	7.4%	6.0%	6.8%
Std Deviation	5.1%	4.8%	5.0%
Sharpe Ratio	1.45	1.27	1.36
Skewness	0.09	-0.16	-0.11
Kurtosis	2.31	1.87	1.99
Max Drawdown	-7.4%	-6.2%	-9.0%
Ave Drawdown	-1.7%	-1.3%	-1.7%
Alpha (GSCI)	7.4%	5.9%	6.6%
t-stat	4.06	3.51	3.76
Alpha (MSCI)	6.6%	5.5%	6.1%
t-stat	3.78	3.31	3.53
Alpha (Both)	6.6%	5.5%	6.1%
t-stat	3.81	3.32	3.54

Source: J.P. Morgan, S&P, Bloomberg.

Chart 13.A: Energy alpha strategy
% allocation

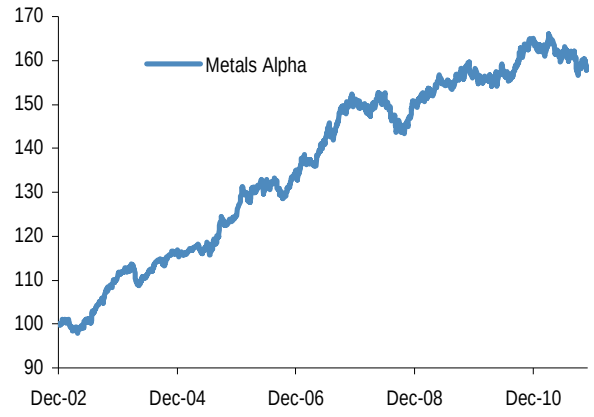


Source: J.P. Morgan, S&P, Bloomberg.

Single commodity sectors

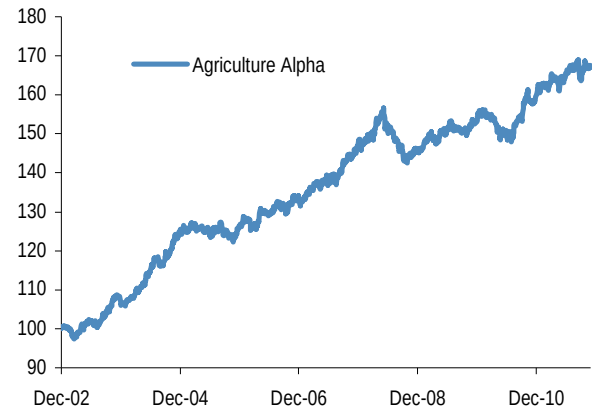
The relative value strategy **also works well in the single commodity sector level** (Table 6). We revisit the long-short strategy discussed in an earlier section, but now apply it to energy, metals or agriculture each at a time. The short position is the S&P GSCI index of the respective sector. We also apply a risk control mechanism to limit the volatility of the long-short position. We also considered a version that matches the volatility of the long and short positions and risk profiles could be potentially quite different. Charts 13.A to 13.C show that the strategy adds value for every single sector.

Chart 13.B: Industrial metals alpha strategy
% allocation



Source: J.P. Morgan, S&P, Bloomberg.

Chart 13.C: Agriculture alpha strategy
% allocation



Source: J.P. Morgan, S&P, Bloomberg.

Other robustness tests

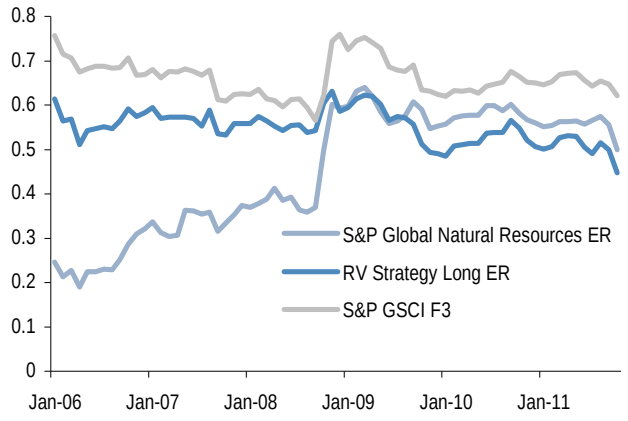
For the sake of brevity, we omit some of the robustness tests that were performed. One of these tests was to consider **multiple definitions of commodity slope/slide**. The base-case strategy uses the slope of the contract selected by the S&P GSCI F3 index (or the chosen index), which is the obvious choice of slope as it measures the slide of that contract. Nevertheless, we also tested the strategy with other definitions of slope (front slope and one-year slope) with similar qualitative results. For a similar discussion, see Ribeiro, R.M. *Profiting from slide in commodity markets*, 2009. In the base case strategy, we use a two-month average of current and past slope.

We have also tested the sensitivity of **other minor parameters of the model**. For example, we looked at the effect of changing the **beta estimation** window in equity hedging or of using an exponentially-weighted beta. In all cases, we found the model to be quite robust. We also considered a **neutral zone for the relative value measure**, so whenever the measure is not clearly negative or positive given a chosen threshold, we select a balanced position into both futures and equities.

Inflation hedging

The relative value strategy adds alpha to a long-only commodity investment, while **maintaining a similar risk profile**. In particular, we find that the relative-value long-only strategy remains an **efficient inflation hedging asset** as the rolling correlation to future inflation is of the same magnitude (Chart 14). The average correlation to inflation is 0.55, while S&P GSCI has a correlation of 0.66 since 2002.

Chart 14: Inflation hedging benefits: correlation to US Inflation
Rolling 36-month correlation



Source: J.P. Morgan, S&P, Bloomberg.

Table 7: Diversification benefits
Montly statistics, sample 2002-2011

	RV Strategy Long ER	Hedged Commodity Equity	S&P Global Natural Resources ER	S&P GSCI F3
Avg Exc Return	19.8%	13.2%	13.3%	12.0%
Std Deviation	19.5%	18.0%	27.0%	26.3%
Sharpe Ratio	1.02	0.73	0.49	0.46
	Correlation			
MSCI World	0.53	0.61	0.88	0.43
S&P 500	0.34	0.40	0.72	0.31
US 10yr Bond	-0.15	-0.16	-0.28	-0.20
US High Grade	-0.06	-0.06	-0.14	-0.12
US High Yield	0.32	0.37	0.48	0.28

Source: J.P. Morgan, S&P, Bloomberg.

Diversification benefits

We also find that the **diversification benefits are improved with this relative value strategy**. Table 8 confirms that the relative value strategy has the same correlation to global equities that S&P GSCI has, but significantly lower volatility. From the point of view of an US investor, the correlation to other asset classes, such as equities, government bonds, high grade and high yield is also similar, while performance has been superior. Hence, a tactical allocation to commodity future indices seems to be better than a passive one. We have made similar arguments in previous papers such as Ribeiro, R, *Economic and Price Signals for Commodity Allocation*, 2009.

Conclusion

Investors are increasingly obtaining strategic exposure to commodities, mostly to gain diversification, to hedge against event risks from supply disruption, and to be positioned for the eventual exhaustion of natural resources. But the frequent negative yield (roll) on commodity futures is preventing many investors from holding as much as they would like. We offer here a dynamic investment rule, that switches commodity exposure from futures to commodity equities — stocks issued by commodity producers — when the yield on these equities exceeds the roll on futures. The paper shows that this rule significantly increases the return from holding commodities without having much impact on their role in hedging against commodity price shocks and inflation.

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