The Skewness of Commodity Futures Returns

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This article investigates the link between the skewness of the distribution of commodity futures returns and subsequent price changes. A trading strategy that goes long futures contracts with the most negative skew and shorts futures contracts with the most positive skew has historically generated significant alpha. A tradeable skewness factor can explain the cross-section of commodity futures returns beyond exposure to known risk factors. The rationale for these findings is investors' preferences under cumulative prospect theory and selective hedging practices.

Introduction

The question of whether asset skewness contains information about future asset prices has been the subject of a large empirical literature for equities. Behavioral theory predicts a negative relation between skewness and expected returns. Many empirical studies for equities show a significant relation, but the evidence on the sign is mixed.

This paper contributes to the commodity markets literature by addressing this question: Does skewness of the distribution of commodity futures returns tell us anything about expected returns? The authors address this question using both a time-series (portfolio formation) framework and a cross-sectional (pricing) framework.

Using firstly a time-series framework, they examine the out-of-sample (OOS) performance of a long-short portfolio formed according to a *total skewness* signal. Taking fully-collateralized long (short) positions in the commodities with the most negative (positive) skew generates a mean excess return of 8.01% and an alpha of 6.21% (both annualized) on average across pricing models. The second stage of the investigation is aimed at testing empirically the pricing ability of a tradeable skewness factor for the

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cross-section of commodity futures returns. The price of skewness is economically and statistically significant and positive, consistently across models.

Relevance of the Research Question

A study of the relation between skewness and expected returns is of interest to academics and practitioners. At a practical level, the findings are relevant for market practitioners suggesting the possibility of capturing excess returns (premia) through long-short portfolios formed according to an easy-to-measure skewness signal.

At a theoretical level, the significant negative relation between skewness and expected returns that the paper documents may instigate further research aimed at better understanding the price formation process in commodity futures markets. Traditional commodity pricing theories – the theory of storage of Kaldor (1939) and the hedging pressure hypothesis of Cootner (1960) – do not predict such relation, in contrast to the Barberis and Huang (2008) behavioral theory on *skewness preferences*. Barberis and Huang (2008) use the cumulative prospect theory framework of Tversky and Kahneman (1992) to show that overweighting the probability of the occurrence of tail events leads to a preference for positive-skew assets. This phenomenon induces overpricing of positively-skewed assets and subsequently lower returns. The overpricing is not necessarily arbitraged away by short positions because positive skewness has a non-negligible influence on commodity investors' utility functions.

The findings support the *selective hedging hypothesis* by which hedgers' perceptions of future price movements influence their optimal hedge ratio. Hedgers with lottery-type preferences may not only seek to minimize risk but also to maximize positive skewness. The findings of the paper are aligned with the notion that commercial traders have a propensity to take relatively greater (lower) hedges in positive (negative) skew commodities as a reflection of their preference for positive skewness.

Data and Skewness Signal

The main data are daily settlement prices from January 1987 to November 2014 on front-end and second-nearest futures contracts for 27 commodities from the agricultural, energy, livestock, and metal sectors together with random length lumber.

The trading signal is *total skewness* of daily commodity futures returns which is measured using the Pearson's third moment coefficient as follows

$$\widehat{Sk}_{i,t} = \left[\frac{1}{D}\sum_{d=1}^{D}\left(r_{i,d,t} - \hat{\mu}_{i,t}\right)^3\right] / \hat{\sigma}_{i,t}{}^3 \qquad (1)$$

where $t = 1, \ldots, T$ denotes each portfolio formation time (month-end in this analysis), $r_{i,d,t}, d = 1, \ldots, D$ are daily returns of the *i*th commodity within the most recent 12-month period (i.e., D is the number of daily observations within the [*t*-11, *t*] window) and $\hat{\mu}_{i,t} = \frac{1}{D}\sum_{d=1}^{D} r_{i,d,t}$ and $\hat{\sigma}_{i,t}{}^2 = \left[\frac{1}{D-1}\sum_{d=1}^{D}\left(r_{i,d,t} - \hat{\mu}_{i,t}\right)^2\right]$ are the mean and variance estimates.

At each month-end *t*, the authors rank the *i* = 1,…,*N* commodities in the cross-section (*N* = 27) according to their $\widehat{Sk}_{i,t}$ values and group them into five quintiles; quintile Q1 contains the 20% of commodities with the lowest $\widehat{Sk}_{i,t}$, and quintile Q5 contains the 20% of commodities with the highest $\widehat{Sk}_{i,t}$. The resulting long(Q1)-short(Q5) portfolio is held for one month, and then the signal is measured anew to form a new long-short portfolio (i.e., monthly rebalancing), and so forth until the end of the sample period.

Results of Time-Series Tests: Performance of Skewness-Sorted Portfolios

Examining the frequency with which each commodity enters the long (Q1) and short (Q5) portfolio per sector, the authors observe that none of the commodities is perpetually part of the Q1 or Q5 portfolios, namely, the Q1-Q5 return differential is not driven by the exceptional behavior of a few commodities.

The skewness long-short strategy generates a mean excess return of 8.01% a year, a Sharpe ratio of 0.7848 and an Omega ratio of 1.8136. Interestingly, these performance measures are far better than those of the long-short term structure, momentum and hedging pressure portfolios that are popular among academics and practitioners alike.

The authors measure the alpha of the skewness portfolio using a pricing model with four factors: the excess returns of an *equally-weighted long-only* portfolio of the 27 commodity futures, and the excess returns of three long-short (*term structure*, *momentum*, and *hedging pressure*) portfolios that proxy the risks associated with the backwardation/contango cycle of commodity futures. A significant alpha of 6.58% p.a. indicates that the profitability of the skewness portfolios is not merely a compensation for exposure to known commodity risk factors.

Cross-Section Tests: Pricing Ability of Tradeable Skewness Factor

The authors test whether the tradeable skewness factor explains the cross-sectional variation in commodity futures returns. The average price of skewness risk is a significant 5.02% *per annum*. Thus, investors demand a higher compensation or premium for exposure to commodity futures with more negative skewness. The paper provides evidence of a pervasive increase in explanatory power when a 'traditional' pricing model that includes risk factors that relate to the backwardation/contango cycle is extended with the tradeable skewness factor. The increase in explanatory power of about 4% across models is similar to that documented in equity market research.

Conclusions

This article investigates the relation between skewness and expected returns of commodity futures. A skewness long-short portfolio that buys (shorts) the most negatively (positively)-skewed commodities at each month-end from January 1987 to November 2014 generates attractive risk-adjusted performance. The skewness portfolio earns a sizeable alpha according to various commodity pricing models. Through cross-sectional pricing tests, the paper further establishes that the tradeable skewness factor is more strongly priced than any of the risk factors thus far considered in the literature.

The key finding of the paper is a negative relation between the skewness of the distribution of daily commodity futures returns and expected returns. More specifically, the findings suggest that the third moment of the return distribution contains information about subsequent price changes. Building on cumulative prospect theory, the paper confirms that the preference for lottery-type (positive skew) assets influences the utility function of hedgers, inducing overpricing and lower expected returns.

Endnotes

This commodity research paper is also included in the J.P. Morgan Center for Commodities' *Global Commodity Issues eJournal*. The author of this digest article is a member of the Editorial Advisory Board (EAB) of the *Global Commodities Applied Research Digest (GCARD).* The *GCARD*'s EAB membership is listed here: http://jpmcc-gcard.com/editorial-advisory-board/.

References

Barberis, N. and M. Huang, 2008, "Stocks as Lotteries: The Implications of Probability Weighting for Security Prices," *American Economic Review*, Vol. 98, No. 5, December, pp. 2066–2100.

Cootner, P., 1960, "Returns to Speculators: Telser vs. Keynes," *Journal of Political Economy*, Vol. 68, August, pp. 396–404.

Kaldor, N., 1939, "Speculation and Economic Stability," *Review of Economic Studies*, Vol. 7, No. 1, October, pp. 1-27.

Tversky, A. and D. Kahneman, 1992, "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty*, Vol. 5, No. 4, pp. 297–323.

Keywords

Skewness, commodities, futures pricing, selective hedging.