Fear of Hazards in Commodity Markets

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This paper examines the predictive content of active attention to hazards or "hazard fear" which is proxied by changes in the volume of internet search queries (or active attention) by 149 weather, disease, geopolitical or economic terms. A long-short portfolio strategy that sorts the cross-section of commodity futures by a hazard fear signal -- inferred from the co-movement of past excess returns with the active attention -- is able to capture an economically and statistically significant premium. A time-series analysis suggests that this hazard fear premium partially reflects compensation for known risks such as those formalized as hedging pressure, momentum, illiquidity and skewness factors, but is not subsumed by them. Exposure to hazard-fear is strongly priced in the cross-section of individual commodity futures and commodity portfolios over and above known risk factors. The hazard fear premium is significantly greater in periods of higher financial investor pessimism which reveals a channel for the transmission of sentiment to commodity futures markets.

Introduction

Commodity hazard fear is broadly defined as the economic agents' apprehension or anxiety about potential weather, agricultural disease, geopolitical and economic threats that may shift the commodity supply or demand curves. Building on economic psychology, the empirical investigation conducted by the authors builds on the assumption that economic agents' fear about threats induces them actively to search for information (Lemieux and Peterson, 2011). This active information demand is referred to as "attention" in the recent asset pricing literature (Da *et al*., 2011, 2015; Han *et al*., 2017a, 2017b; Vozlyublennaia, 2014). The authors hypothesize that fear of rare and extreme events contains predictive content for commodity futures returns and influences the pricing of commodity futures contracts over and beyond the fundamental backwardation and contango cycle. Fear of hazards induces expectations of a sharp rise/decline in spot prices. These expectations, in turn, can influence the hedging decisions of commodity market participants and the compensation demanded by speculators to absorb changes in net hedging. For instance, when there is fear about a threat inducing a dramatic drop in supply and thus, when the spot price is expected to sharply rise, speculators may demand a higher premium for taking short positions (than in the absence of such fear) which implies higher current futures prices; thus, the

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decrease in the futures price as maturity approaches is the overall premium captured by short speculators which incorporates a fundamental and a hazard-fear component.

Economic agents' fear can arise from many reasons. In our paper, building on the aforementioned literature on the pricing content of "attention" we are agnostic as to whether the internet searches by the hazard terms are induced by news releases about impending hazards or simply by a phenomenon akin to the "representativeness" heuristic – for instance, a coffee producer may be anxious about extreme weather pre-harvest because her crops were thus adversely affected in the past or because she is mindful of extreme weather phenomena that had dramatically shifted inward the supply of other commodities.

The paper provides three contributions to the literature. Using the internet search volume by 149 commodity hazard-related keywords as a proxy for hazard-fear, the authors adapt the framework of Da *et al*. (2015) to obtain a commodity-specific hazard fear characteristic (hereafter CFEAR) that reflects the co-movement between the commodity futures returns and the hazard-fear. Second, they construct a CFEAR-sorted portfolio of commodities to formally assess the out-of-sample predictive content of the CFEAR characteristic for commodity futures returns (the fear premium) and deploy time-series spanning tests to examine whether the fear premium is subsumed by well-known commodity risk factors. Third, the paper contributes to the commodity pricing literature by providing cross-sectional tests for commodity portfolios (sorted on characteristics and sectors) and individual commodities to investigate whether the CFEAR factor captures priced risk over and above known commodity risk factors.

Relevance of the Research Question

The analysis conducted in this paper fills a void in the futures markets literature by investigating whether fear of (and attention to) hazards conveys expectations about subsequent futures prices. By demonstrating that a long-short portfolio strategy based on a fear signal is able to capture a significant premium and that this premium is not subsumed by fundamental premia such as term structure, hedging pressure or momentum (inter alia) the paper provides novel evidence that hazard fear can also influence commodity futures prices over and above the fundamentals. Filling a void in the literature, the authors show that "animal spirits" (paraphrasing the British economist John Maynard Keynes) in the form of adverse moods or pessimism (i.e., sentiment) in the broad financial markets, as proxied by VIX levels, can be channeled into commodity futures markets by exacerbating the hazard fear.

Data, CFEAR Signal and Portfolio Construction

Inspired by the extant literature that uses Google search volume as a proxy for investor attention (or information demand) in financial markets, this paper introduces a commodity hazard-fear characteristic that is constructed from internet search volume data from *Google Trends* using an array of 149 hazards as query terms. The Google searches are sampled at a weekly frequency (as daily searches are likely to be noisier) with each observation capturing the search queries from Monday 00:00:00 to Sunday 23:59:59. Thus, the portfolio rebalancing is carried out at the start of each Monday to exploit the previous-week searches. As in Da *et al*. (2015), the measure of interest is the weekly log change in the Google search volume or attention to hazard *j* defined as $\Delta S_{j,t} \equiv \log(s_{j,t}/s_{j,t-1}), j = 1, \dots, J$, so that sharp increases in the attention to hazards can be taken to signal a surge in hazard-specific fear. Following Da *et al*. (2015),

in order to make the attention series comparable across the $j = 1, \dots, 149$ keywords we standardize each as $\Delta S^*_{j,t} \equiv \Delta S_{j,t} / \sigma^{\Delta S}_{j,t}$ where $\sigma^{\Delta S}_{j,t}$ is the standard deviation of the series $\Delta S_{j,t}$ using data from week 1 to *t*. As in Da *et al*. (2015), we run backward-looking regressions to measure the strength of the historical contemporaneous relationship between searches and commodity futures returns:

$$r_{i,t-l} = \alpha + \beta^{CFEAR}_{i,j,t-l} \cdot \Delta S^*_{j,t-l} + \varepsilon_{t-l}, \quad l = 0, \dots, L-1 \tag{1}$$

for each of the $j = 1, \dots, 149$ keywords in the sample. We estimate Equation (1) by OLS and, for commodity i we construct the CFEAR characteristic as follows:

$$CFEAR_{i,t} \equiv \sum_{j=1}^{J} \hat{\beta}^{CFEAR}_{i,j,t-l} \tag{2}$$

by aggregating the corresponding sensitivity measures for the $J = 149$ keywords. The long-short CFEAR portfolio takes long positions on the commodities with the most negative ($CFEAR_{i,t} < 0$) signal, and short positions on those with the most positive ($CFEAR_{i,t} > 0$) signal. To avoid a look-ahead bias, the analysis is conducted out-of-sample; namely, the buy or sell decisions at each week *t* hinge on past data.

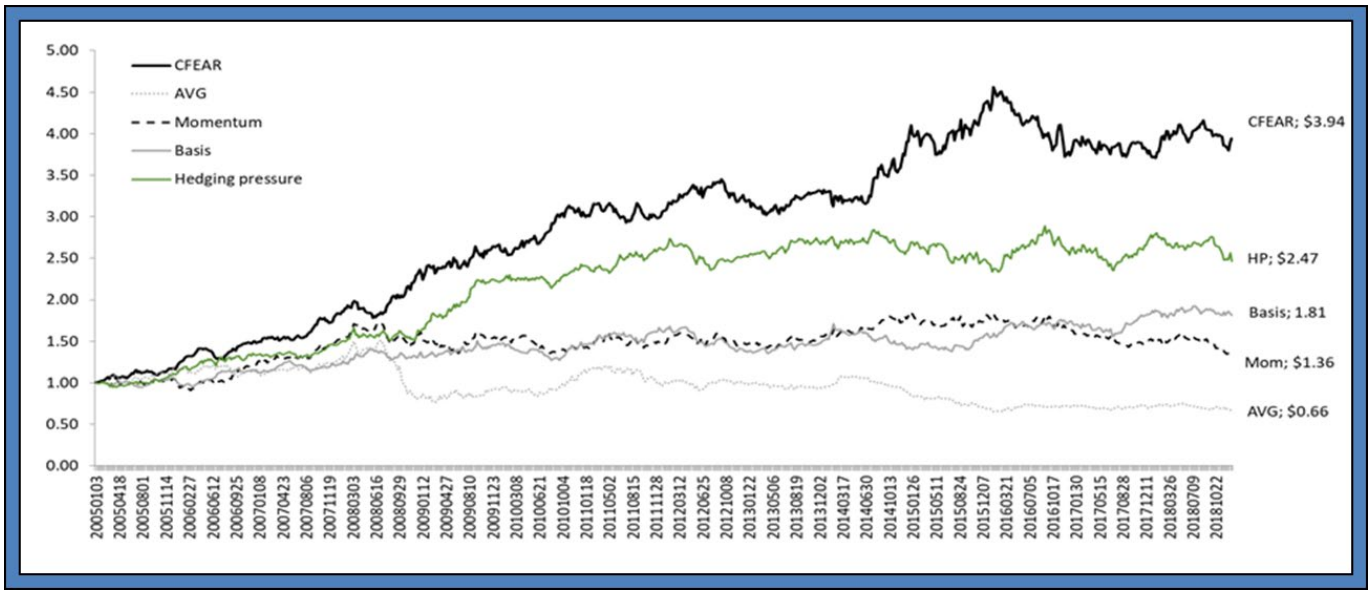
The authors deploy the long-short portfolios on a cross-section of 28 commodity futures contracts comprising 17 agricultural (4 cereal grains, 4 oilseeds, 4 meats, 5 miscellaneous other softs), 6 energy, and 5 metals (1 base, 4 precious). The observation period is from January 1, 2004 (as dictated by the availability of weekly *Google Trends* search data) until December 31, 2018.

Results

The fully-collateralized long-short CFEAR portfolio captures an economically and statistically significant premium of 9.28% p.a. ($t = 3.35$) which stands well relative to traditional premia as shown in Figure 1 on the next page. In addition, the CFEAR portfolio has an appealing risk profile, that materializes in a Sharpe ratio of 0.9012 versus 0.3387 (term structure portfolio), 0.5926 (hedging pressure) and 0.1296 (momentum). Further, the CFEAR portfolio presents relatively favorable tail (crash) risk characteristics as borne out, for instance, by a 99% VaR and maximum drawdown of 0.0341 and -0.1881, respectively, while the corresponding risk measures for aforementioned long-short traditional portfolios lie in the ranges [0.0356, 0.0421] and [-0.2872, -0.1828], respectively.

Figure 1 shows the evolution of $1 invested in the long-only equally weighted portfolio of the 28 commodities (AVG), and the long-short basis, momentum, hedging pressure and CFEAR portfolios.

Figure 1
Future Value of $1 Invested in Commodity Portfolios



Examining the excess returns of the long versus short legs of the portfolio reveals that the CFEAR premium is mostly driven by the short positions. This finding is consistent with the inherent asymmetry of inventories which can be built up to dampen commodity price falls but their natural zero lower bound makes them likely to be perceived by agents as an ineffective lever to stifle upswings in commodity prices.

Next the authors estimate time-series regressions of the returns of the long-short CFEAR portfolio on the term structure, hedging pressure and momentum factors – and other factors suggested in the literature such as basis-momentum, convexity, illiquidity and skewness inter alia (Gu *et al*., 2019; Boons and Prado, 2019; Fernandez-Perez *et al*., 2018; Szymanowska *et al*., 2014). The results reveal exposure to some of these factors but the regression intercept (or alpha) remains economically and statistically significant. Therefore compensation for exposure to fundamentals risks does not tell the whole story.

Cross-sectional asset pricing tests deployed both for individual commodities and commodity portfolios as test assets reveal that exposure to the CFEAR factor is consistently priced, and that the CFEAR factor is able to improve the explanatory power (reduce the pricing error) of extant commodity pricing models.

The mean excess return and alpha of the CFEAR portfolio are found to be greater when VIX levels are high; i.e., when risk-aversion is high or when sentiment is adverse. A rationale is that speculators may demand a higher premium in high VIX periods because their risk-bearing ability has been then impaired (due either to funding liquidity constraints or to their reluctance to take risks in bad times) or because their investment decisions are contaminated by adverse sentiment (pessimism). Given that risk aversion and sentiment are likely to co-vary over time, it is challenging to tell the two explanations apart. However, an identical analysis conducted for the fundamental term structure, hedging pressure and momentum premia reveals that they are, in sharp contrast, unrelated to the VIX; this suggests that broad financial market sentiment can be channeled into commodity futures pricing through hazard fear. The intuition is

that when investors are out of their comfort zone because of turmoil in financial markets, as signaled by a high VIX, they are more vulnerable to emotions such as (hazard) fear.

A battery of robustness tests are not able to challenge the above findings. These tests include alternative portfolio formation approaches (e.g., monthly rebalanced), and CFEAR signal extraction methods. Among the latter, the authors measure the CFEAR signal in a manner that controls for the impact of media coverage defined, as in Fang and Peress (2009) and others, as the number of news articles published about each commodity per week to proxy for its overall media exposure (or information supply).

Seeking to rule out concerns that the finding of a significant hazard-fear premia in commodity futures markets is an artefact of the methodology employed, the authors carry out an intuitive "placebo" test (focusing on the 123 keywords in the weather and crop disease categories) that consists of deploying the same long-short portfolio strategy for 4 cross-sections of commodity, equity, currency and fixed income futures contracts, respectively. The fear premium remains sizeable and statistically significant in commodity futures markets at 8.17% p.a. (t=3.06) but is merely 1.83% p.a. (t=1.62) in equity index futures markets, 0.19% p.a. (t=0.25) in fixed income futures markets and 1.16% p.a. (t=1.50) in currency futures markets. This suggests that the CFEAR premium in commodity futures is unlikely to be spurious.

Conclusions

Does the human emotion known as fear influence commodities futures pricing? This paper addresses this question by focusing on weather, agricultural pests, geopolitical or economic threats to the commodity supply or demand. Fear is proxied by surges in the active search for information or attention.

A long-short CFEAR portfolio is able to earn a sizeable premium in commodity futures markets. Using time-series spanning tests, it is shown that this premium cannot be fully rationalized as compensation for exposure to known risk factors. Through asset pricing tests the paper further demonstrates that exposure to hazard-fear is a key determinant of the cross-sectional variation in the excess returns of both individual commodities and commodity portfolios beyond known fundamental pricing factors. The results are robust to trading costs and to alternative CFEAR signal measurement and portfolio construction methods. The CFEAR premium magnifies in periods of pessimism as proxied by the VIX revealing a channel for overall financial investor sentiment to transmit into commodity futures markets. A key takeaway is that fear about potential hazards contains predictive information about commodity futures prices.

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Keywords

Commodity supply, commodity demand, hazards, fear, attention, search activity, sentiment, long-short portfolios.