Speculator Spreading Pressure and the Commodity Futures Risk Premium

Yujing Gong[a], Arie E. Gozluklu[b], Gi H. Kim[c]

December 12, 2019

Abstract

This paper investigates the impact of speculative trading on the commodity futures risk premium. We focus on speculators' spread positions, and study the asset pricing implications of *spreading pressure* on the cross-section of commodity futures returns. Spreading pressure negatively predicts futures excess returns even after controlling for well-known determinants of futures returns such as basis-momentum. The spreading pressure factor-mimicking portfolio carries a significant risk premium of 21.55% per annum after commodity market financialization. Our single-factor model provides a better cross-sectional fit than the existing factor models. We show that spreading pressure reflects speculators' expectation on the change in the slope and curvature of futures term structure, and our spreading pressure is explained by innovations in real economic uncertainty.

[a]University of Warwick, Scarman Road, Coventry, CV4 7AL. E-mail: phd16yg@mail.wbs.ac.uk
[b]University of Warwick, Scarman Road, Coventry, CV4 7AL. E-mail: Arie.Gozluklu@wbs.ac.uk
[c]University of Warwick, Scarman Road, Coventry, CV4 7AL. E-mail: Gi.Kim@wbs.ac.uk

1 Introduction

The Futures Industry Association (FIA) annual survey shows that the trading volume of global commodity futures increased markedly from 2.19 billion contracts in 2009 to 5.74 billion contracts in 2018. The dramatic increase and subsequent sharp decrease in commodity prices during mid-2008 has triggered heated debates about the role of speculators' trading activities in commodity price swings. Part of the literature argues that speculating activities do not impact these swings and they actually moderate swings caused by fundamentals. Other papers, on the other hand, document that the 'financialization' of commodity markets enable speculators to shift drifts and volatilities of commodity prices. Building upon the second standpoint, this paper investigates the impact of speculators' trading activities on the commodity futures risk premium. In particular, we focus on speculators' *spread* positions, and study the asset pricing implications for the cross-section of commodity futures returns.

The spread positions are held by speculators, which is created by entering the same amount of long and short positions on a single commodity with different time-to-maturities.[1] Spread strategies in commodity futures markets has gained its pouplarity since there exists a lower barrier/cost to pursue such strategies compared to equit market counterparts (i.e., no short-selling constraint, lower margin requirements to obtain high leverage). Especially, it is shown that spread trading volume has significantly increased around 2005 due to the finacialization of commodity markets (Tang and Xiong, 2012; Bonato and Taschini, 2015). Mou (2011) and Singleton (2013) document ratios of speculator spreading positions relative to total open interests increased dramatically from around 5% before 2005 to more than 20% after 2005.[2] Speculators take intra-commodity spread positions to get risk expousures

[1]Market players' trading positions among commodities are published by Commodity Future Trading Commission (CFTC) and the data begins from 1986. Weekly Commitment of Trader (COT) reports contain the number of positions of each commodity held by "Commercial", "Noncommercial" and ''Non-reportable" traders. In the literature, the "Commercial" and "Non-commercial" traders are labelled as hedgers and speculators, respectively. In addition to the long and short positions taken by hedgers and speculators, the spread positions held by speculators also reported separately

[2]Due to the sharp contrast in the significance of spread trades for the pre- and the post-2005 period, we also examine their influence on commodity future returns for two sub-periods.

to the change in the shape of term structures of commodity futures prices (either slope or curvature, or both).[3] Hence, the extent to which speculators enter the spread position (*spreading pressure*) can convey the information on the commodity futures term structure.

Predicting commodity futures curves is a challenging task. The shape of futures term structures are different in different periods and different commodities, i.e., the slope changes between upward and downward, and the curvature move between convex and concave. This fact is not only influenced by commodity demand and supply in the cash market, but also explained as the demand-supply imbalance of futures contracts for specific maturities by Keynesian analysis. Previous studies take both model-based and model-free approach to extract the slope and the curvature of commodity futures curve. Karstanje, Wel and Dijk (2015), Etienne and Mattos (2016) and Huellen (2018) employ the Nelson-Siegel approach (Nelson and Siegel (1987)) to decompose future curves into three components. Irwin et al. (2011) and Brunetti and Reiffen (2014) use calendar spreads to represent the slope of term structure, but ignore the non-linear shape of the future curve. Boons and Prado (2019) use the difference between two nearby calendar spreads, equivalent to the butterfly spread, to capture the curvature of the future curve. This paper will take the second (model-free) approach to extract the term structure information based on speculators' spreading pressure, and take it further to derive its asset pricing implications. In doing so, we relate spreading pressure to the cross-section of commodity futures returns.[4]

[3]Intra-commodity spread trading strategies include *calendar spread* positions and *butterfly spread* positions. The calendar spread mainly exposes to risk caused by changes of slope and curvature and the butterfly spread mainly exposure to the risk caused by curvature changes only.

[4]Commodities future returns are known to be driven by a number of factors related to both derivatives (futures) and underlying cash (commodity inventory) markets (Pindyck, 2001; Geman and Ohana, 2008; Liu and Tang, 2010). There exist largely two strands of theoretical literature understanding the commodity future risk premium by accounting for these two different markets. Firstly, on the cash market, the traditional Theory of Storage (Kaldor, 1939; Working, 1949; Brennan, 1958) shows that the increase in commodity inventory level will lead to the decrease in the benefit (called convenient yield) received by the owner of inventories. When the inventory is at a normal level, the market usually exhibits as contango market. Note that, downward slope (future price<spot price) and upward slope (future price>spot price) of future term structure called *backwardation* and *contango*, respectively. Secondly, on the future market, the Theory of Normal Backwardation (Keynes, 1930) explains the backwardation market by using the hedging pressure in the future market. It assumes that the producer and inventory holders take short positions to hedge risk exposure. To incentive speculators to take opposite positions, a discount of future price (backwardation) will be served as the risk premium for speculators.

In this paper, we present four maing findings. First, spreading pressure predicts futures excess returns negatively and significantly, even after controlling for an important determinant of futures returns, basis-momentum. After controlling systematic differences across time and commodity, commodity futures excess returns will decrease 11.76% (t-statistics = -5.43) when spreading pressure increase 1%. Second, we construct a spreading pressure factor-mimicking portfolio by longing three lowest spreading pressure commodities and shorting three highest spreading pressure commodities. This portfolio generates 21.19% return per annum after 2005, which is higher than factor-mimicking portfolios sorted on well-known factors, basis, momentum and basis-momentum (cumulative returns in Figure 6). Third, we find spreading pressure is a priced factor in commodity future market after 2005. The estimated price of risk on spreading pressure is 21.55% (t-statistics = 7.58) per annual under single-factor model and $R^2 = 70\%$. Our single-factor model including spreading pressure provides a cross-sectional fit that is better than the existent 2-factor or 3-factor models and is similar to multi-factor models as it includes spreading pressure and the other existent factors. Fourth, spreading pressure reflects expected slope and curvature of commodity future curve and spreading pressure factor is linked to innovations in real economic uncertainty.

The literature on commodity futures pricing shows that commodity future returns can be explained by a small number of priced commodity factors. First, Szymanowska, de Roon, Nijman, and Goorbergh (2014), Yang (2013) and Bakshi, Gao and Rossi (2017) introduce the carry factor based on a term structure signal, basis. They find the Low-basis commodity futures has higher risk premium on this factor than high-basis commodity futures. Economically, this factor is related to innovations in equity volatility, which presents technological progress in new capital producing. Second, Gorton, Hayashi and Rouwenhorst (2013) and Bakshi, Gao and Rossi (2017) show that the risk premium on momentum factor is significant, and this factor is constructed by using commodity futures past performance as a signal. Commodity futures with good past performance has higher risk premium on this factor than the bad performance commodity futures. Bakshi, Gao and Rossi (2017) provide an economic interpretation of this factor as the measurement of innovations in speculative activity. Third, risk premium on hedging pressure (Bessembinder, 1992; Basu and Miffre, 2013; Dewally Ederington and Fernando, 2013) is documented in the literature. Commodity futures with high short demand from hedgers has higher risk premium on this factor than the the other commodity futures. Fourth, similar to equity markets, Frijns, Fuertes and Miffre (2018) find that risk premium on skewness is significant in commodity future market. Commodity futures with the most negative skew has significant higher return than commodity futures with the most negative skew and this return difference could be explained by investors' preferences for skewness under cumulative prospect theory and selective hedging practices. Moreover, commodity value factor (Asness Moskowitz and Pedersen, 2013), commodity volatility factor (Bakshi, Gao and Rossi, 2017), commodity liquidity factor (Marshall Nguyen and Visaltanachoti, 2011) and inflation β (Hong and Yoga, 2012) are also proposed in the literature. Last but not least, Boons and Prado (2019) propose the basis-momentum factor, which is derived from slope and curvature of the futures term structure, and captures the imbalanced demand and supply of future contracts. They show the basis-momentum factor is a priced factor, and a two-factor asset pricing model (including a commodity market factor and their basis-momentum factor) has better performance than alternative three-factor models (Szymanowska, de Roon, Nijman, and Goorbergh, 2014; Bakshi, Gao and Rossi, 2017). Boons and Prado (2019) also find that the basis-momentum factor has higher predictive power on the commodity premiums when speculators' intracommodity spread positions are high. In light of Boons and Prado (2019), this paper investigates whether spreading pressure (spread positions scaled by open interest) can predict commodity future return, and whether spreading pressure factor (Low-High portfolio sorted on 12-month average spreading pressure) is a priced factor.

This paper contributes to the aforementioned literature of commodity futures pricing in four aspects. First, this paper contributes to the literature of commodity return predictors, since we find the predictability of spreading pressure on commodity future excess returns. Second, our paper contributes to the literature of commodity factor pricing models by proposing a novel pricing factor, and the superiority of a parsimonious single-factor model over multi-factor models. Third, this paper establishes the link between speculators' spread positions to the commodity future risk premium. It also contributes to the literature of the role of speculators in particular, and financial intermediation in general in commodity futures markets. Finally, this paper is one of the first studies to explore the economic determinants and information content of spreading pressure.

2 Data and summary statistics

2.1 Commodity Futures Prices

We obtain daily prices for individual commodity's future contracts from Bloomberg and the sample period is between January 2, 1986 and June 30, 2018. Our analysis focuses on 27 commodity future contracts with different maturities covering five major categories, namely, (1) Energy (heating oil, natural gas, RBOB/unleaded gasoline and WTI crude oil), (2) Grains (corn, oats, rough rice, soybean oil, soybean meal, soybeans and wheats), (3) Meats (Feeder cattle, lean hogs, live cattle and frozen pork belly), (4) Metal (high grade copper, palladium, platinum, silver and gold) and (5) Soft (cocoa, coffee, cotton, lumber, orange juice and sugar).

We calculate monthly excess returns of long and short positions based on the assumption of fully collateralized futures positions (e.g., Gorton, Hayashi and Rouwenhorst, 2013; Koijen, Pedersen, Moskowitz, and Vrugt, 2015; Bakshi, Gao and Rossi, 2017; Boons and Prado, 2019):

$$R^{(n)}_{long,t+1} = \frac{F^{(n)}_{t+1}}{F^{(n)}_{t}} - 1, \quad R^{(n)}_{short,t} = -\left(\frac{F^{(n)}_{t+1}}{F^{(n)}_{t}} - 1\right), \quad n \geqslant 0 \tag{2.1}$$

where $F^{(n)}_{t}$ is the price of the future contract with the $(n+1)$-th shortest maturity at the end of month t among all available contracts, which isdefined as price of the n-th nearby contract when $n \geqslant 1$ and spot price when $n = 0$. For example, $F_t^{(0)}$ and $F_t^{(1)}$ are prices of future contracts with the 1st and 2nd shortest maturities at the end of month t and are also named as spot price and price of first nearby contract. Due to the irregularities in first notify and delivery dates, the first notify day and the first delivery day of the contract with the 1st shortest maturity could occur before the end of month t+1. Therefore, we follow Bakshi, Gao and Rossi (2017) to take position in commodity future contract with the 2nd shortest maturity at the end of month t, i.e., $F_t^{(1)}$. This approach avoids facing a physical delivery or delivery demand from investors' counterparty, and the influence from unusual price and volume behavior when a contract is close to expiration. Since the commodity spot market is illiquid, the price of future contract with the 1st shortest maturity $\left(F_t^{(0)}\right)$ is used to approximate the spot price. This paper focuses on the 1st-nearby contracts with high liquidity for the analysis related to commodity future return, but we also use 2nd- and 3rd-nearby contracts as robustness test.

Table 1 shows the statistics summary for annualized excess returns of the 1st-, 2nd- and 3rd-nearby contracts. There are 19 (18) out of 27 commodities' 1st- and 2nd- (3rd-) nearby contracts have Sharp ratios below 0.25. That means investing in a single commodity contract is not attractive. The average returns are different across commodities and along their future curves. Only 5 out of 27 commodities' return differences along the future curves are less than 1%. The largest return difference is natural gas, with -6.6% and -0.66% average return for the 1st- and 2nd-nearby contracts respectively. The volatility along the future curve exhibits that future contracts with long maturities are less volatile than the first nearby contract, which is consistent with Samuelson effect (1965).

We define the slope and curvature of future curve (Boons and Prado, 2019) as

$$slope_t = \ln F_t^2 - \ln F_t^0$$

$$curvature_t = \sum_{s=t-12}^{t} \left(\ln F_s^2 - \ln F_s^1\right) - \left(\ln F_s^1 - \ln F_s^0\right)$$

Figure 1 and 2 present the time-variation of slope and curvature of future curves among 27 commodities in five categories. We observe that slope and curvature of commodity future curve varies over time. Except WTI crude oil and commodities in metal category, future curve slopes of the majority of the rest commodities exhibit seasonal patterns in some extent, for example, Lean hogs in meats category has strong seasonality in the slope of future curve. This is consistent with previous studies, which show that the slope, or basis, are related to the commodity's inventory level. There is no significant seasonal pattern in curvatures of future curve across commodities, since our definition of curvature is the sum of curvature in 12 month.

2.2 Traders' Positions

To study the various types of investor's behavior in the commodity future market, we obtain the publicly data provided by the Commodity Futures Trading Commission (CFTC). The weekly Commitment of Trader (COT) Reports contains the aggregate long and short positions of three types of traders, commercials, non-commercials and non-reportable, and the spread positions of non-commercials investors. Following the literature, we also view commercial as hedgers, non-commercial as speculators and non-reportable as small speculators. We use the positions in the last week of the month to convert the weekly data to monthly data.

According to the available information from COT report, we measure position size and trading behavior of commodity future traders by using 5 different measurements: (1) the percentage of total market held by different type of traders, (2) Hedging Pressure (HP), (3) Spreading Pressure (SP) (4) net trading (Q) by hedgers and speculators, (5) the propensity to trade (PT) of hedgers and speculators. We calculate these measurements for hedgers, speculators and small speculators. Note that we calculate these measurements for speculators holding only one leg and speculators holding spread positions separately.

At the commodity level, the total long positions are equal to the total short positions, and equal to the open interest. So we calculate the percentage of total market held by different traders in commodity level as

$$percentage\, market\, held\, by\, trader\; i_t = \frac{Long_{i,t} + Short_{i,t}}{2 \times Open\, Interest_t}$$

To convert it to the sector level, we use open interest in commodity level as the weight and calculate the weighted-average of percentage market held by trader i for commodities in same sector.

Figure 3 reports the percentage of total market held by different traders in five categories. The common features of five categories are the increase of market percentage held by speculators and the decrease of the relative positions held by small speculators. Specifically, the percentage of total market held by hedgers significantly decreased after 2002 in energy category but remained at a certain level in the other four categories. Moreover, the percentage of metal market held by speculators with spread positions is different with the other markets. In metal category, the market percentage held by speculators with spread positions increases significantly before 2008 financial crisis and decreases during the crisis, but there is no significant decrease or increase during crisis in the other categories. Boons and Prado (2019) document traders opt for a spreading position when a commodity market is highly uncertain. However, we did not find a significant increase of spread positions during 2008 financial crisis among all commodity categories. We will undertake an in-depth analysis of the interaction of the market percentage of speculators spread positions, and commodity market volatility. Besides, in energy market, speculators with spread positions has higher market percentage than speculators with long or short leg only. Furthermore, the increase of speculators spread positions occurred around 2005, that means spread position traders became more active than before, and their trading behavior may carry more information. Last and most importantly, we find that there is no significant correlation between the market percentage held by long/short only speculators and speculators with spread positions.

Sincethe trading behavior and market influence of speculators with spread positions changes significantly around 2005 due to the commodity market finacialization (Tang and Xiong, 2012; Bonato and Taschini, 2015), we will use the beginning of 2005 as a cut-off date in our empirical test.

Hedging Pressure of commodity i is used to capture hedging demand and is defined as hedgers' total short positions minus their total long positions and then divided by total open interest:

$$HP_{i,t} = \frac{Short_{herdger,i,t} - Long_{hedger,i,t}}{Open\,Interest_{i,t}}$$

Spreading Pressure (SP) (Boons and Prado, 2019) of commodity i is the total spread positions held by speculators at time t divided by the open interest at the same time:

$$SP_{i,t} = \frac{Spread_{speculators,i,t}}{Open\,Interest_{i,t}}$$

which is same as the definition of market percentage held by speculators with spread positions.

Following Kang, Rouwenhorst and Tang (2016), we calculate the net trading (Q) of hedgers and speculators separately, which is the change in traders' net long position from month $t-1$ to month t and normalized by the open interest at month $t-1$:

$$Q_{i,t} = \frac{NetLong_{i,t} - NetLong_{i,t-1}}{Open\,Interest_{t-1}}$$

where $NetLong$ is the net long positions held by different trader categories. The limitation of this measurement is the speculators' net trading only reflects position changes of speculators with long or short only, but cannot measure position changes of speculators with spread position, since their $NetLong$ is zero.

Kang, Rouwenhorst and Tang (2016) propose the propensity to trade (PT) of traders i, which is the sum of the absolute changes of long and short positions between month $t-1$

and t of traders i, and scaled by total long and short positions of trader i at time $t-1$:

$$PT_{i,t} = \frac{abs(Long_{i,t} - Long_{i,t-1}) + abs(Short_{i,t} - Short_{i,t-1})}{Long_{i,t-1} + Short_{i,t-1}}$$

we calculate this measurement for hedgers, speculators and the difference between this two traders. Then we also calculate it for speculators held one leg (long/short speculators) and speculator held spread positions (spread speculators) separately.

Table 2 reports the summary statistics of the last four measurements of different traders position size and trading behaviors among 27 commodities. First, the average hedging pressures are positive for all commodities except Feeder Cattle in meats category. In category level, the metal (meats) market has highest (lowest) hedging. Second, the average spread pressure in market level is 8.26%. The highest spreading pressure is in the energy market, which consistently with Figure 3, illustrates the largest market percentage held by speculators with spread positions is the energy market. Third, net trading of hedgers and speculators are related to changes in the hedging pressure and long demand from speculators. The average absolute net trading among hedgers and speculators is about 7.81%. Hedgers' net trading is higher than the speculators in all commodities except meats category. That means changes of speculators' long demand is higher than the changes in hedgers' short demand in average in meats market. Since the meats market has the lowest hedging pressure among five sectors, speculators might shift from traditional liquidity provision to liquidity consumption. Last, the last part of this table is about the average propensity to trade, which is similar to the portfolio turnover rate in the stock market. In general, speculators has higher propensity to trade than hedgers. The highest (lowest) difference of the propensity to trade between hedgers and speculators are energy and soft (meats) markets. We also report the propensity to trade of long/short only speculators and speculators with spread positions. On average, spread speculators have higher propensity to trade than long/short only speculators. This result remains the same even if we exclude the extreme high propensity to trade of speculators with spread positions in Oats, Palladium and Platinum. Motivated by the above empirical evidence related to traders position size and trading behavior, we propose that speculators with spread positions are different from long/short only speculators.

3 Spreading Pressure and Excess Return

3.1 Commodity Average Excess Return and Traders' Positions

Based on the observations related to speculators' spread position in Section 2, we investigate whether spreading pressure carries any information related to commodity future excess returns. In order to do so, we run a cross-section regression of average risk premium on average spreading pressure. After that, we run cross-section regressions of average risk premium on pressures caused by the other trader categories separately, and test whether spreading pressure carries more information about commodity future excess return than the activity of other commodity market participants. The hedging pressure and spreading pressure are well-defined in the last section. Here we define pressure from the other two categories, large speculators holding one leg only and small speculators, as their net long positions scaled by total interest rate. We name pressure from large speculators holding one leg only as speculating pressure.

Figure 4 and Figure 5 are cross-section regressions results of average risk premia on average pressure from different trader categories by using the full sample and subsample (after 2005) respectively. Figure 4 shows that correlations between risk premium and hedging pressure, speculating pressure and average pressure from small speculators are positive, and risk premia are negatively correlated with spreading pressure, but all these correlations are insignificant. However, since we found that the market percentage held by different traders had great changes around 2005, we assume information contained in the traders positions data might have changed as well. Therefore, we show cross-section regressions results by using the subsample data after 2005, in Figure 5. Similar to Figure 4, average risk premia is positively correlated with the average hedging pressure and average speculating pressure, and negatively correlated with average spreading pressure. In this case all the correlations are significant, apart from the coefficient of average pressure from small speculators. This means the trading behavior of the latter group does not contain information to explain cross-sectional variation of commodity risk premia. Importantly, the spreading pressure has the highest explanation power of the cross-sectional variation of the average risk premia (R^2= 32.56%).

More specifically, our regression result related to hedging pressure, subfigure (a), is consistent with the Normal Backwardation Theory, which illustrates hedgers natural character is taking short positions and the increase of hedgers' short demand will discount future price to find counterparties. Counterparties of hedgers short positions are speculators' long positions. Regression results related to net long positions of large speculators and small speculators are in subfigure (c) and subfigure (d). Traditional theory illustrates the increase of speculators' net long position is the consequence of hedging demand increase. Consistent with traditional theory and the empirical result related to hedging pressure, subfigure (c) shows that the increase of speculating pressure is positive related to the excess return increase. However, in the Table 2, we find that the balance of hedging demand in most commodities (exclude RBOB gasoline and Silver) is not always in the short side of the market. This means that when hedgers' short demand is lower than the long demand from speculators, speculators will switch to be liquidity takers and contribute to increase risk premia. Therefore, the positive correlation between speculators' long demand and commodity risk premia is contributed by hedging pressure or speculators' liquidity search. Furthermore, we find that the increase of spread positions held by speculators will decrease risk premia.

We conclude that spreading pressure is negative related to commodities average excess returns and has the highest explanation power of the cross-sectional variation of commodities average excess returns. Then we will examine whether spreading pressure can be a signal to predict commodity future excess returns.

3.2 Does Spreading Pressure Predict Excess Returns?

3.2.1 Univariate Sort

We construct portfolios by sorting commodities according to past spreading pressure and calculate their post-ranking returns. We use the past 12 months spreading pressure as the signal to sort 27 commodities into 3 portfolios from January 2, 1986 to June 30, 2018. C1, C2, C3 designate portfolios means that portfolios constructed by long and short 1, 2, or 3 commodities with the highest and lowest spreading pressure respectively. Portfolios Low3 (High3) means portfolios of long three commodities with lowest(highest) ranked signal and Mid means all remaining commodities after excluding commodities in Portfolio Low3 and High3. We rank commodities based on the signal in month t and form portfolios. Then we calculate equal-weighted nearby returns of the portfolios in month $t + 1$ and the Low3-High3 (Low3 portfolio minus High3 portfolio) portfolio is our main interest. To compare spreading pressure portfolio performance, we use portfolios sorted by basis, momentum and basis-momentum as benchmark.

Table 3 shows statistic summary of nearby returns for the Low3-High3 (High3-Low3) portfolio sorted on the 12 month average spreading pressure (basis-momentum) in full sample (panel A) and sub-sample (panel B) respectively. In full sample (Panel A), even though the average excess return of the Low3-High3 portfolio sorted on 12 month average spreading pressure (spreading pressure portfolio) is lower than the High3-Low3 portfolio sorted on basis-momentum (basis-momentum portfolio), the volatility and kurtosis of spreading pressure portfolio is also lower than basis-momentum portfolio and the skewness of spreading pressure portfolio is higher than basis-momentum portfolio. These higher moments indicate spreading pressure factor represent attractive investment. To compare performance portfolios sorted on basis-momentum and spreading pressure more directly, we calculate Sharpe Ratio for sorted portfolios. Basis-momentum portfolio has a slightly higher Sharpe Ratio than spreading pressure portfolio, which indicate the basis-momentum strategy has a slightly better performance than the spreading pressure strategy. However, an assumption behind Sharpe Ratio is portfolio's return is normal distribution and our portfolios do not satisfied. To incorporate high moments information into the comparison, we calculate the Adjusted Sharpe Ratio of all the portfolios. Pezier and White (2006) suggest using the Adjusted Sharpe Ratio which adjusts for skewness and kurtosis by including a penalty factor for negative skewness and excess kurtosis as follows:

$$Adjusted\,Sharpe\,Ratio = SR \times \left[1 + \left(\frac{Skewness}{6}\right) \times SR - \left(\frac{Kutosis - 3}{24}\right) \times SR^2\right].$$

where SR is Sharpe Ratio. We find that both spreading pressure portfolio and basis-momentum portfolio have almost same Adjusted Sharpe Ratio, 0.57 and 0.58 repectively. It demonstrate these two strategies have same performance in our full sample period from January 2, 1986 to June 30, 2018.

Then we report sorted portfolios performance by using a sub-sample (Post-2005). It shows that spreading pressure portfolio has significant better performance than the basis-momentum portfolio. Specifically, spreading pressure portfolio has higher average excess return (21.19) and higher Adjusted Shape Ratio (0.86) than the basis-momentum portfolio, which has 14.5 average excess return and 0.59 Adjusted Shape Ratio.

Figure 6 exhibits cumulative excess returns of carry (basis), momentum, basis-momentum and spreading pressure portfolios in full sample (top) and sub-sample (bottom) separately. The top plot shows that basis-momentum portfolio performs better than the other factors and there is no significant excess return differential between carry, momentum and spreading pressure portfolios before 2005. As we discussed before, the spreading position increased significantly since 2005 and the market percentage held by different traders changed significantly as well. Thus, our expectation is spreading pressure portfolio will have better performance after 2005, and empirical results are consistent with our expectation. The bottom figure shows that the cumulative return of spreading pressure portfolio has the best performance than the other most popular three trading strategies after 2005. It is not surprise that carry, momentum and basis-momentum portfolios have relatively worse performance after 2005. Mou (2011) links the jump of spreading pressure around 2005 to arbitrageurs behaviors, which means arbitrageurs paid more attention to the market anomaly (i.e. carry, momentum) and invest more capital to exploit the price impact. Then the increase of arbitrage capital used to take the advantage of the market anomaly lower the profit of trading on well-known anomaly. Boons and Prado (2019) also document the increase of spreading position lower the profit of average commodity basis-momentum portfolio.

We conclude that all these four signals, carry, momentum, basis-momentum and spreading pressure contain information about excess returns of commodity future nearby contracts, but spreading pressure is the strongest predictor after 2005. Firstly, we consider the spreading pressure of a commodity contains the information about market liquidity of this commodity. Secondly, since the traders construct spread positions when they have a certain expectation about a change of the shape of a commodity future curve (both slope and curvature), we propose that the spreading pressure of a commodity contains the information about a shape movement of a commodity future curve.

3.2.2 Pooled Predictive Regression

To examine commodity market signals predictability, we followBoons and Prado (2019) to design pooled predictive regression,

$$R_{i,t+1} = \lambda_F F_{i,t} + \alpha_{t+1} + \mu_i + \epsilon_{i,t+1}$$

$F_{i,t}$ is a set of features of commodity i at time t including spreading pressure, basis-momentum, carry and momentum, written as $\{SP_{i,t}, BM_{i,t}, C_{i,t}, M_{i,t}\}$. α_{t+1} is used to control time fixed effect and μ_i is used to control commodity fixed effect, which are Time FE and Commodity FE in table 4. Adding fixed effects will split factor predictability into its passive and dynamic components. Since our main variable is the spreading pressure factor, we begin our test from $F_{i,t} = SP_{i,t}$ with or without time-series fixed effects and cross-sectional fixed effects (model (1) to (4)). Then we compare the predictive power of the other single factor models by employing $BM_{i,t}, C_{i,t}, M_{i,t}$ as a factor separately (model (5) to (7)). In the end, we select factors which have significant predictability and use them as control variables to test whether the predictability of spreading factor is robust (model (8)).

Table 4 is the pooled predictive regression result by using different models. Without time fixed effect and commodity fixed effect, model (1) shows that the total excess return predictability from spreading pressure is negative and insignificant. After eliminating the passive components generated by cross-sectional variation or by time-variation in average commodity excess returns, the coefficients of spreading pressure are -7.58 in model (2) and -6.78 in model (3) with t-statistics above 4. That means spreading pressure cannot predict passive variations in average commodity returns along the time and across commodities. After controlling both effects, model (5) shows that the coefficient of spreading pressure is -11.76 with t-value -5.43, which implies that the the dynamic component of spreading pressure predictability is dominant. Model (6) to (7) present that basis-momentum has significant predictive power, but carry and momentum factor does not have. So we use basis-momentum as control factor to do the robust test in model (8). The regression result illustrate spreading pressure predictability is robust to the inclusion of basis-momentum and is as impressive as the predictability of basis-momentum Boons and Prado (2019).

3.3 Is Spreading Pressure a Priced Commodity Factor?

In this section, we will investigate whether spreading pressure is a priced commodity factor by using both time-series tests and cross-section tests. We construct spreading pressure factor as the excess return of Low3-High3 portfolio sorted on spreading pressure. Following Boons and Prado (2019), we calculate basis-momentum factor as the High3-Low3 portfolio excess return by using basis-momentum as sorting condition. According to Bakshi, Gao and Rossi (2017), we define the excess return of Low4-High4 portfolio sorted on basis as carry factor, the excess return of momentum High5-Low5 portfolio as momentum factor, and the equal-weighted average excess return on all commodities as average commodity market factor.

Table 5 (1) shows that the absolute value of correlations between spreading pressure factor and all well-known factors are lower than 0.5. Table 5 (2) presents correlations between portfolios sorted on spreading pressure and returns of 5 sector portfolios (Energy, Grain, Meats, Metal, Soft). We find correlations between spreading pressure factor (Low3-High3 portfolio) and returns of sector portfolios are below 0.5 in absolute value. Hence, spreading pressure factor has its own independent variation and independent on certain sectors.

We use models proposed by Boons and Prado (2019) and Bakshi, Gao and Rossi (2017) as our benchmarks.

3.3.1 Time-series Regression: Do existing models explain spreading pressure?

Boons and Prado (2019) compare different asset pricing models by regressing one model's factors (i.e. model A) on the other model's factors (i.e. model B) and analyze whether the intercept is significant. This approach was originally proposed by Barillas and Shanken (2017; 2018). They explain an insignificant intercept means factors in model A can be explained by factors in model B and a significant intercept means factors in model B cannot price factors in model A.

$$R_{SP} = \alpha + \sum_{i=1}^{K} \beta_i F_{i,t} + \epsilon_t$$

where K is the number of factors and $F_{i,t}$ is factor i at time t. Table 6 shows that the multi-regression of spreading pressure factor on factors of models proposed by Boons and Prado (2019) and Bakshi, Gao and Rossi (2017) separately. In the full sample, intercepts of these two regression are significant and equal to 12.91 and 13.06 respectively. In the subsample Pre-2005, intercepts under these two regressions are insignificant, which means spreading pressure factor can be explained by existent models. However, in the subsample Post-2005, abnormal return provided by spreading pressure factor is 17.83 (17.2) estimated by model proposed by Boons and Prado (2019)' (Bakshi, Gao and Rossi (2017)) and Newey-West t-values of abnormal returns are more than 2.5. So spreading pressure factor provide a high abnormal return and can improve mean-variance efficiency when added to the benchmark factors.

3.3.2 Cross-sectional Regression

We use Fama-MacBeth cross-section regression to test whether spreading pressure factor is a priced factor in commodity market and do comparison among commodity factor pricing models. As a portfolio level test, there are 17 portfolios sorted on carry (3), momentum (3), basis-momentum (3), spreading pressure (3) and sector (5). Then, we test five candidate models nested in

$$R_{t,i} = \gamma_{t,0} + \lambda_{t,SP}\beta_{t,SP} + \lambda_{t,BM}\beta_{t,BM} + \lambda_{t,C}\beta_{t,C} + \lambda_{t,M}\beta_{t,M} + \lambda_{t,Avg}\beta_{t,Avg} + \epsilon_{t,i}$$

where λ is factor risk premia. We use β_t estimated in the whole sample, then β_t is constant number. The 1st model specification is $\lambda_{t,BM} = \lambda_{t,C} = \lambda_{t,M} = \lambda_{t,Avg} = 0$, which means spreading pressure is the only factor in this model. The 2nd model specification is $\lambda_{t,SP} = \lambda_{t,C} = \lambda_{t,M} = 0$, which is equalivate to Boons and Prado (2019)'s model with two factors, basis-momentum and average commodity market factor. The 3rd model specification is Bakshi, Gao and Rossi (2017)'s model, $\lambda_{t,SP} = \lambda_{t,BM} = 0$, and factors in this model are carry, momentum and average commodity market factor. The 4th and 5th model specifications are used to test whether spreading pressure is still priced after adding to Boons and Prado (2019)'s and Bakshi, Gao and Rossi (2017)'s models, which are with $\lambda_{t,C} = \lambda_{t,M} = \lambda_{t,Avg} = 0$ and $\lambda_{t,BM} = 0$ respectively. In addition, the previous test shows that the spreading pressure might be not carry enough information before 2005, so we will do all the above tests by using full sample data and two subsamples, before and after 2005.

The cross-sectional asset pricing tests results are in Table 7. The estimation results of

Model (1) in three samples shows that the risk premia from spreading pressure is significant in full sample and after 2005. The risk premia on spreading pressure factor is insignificant before 2005 and 21.55 after 2005, which is consistent with our hypothesis that spreading pressure became a priced factor after huge market percentage changes around 2005. Model (2) has a slightly better regression results (high R^2) in the sample period before 2005 compared with the other sample period and significant risk premia on basis-momentum shows that basis-momentum is always priced in the commodity market. The estimation results of Model (3) present risk premia on carry factor is significant in the sub-sample before 2005, momentum factor's risk premia is significant in the sample after 2005. In the sample after 2005, Model (4) and (5) exhibit that spreading pressure factor is still significantly priced after adding to each of two benchmark models. Lastly, we find that single factor model, Model (1), has excellent cross-sectional fit, 70%, after 2005.

Based on all the above tests, our conclusion is that spreading pressure contains independent information about the cross-sectional commodity excess returns and is a priced factor in the commodity market after the huge change of total market held by different traders. According to the model comparison, we find that the single-factor model using spreading pressure has excellent cross-sectional fit after 2005.

4 Explainations for Spreading Pressure

4.1 Is There a Common Factor driving Spreading Pressure?

We conduct a principal component analysis with spreading pressure of commodities in same sector to test whether there is a common factor of spreading pressure in each sector. Based on the explanation power of first components in different sector, the left part of Table 8 shows that the highest common factor is in energy sector (90.48%) and the lowest one is in metal sector (57.43%). It seems common factors of spreading pressure is existent in sector-level. Then we test whether there are common factors driving the 1st, 2nd or 3rd components among all sectors. We collect 1st, 2nd and 3rd components in all sectors separately, and using Principal Components Analysis again to analyze the common factor in different components from all sectors. The right part of the Table 8 shows that there are strong common factors to explain t 1st components of spreading pressure among five sectors with 90.98% explanation power of total variation. Row 2 and 3 shows that there might be no common factor driving 2nd or 3rd components among 5 sectors. According to the above evidence, there is a market-level factor driving the movement of spreading pressure in all commodities markets.

4.2 Spreading Pressure is Related to Slope and Curvature of Future Term Structure

We next analyze the correlation between 12-month average spreading pressure and the current and lagged shape of future term structure after 2005. To do so, we conduct a pooled regression with time fixed effect and commodity fixed effect,

$$SP_{i,t+k} = \alpha_k + \beta_{slope} Slope_{i,t}^{avg} + \beta_{curvature} Curvature_{i,t}^{avg} + \varepsilon_{i,t+k}$$

where $Slope_{i,t}^{avg}$ and $curvature_{i,t}^{avg}$ are 12-month average of slope and curvature of the commodity i's future term structure and k is lags. The first two model specifications (model (1) and (2)) are using slope and curvature separately in the right-side and the last model specification (3) is using both slope and curvature in the right-side of the equation.

Table 9 (Panel A) report regression results when $k = 0$ and $k = 12$. When $k = 0$, β_{slope} and $\beta_{curvature}$ are significant under three model specification, indicating the exploitation power of 12-month average of slope and curvature of commodity future term structures on spreading pressure. The right side of the table is regression results when $k = 12$, which is a predictive regression and β_{slope} and $\beta_{curvature}$ are still significant. We further find spreading pressure is increasing in slope and lagged-slope, and decreasing in curvature and lagged-curvature.

Many researchers explain slope and curvature of future term structure by using observable economic fundamentals and show behaviors of different type of market participators can influence the shape of future term structure. Karstanje, Wel and Dijk (2015) link the slope of future curves to hedging pressure, housing (construction growth) and inventories and find the curvature component is positively related to interest rates and business inventories (new orders growth) and negatively related to industrial production. Focus on the players on oil future market, Heidorn et al. (2015) introduce fundamental investors (producers, merchants, processor, and users) only influence the level of future term structures and financial traders (swap dealers and managed money) impact on the slope and curvature of these curves. Huellen (2018) links the shape of term structures to the index investment and shows that the index pressure will cause upward concave term structure and the hedging pressure will cause downward convex future curve. However, when the index traders' long positions exceed the short positions' demanding of hedgers, the term structure of commodity futures will became temporary wave-like shapes. Therefore, we support spreading pressure contains information about commodity future curve slope and curvature, which reflects economic fundamentals.

To investigate whether spreading pressure contains information about traders' expected commodity future curve slope and curvature in the future, we conduct a predictive pooled regression of 12-month average of slope and curvature of future term structure on 12-month lagged 12-month average spreading pressure with or without time fixed effect and commodity fixed effect,

$$\{Slope^{avg}_{i,t+12}, Curvature^{avg}_{i,t+12}\} = \alpha + \beta_{SP} SP^{avg}_{i,t} + \varepsilon_{i,t+12}$$

Table 9 (Panel B) report the regression result after/without controlling time fixed effect and commodity fixed effect in the sample period after 2005. It shows that spreading pressure can significantly predict 12-month average of slope and curvature of future curve. When both fixed effects are included, the coefficient on lagged spreading pressure is still large and significant, which is 0.03 (t-statistics = 5.79) for slope and -0.01 (t-statistics = 2.48) for curvature.

4.3 Spreading Pressure Factor is Related to Real Economic Uncertainty

Real economic uncertainty is negative related to shock to production and constructed by using 73 real activity variables (Ludvigson, Ma and Ng, 2015). Negative shock to production increase the real economic uncertainty, which indicates a bad economic state. Based on our finding that there is a sizeable risk premium on spreading pressure on commodity market, the objective of this section is to examine whether commodities in long and short legs are sensitive to real economic uncertainty differently and identify whether spreading pressure factor is associated to real economic uncertainty.The data is obtained from Sydney C. Ludvigson website.

In order to examine whether commodities in long and short legs of spreading pressure portfolio are sensitive to real economic uncertainty in different extent we regress return of commodity i on changes of real economic uncertainty,

$$R_{i,t} = \beta_{i,RealUncertainty} \Delta RealUncertainty_t + \varepsilon_{i,t},$$

where $\Delta RealUncertainty_t$ is normalized changes of real economic uncertainty. Then we sort commodities according to its holding percentage in long and short legs respectively.

Figure 7 shows that commodities in long leg of spreading pressure portfolio are mainly negatively related to changes of real economic uncertainty. In contrast, there is a positive relationship between most of commodities in the short leg and changes of real economic uncertainty.

According to the above evidence, then we regress spreading pressure factor on normalized changes of real economic uncertainty,

$$R_{SP,t} = \beta_{RealUncertainty} \Delta RealUncertainty_t + \varepsilon_t,$$

Table 10 shows that spreading pressure factor is significantly and negatively related to changes of real economic uncertainty, which is -18.92 with t-statistics = -2.66. Specifically, the return from long leg with low spreading pressure commodities is significantly expose to risk caused real economic uncertainty (coefficient = -16.75 and t-statistics = -2.45), but the short leg (high spreading pressure commodities) return is insignificantly related to changes of real economic uncertainty.

In general, our empirical evidence in Figure 7 and Table 10 support that high excess return of spreading pressure factor can be explained by innovations in real economic uncertainty.

5 Conclusion

In this paper, we identify speculators held spread positions and speculators held long or short positions only have different trading behaviors and market impact. After fictionalization, the trading behavior of speculators held spread positions carry more information about commodity risk premia. The spreading pressure related to the speculators held spread positions has excellent predictive power of dynamic components of commodity future excess returns. After controlling systematic differences across time and commodity, commodity futures excess returns will decrease 11.76% (t-statistics = -5.43) when spreading pressure increase 1%. The risk exposure to a spreading pressure factor is priced after 2005, and the single-factor model including spreading pressure factor has great fit of cross-sectional variation in nearby commodity returns.The estimated price of risk on spreading pressure is 21.55% (t-statistics = 7.58) per annual under single-factor model and $R^2 = 70\%$. Our single-factor model including spreading pressure provides a cross-sectional fit that is better than the existent 2-factor or 3-factor models and is similar to multi-factor models as it includes spreading pressure and the other existent factors. Lastly, spreading pressure reflects expected slope and curvature of commodity future curve and spreading pressure factor is linked to innovations in real economic uncertainty.

References

Acharya, V.V., Lochstoer, L.A. and Ramadorai, T., 2013. Limits to arbitrage and hedging: Evidence from commodity markets. Journal of Financial Economics, 109(2), pp.441-465.

Asness, C.S., Moskowitz, T.J. and Pedersen, L.H., 2013. Value and momentum everywhere. The Journal of Finance, 68(3), pp.929-985.

Bakshi, G., Gao, X. and Rossi, A.G., 2017. Understanding the Sources of Risk Underlying the Cross Section of Commodity Returns. Management Science.

Barillas, F. and Shanken, J., 2017. Which alpha?. The Review of Financial Studies, 30(4), pp.1316-1338.

Barillas, F. and Shanken, J., 2018. Comparing asset pricing models. The Journal of Finance, 73(2), pp.715-754.

Basu, D. and Miffre, J., 2013. Capturing the risk premium of commodity futures: The role of hedging pressure. Journal of Banking & Finance, 37(7), pp.2652-2664.

Bessembinder, H., 1992. Systematic risk, hedging pressure, and risk premiums in futures markets. The Review of Financial Studies, 5(4), pp.637-667.

Bonato, M. and Taschini, L., 2015. Comovement and the financialization of commodities. Grantham Research Institute on Climate Change and the Environment.

Boons, M. and Prado, M.P., 2019. Basis-Momentum. The Journal of Finance, 74(1), pp.239-279.

Brennan, M.J., 1958. The supply of storage. The American Economic Review, 48(1), pp.50-72.

Celso Brunetti, David Reiffen Commodity index trading and hedging costs J. Financ. Mark., 21 (Federal Reserve Board) (2014), pp. 153-180

Dewally, M., Ederington, L.H. and Fernando, C.S., 2013. Determinants of trader profits in commodity futures markets. The Review of Financial Studies, 26(10), pp.2648-2683.

Diebold, Francis X., Li, Canlin, 2006. Forecasting the term structure of government bond yields. J. Econom. 130, 337e364.

Diebold, F.X., Rudebusch, G.D. and Aruoba, S.B., 2006. The macroeconomy and the yield curve: a dynamic latent factor approach. Journal of econometrics, 131(1-2), pp.309-338.

Etienne, X.L. and Mattos, F., 2016. The Information Content in the Term Structure of Commodity Prices. In Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. St. Louis, MO.

Fernandez-Perez, A., Frijns, B., Fuertes, A.M. and Miffre, J., 2018. The skewness of commodity futures returns. Journal of Banking & Finance, 86, pp.143-158.

Geman, H. and Ohana, S., 2008. Time-consistency in managing a commodity portfolio: A dynamic risk measure approach. Journal of Banking & Finance, 32(10), pp.1991-2005.

Gorton, Gary B., Fumio Hayashi, and K. Geert Rouwenhorst. "The fundamentals of commodity futures returns." Review of Finance 17, no. 1 (2012): 35-105.

Heidorn, T., Mokinski, F., Rï¿œhl, C. and Schmaltz, C., 2015. The impact of fundamental and financial traders on the term structure of oil. Energy Economics, 48, pp.276-287.

Hong, H. and Yogo, M., 2012. What does futures market interest tell us about the macroeconomy and asset prices?. Journal of Financial Economics, 105(3), pp.473-490.

Huellen, Van S., 2018. Too much of a good thing? Speculative effects on commodity futures curves. Journal of Financial Markets.

Irwin, S.H., Garcia, P., Good, D.L. and Kunda, E.L., 2011. Spreads and non-convergence in Chicago board of trade corn, soybean, and wheat futures: Are index funds to blame?. Applied Economic Perspectives and Policy, 33(1), pp.116-142.

Kaldor, Nicholas, 1939. Speculation and economic stability. Rev. Econ. Stud. 7 (1), 1e27.

Karstanje, Dennis M., Michel van der Wel, and Dick van Dijk, 2015, Common factors in commodity futures curves, Working paper, Erasmus School of Economics.

Kang, W., Rouwenhorst, K.G. and Tang, K., 2017. A tale of two premiums: The role of hedgers and speculators in commodity futures markets. Yale International Center for Finance Working Paper, (14-24).

Keynes, John Maynard, 1930, Treatise on Money (Macmillan, London)

Koijen, R.S., Moskowitz, T.J., Pedersen, L.H. and Vrugt, E.B., 2018. Carry. Journal of Financial Economics, 127(2), pp.197-225.

Liu, P., and Tang, K. (2010). No-arbitrage conditions for storable commodities and the models of futures term structures. Journal of Banking & Finance, 34(7), 1675-1687. doi:10.1016/j.jbankfin.2010.03.013

Ludvigson, S.C., Ma, S. and Ng, S., 2015. Uncertainty and business cycles: exogenous impulse or endogenous response? (No. w21803). National Bureau of Economic Research.

Marshall, B.R., Nguyen, N.H. and Visaltanachoti, N., 2011. Commodity liquidity measurement and transaction costs. The Review of Financial Studies, 25(2), pp.599-638.

Mou, Yiqun, 2011. Limits to Arbitrage and Commodity Index Investment: Front-running the Goldman Roll (Working Paper). Columbia Business School.

Nelson, Charles R., Siegel, Andrew F., 1987. Parsimonious modeling of yield curves. J. Bus. 60 (4), 473e489.

Pindyck, R.S., 2001. The dynamics of commodity spot and futures markets: a primer. The energy journal, pp.1-29.

Pezier, J. and White, A., 2006. The relative merits of investable hedge fund indices and of funds of hedge funds in optimal passive portfolios (No. icma-dp2006-10). Henley Business School, Reading University.

Singleton, K.J., 2013. Investor flows and the 2008 boom/bust in oil prices. Management Science, 60(2), pp.300-318.

Szymanowska, M., De Roon, F., Nijman, T. and Van Den Goorbergh, R., 2014. An anatomy of commodity futures risk premia. The Journal of Finance, 69(1), pp.453-482.

Tang, K. and Xiong, W., 2012. Index investment and the financialization of commodities. Financial Analysts Journal, 68(6), pp.54-74.

Working, H., 1949. The theory of price of storage. The American Economic Review, pp.1254-1262.

Yang, Fan, 2013, Investment shocks and the commodity basis spread, Journal of Financial Economics, 110, 164–184

Table 1: **Commodity Annualized Excess Return Summary Statistics**

This table presents summary statistics for commodity future returns. The sample period is from January 2, 1986 to June 30, 2018. This table reports annualized mean, standarnd deviation and Sharp Ratio of the first-, second- and third- nearby contracts seperately. The excess return of a commodity in month t is defined as $R^{(n)}_{long,t+1} = \frac{F^{(n)}_{t+1}}{F^{(n)}_{t}} - 1$, where n is n-nearby contract at time t.

Classification	Commodity	1st nearby contract			2nd nearby contract			3rd nearby contract		
		mean	std. dev.	Sharp Ratio	mean	std. dev.	Sharp Ratio	mean	std. dev.	Sharp Ratio
Energy	Heating Oil	9.03	30.38	0.30	8.66	28.56	0.30	9.16	27.34	0.34
	Natural Gas	-6.60	47.60	-0.14	-2.93	40.97	-0.07	-0.66	35.43	-0.02
	RBOB gasoline	7.37	30.47	0.24	6.15	29.02	0.21	5.94	27.90	0.21
	Unleaded gasoline	21.68	33.19	0.65	19.21	29.34	0.65	18.33	26.84	0.68
	WTI Crude Oil	8.45	33.62	0.25	9.34	31.61	0.30	9.51	29.98	0.32
Grains	Corn	-4.43	26.41	-0.17	-3.29	25.59	-0.13	-1.65	24.16	-0.07
	Oats	1.07	35.80	0.03	-0.49	32.41	-0.02	-1.64	29.23	-0.06
	Rough rice	-6.65	26.68	-0.25	-4.25	25.10	-0.17	-2.94	23.66	-0.12
	Soybean Oil	-2.03	24.18	-0.08	-2.02	23.83	-0.08	-0.59	23.45	-0.03
	Soybean meal	14.01	27.32	0.51	10.26	25.60	0.40	9.20	24.86	0.37
	Soybeans	5.34	23.43	0.23	4.09	23.15	0.18	4.58	22.69	0.20
	Wheat	-4.82	27.38	-0.18	-2.76	25.96	-0.11	-0.09	24.55	0.00
Meats	Feeder cattle	4.18	14.26	0.29	3.50	13.94	0.25	4.67	13.07	0.36
	Lean hogs	1.00	25.85	0.04	2.24	21.71	0.10	5.23	18.69	0.28
	Live cattle	3.78	14.15	0.27	4.15	12.46	0.33	2.79	10.44	0.27
	frozen Pork belly	3.23	39.73	0.08	2.53	35.06	0.07	6.18	30.50	0.20
Metal	High Grade Copper	7.93	25.55	0.31	8.05	25.19	0.32	8.28	24.85	0.33
	Palladium	12.56	30.11	0.42	13.63	29.68	0.46	13.59	28.40	0.48
	Platinum	2.49	20.72	0.12	2.81	20.59	0.14	0.07	20.10	0.00
	Silver	2.77	27.38	0.10	2.88	27.33	0.11	3.21	27.41	0.12
	gold	1.86	15.39	0.12	1.94	15.45	0.13	1.95	15.45	0.13
Soft	Cocoa	-0.05	29.02	0.00	-1.99	27.54	-0.07	-1.59	26.64	-0.06
	Coffee	-2.55	36.85	-0.07	-3.31	35.56	-0.09	-4.90	32.83	-0.15
	Cotton	4.06	27.16	0.15	3.30	25.31	0.13	4.11	23.65	0.17
	Lumber	-2.10	30.60	-0.07	-0.32	25.27	-0.01	0.42	21.79	0.02
	Orange juice	2.34	30.67	0.08	0.87	29.42	0.03	0.05	27.84	0.00
	Sugar	4.41	32.56	0.14	4.72	29.40	0.16	5.95	27.13	0.22
Average	Average	3.27	28.39	0.12	3.22	26.48	0.12	3.67	24.77	0.15

Table 2: **Traders' Positions Summary Satatistics**

This table presents summary statistics of traders' positions data obtained from CFTC Commitment of Traders (COT) report. The sample period is from January 2, 1986 to June 30, 2018. Hedging Pressure is calculated by $HP_t = \frac{Short_{herdger,t} - Long_{hedger,t}}{Open\ Interest_t}$ and Prob(HP>0) is the probability of short hedging. Spreading Pressure is defined as $SP_t = \frac{Spread_{speculators,t}}{Open\ Interest_t}$. Net trading is $Q_{i,t} = \frac{NetLong_{i,t} - NetLong_{i,t-1}}{Open\ Interest_{t-1}}$, where $NetLong_{i,t}$ is the net long position of trader i in month t. Propensity to trade (PT) of traders i in month t is $PT_{i,t} = \frac{abs(Long_{i,t} - Long_{i,t-1}) + abs(Short_{i,t} - Short_{i,t-1})}{Long_{i,t-1} + Short_{i,t-1}}$.

Commodity	Hedging Pressure (HP) %			Spreading Pressure %		|Net Trading| %		Average Propensity to Trade %				
	Mean	Std. Dev.	Prob(HP>0)	Mean	Std. Dev.	Hedger	Specs	Hedger	Specs	Difference	Specs (no spread)	Specs (spread)
Heating Oil	8.60	8.83	82.04	8.84	5.29	5.86	4.00	9.77	22.68	12.92	33.60	30.38
Natural Gas	0.00	11.54	49.70	19.89	14.34	4.14	3.53	7.95	17.68	9.72	27.46	20.00
RBOB gasoline	21.48	6.28	100.00	12.27	4.89	4.73	3.82	8.25	11.40	3.15	15.73	16.95
Unleaded gasoline	9.17	11.72	75.77	5.34	2.75	8.11	5.92	11.25	32.24	20.99	46.35	44.79
WTI Crude Oil	4.78	10.44	67.95	14.69	11.21	4.20	3.25	6.89	14.24	7.34	22.50	16.96
Corn	1.42	13.16	55.64	8.85	4.68	6.90	6.19	10.01	19.06	9.05	25.80	20.25
Oats	31.80	18.30	93.99	3.31	2.85	10.56	6.78	16.20	30.14	13.93	32.77	264.64
Rough rice	7.15	22.94	60.00	6.58	4.02	9.68	6.76	15.79	30.64	14.86	34.90	64.71
Soybean Oil	11.89	16.75	72.05	13.13	4.90	9.48	6.59	12.23	19.32	7.09	29.98	22.61
Soybean meal	16.87	14.59	83.59	9.74	3.90	8.62	6.29	11.37	22.20	10.82	31.82	26.60
Soybeans	10.44	16.08	73.85	11.34	3.67	7.24	6.38	11.57	17.34	5.77	24.55	19.83
Wheat	2.97	15.99	50.00	11.26	5.52	7.87	6.47	13.83	18.29	4.46	21.88	27.86
Feeder cattle	-8.32	10.78	23.08	8.78	5.34	5.71	7.78	18.38	21.69	3.31	24.72	48.68
Lean hogs	1.12	12.03	57.61	13.30	5.98	6.54	8.34	17.08	19.29	2.21	24.32	28.10
Live cattle	7.83	11.37	71.54	10.72	5.04	4.68	5.52	9.45	16.00	6.55	19.56	24.06
Frozen Pork belly	0.40	14.86	57.03	7.04	4.86	7.86	12.30	36.14	31.16	-4.98	32.89	89.64
High Grade Copper	6.67	20.65	59.01	6.78	5.39	10.56	8.58	13.20	32.05	18.86	33.93	52.07
Palladium	44.29	23.00	92.26	2.33	2.37	10.01	8.20	13.04	21.77	8.73	21.97	164.24
Platinum	44.28	23.18	95.47	1.69	1.48	15.38	13.21	17.45	27.93	10.48	29.27	217.07
Silver	38.69	15.35	100.00	9.92	5.92	9.31	8.27	12.80	17.88	5.08	22.38	24.65
Gold	18.44	27.88	72.31	9.48	4.51	12.29	9.60	14.12	20.42	6.30	29.39	16.45
Cocoa	12.43	16.26	75.38	6.13	5.48	7.54	6.38	8.40	23.29	14.89	26.53	54.10
Coffee	14.34	15.86	75.84	8.58	5.09	9.36	8.41	12.28	23.97	11.69	28.20	39.72
Cotton	9.58	22.14	68.21	5.82	2.67	12.22	9.92	14.06	26.94	12.88	32.43	36.18
Lumber	8.02	20.28	60.76	5.82	4.15	11.62	10.89	33.36	34.01	0.64	37.27	94.34
Orange juice	19.38	25.58	78.46	4.73	3.01	14.26	11.13	16.33	28.63	12.30	33.63	55.04
Sugar	18.48	19.44	78.68	4.97	4.34	10.54	7.36	11.69	27.90	16.21	31.25	114.26
Average	12.94	15.90	68.94	8.26	4.77	8.40	7.21	13.67	22.43	8.76	27.68	58.36

Table 3: **Commodity Portfolios Sorted on Spreading Pressure or Basis-momentum**

This table provides the statists summary of commodity portfolios sorted on spreading pressure signal or basis-momentum signal. Spreading pressure signal is the average of past 12 month spread pressure and basis-momentum is calculate by $\prod_{s=t-11}^{t}\left(1+R_{long,s}^{(0)}\right)-\prod_{s=t-11}^{t}\left(1+R_{long,s}^{(1)}\right)$. Portfolios Low3 (High3) means portfolios of long three commodities with lowest (highest) ranked signal and Mid means all remaining commodities after excluding commodities in Portfolio Low3 and High3. Portfolios excess return is the equal-weighted average excess return of commodities in same portfolio. Adjusted Sharpe Ratio is $Adjusted\,Sharpe\,Ratio = SR \times \left[1+\left(\frac{Skewness}{6}\right)\times SR-\left(\frac{Kutosis-3}{24}\right)\times SR^2\right]$. We present results for full sample from January 2, 1986 to June 30, 2018 and subsample from January 2, 2005 to June 30, 2018

Panel A: Full Sample

Excess Return of Commodity Portfolios Sorted on Spreading Pressure							
	C1	C2	C3	Low3	Mid	High3	Low3-High3
Mean (%)	23.88	16.44	13.65	9.44	3.43	-4.21	13.65
Std. Dev. (%)	46.82	30.77	24.2	21.44	11.72	19.36	24.2
Sharp Ratio	0.51	0.53	0.56	0.44	0.29	-0.22	0.56
Skewness	1.9	0.85	0.7	0.81	-0.44	-0.38	0.7
Kurtosis	22.26	9.82	7.45	9.7	6.2	3.52	7.45
Adjusted Sharp Ratio	0.49	0.53	0.57	0.44	0.28	-0.22	0.57
Excess Return of Basis-Momentum Strategy							
	C1	C2	C3	Low3	Mid	High3	High3-Low3
Mean (%)	24.91	20.46	17.77	-3.3	2.18	14.47	17.77
Std. Dev. (%)	47.7	34.43	28.09	22.28	12.35	20.57	28.09
Sharp Ratio	0.52	0.59	0.63	-0.15	0.18	0.7	0.63
Skewness	0.08	-0.05	-0.24	1.3	-0.33	0.22	-0.24
Kurtosis	3.97	4.26	6.12	12.71	6.47	4.05	6.12
Adjusted Sharp Ratio	0.52	0.58	0.58	-0.14	0.17	0.71	0.58

Panel B: Sub-sample (after 2005)

Excess Return of Commodity Portfolios Sorted on Spreading Pressure							
	C1	C2	C3	Low3	Mid	High3	Low3-High3
Mean (%)	31.87	25.53	21.19	9.64	2.89	-11.55	21.19
Std. Dev. (%)	43.63	30.3	24.42	23.95	14.1	22.69	24.42
Sharp Ratio	0.73	0.84	0.87	0.4	0.2	-0.51	0.87
Skewness	-0.32	-0.26	-0.21	0.12	-0.58	-0.35	-0.21
Kurtosis	3.96	4.32	3.67	6.24	5.97	3	3.67
Adjusted Sharp Ratio	0.72	0.83	0.86	0.4	0.2	-0.51	0.86
Excess Return of Basis-Momentum Strategy							
	C1	C2	C3	Low3	Mid	High3	High3-Low3
Mean (%)	24.54	17.64	14.5	-5.52	1.96	8.98	14.5
Std. Dev. (%)	46.43	32.7	24.49	21.55	15.4	20.35	24.49
Sharp Ratio	0.53	0.54	0.59	-0.26	0.13	0.44	0.59
Skewness	0.08	-0.01	-0.3	0.06	-0.46	-0.3	-0.3
Kurtosis	3.53	3.05	3.8	4.84	5.61	3.66	3.8
Adjusted Sharp Ratio	0.53	0.54	0.59	-0.26	0.13	0.44	0.59

Table 4: **Pooled Regressions of Commodity-level Excess Returns on Spreading Pressure**

This table provides results from pooled regression of commodity-level excess returns on lagged spreading pressure signal, basis-momentum, basis and momentum of 27 commodities. Carry (basis) $\frac{F_t^{(1)}}{F_t^{(0)}} - 1$ and momentum is $\prod_{s=t-6}^{t}\left(1 + R_{long,s}^{(0)}\right)$. Model (1) includes spreading pressure signal only and successively adding commodity fixed effects and time fixed effects in model (2) to model (4). Model (5) to model (7) replace spreading pressure in model (4) by using basis-momentum, carry and momentum respectively. We report coefficients on the characteristic, their t-statistics are presented underneath each estimate in parentheses and each model's R^2. This test used full sample from January 2, 1986 to June 30, 2018.

Model	λ_{SP}	λ_{BM}	λ_C	λ_M	Time FE	Commodity FE	R^2
(1)	-0.02				No	NO	0.001
	(-0.03)						
(2)	-7.58				No	Yes	0.005
	(-4.43)						
(3)	-6.78				Yes	No	0.167
	(-4.48)						
(4)	-11.76				Yes	Yes	0.171
	(-5.43)						
(5)		5.08			Yes	Yes	0.171
		(4.86)					
(6)			-2.78		Yes	Yes	0.169
			(-0.70)				
(7)				-0.11	Yes	Yes	0.169
				(-0.27)			
(8)	-11.12	4.57			Yes	Yes	0.174
	(-5.10)	(4.36)					

Table 5: **Spreading Pressure Factor versus Sectors and Well-known Factors Correlation**

This table (1) presents correlations among portfolios sorted on Spreading Pressure (R_{SP}), Basis-momentum (R_{BM}), Carry (R_C) , Momentum (R_M) and market factor (R_{Avg}) in Full Sample from January 2, 1986 to June 30, 2018and 2 subsample (Pre- and Post- 2005). This table (2) presents correlations between portfolios sorted on Spreading Pressure and 5 sector portfolios (Energy, Grain, Meats, Metal, Soft) in Full Sample from January 2, 1986 to June 30, 2018and 2 subsample (Pre- and Post- 2005). Portfolios Low3 (High3) means portfolios of long three commodities with lowest (highest) spreading pressure and Mid means all remaining commodities after excluding commodities in Portfolio Low3 and High3.

(1) Spreading Pressure Factor versus well-known factors Correlation

	R_{Avg}	R_{SP}	R_{BM}	R_C
Panel A: Full Sample				
R_{SP}	0.07			
R_{BM}	0.04	0.02		
R_C	0.05	-0.02	0.33	
R_M	0.05	0.1	0.2	0.28
Panel B: Pre-2005				
R_{SP}	-0.02			
R_{BM}	-0.01	-0.09		
R_C	0.01	-0.19	0.41	
R_M	0.01	0	0.15	0.25
Panel C: Post-2005				
R_{SP}	0.15			
R_{BM}	0.09	0.21		
R_C	0.1	0.24	0.17	
R_M	0.09	0.24	0.29	0.35

(2) Spreading Pressure Factor versus Sectors Correlation

	Energy	Grain	Meats	Metal	Soft
Panel A: Full Sample					
Low3	0.16	0.47	0.01	0.57	0.60
Mid	0.54	0.71	0.21	0.55	0.64
High3	0.47	0.42	0.27	0.36	0.25
Low3-High3	-0.24	0.08	-0.21	0.21	0.33
Panel B: Pre-2005					
Low3	-0.08	0.36	-0.02	0.36	0.47
Mid	0.52	0.57	0.34	0.31	0.41
High3	0.16	0.44	0.34	0.29	0.10
Low3-High3	-0.17	-0.01	-0.25	0.10	0.31
Panel C: Post-2005					
Low3	0.46	0.57	0.04	0.72	0.72
Mid	0.59	0.83	0.10	0.70	0.80
High3	0.82	0.41	0.20	0.43	0.37
Low3-High3	-0.32	0.18	-0.14	0.31	0.36

Table 6: **Spreading Pressure Factor versus Different Models: Spanning Regressions and GRS Tests**

This table presents regression test to invistigate whether spreading pressure factor provide significant intercept by using Boons and Prado (2019)'s 2-factor model and Bakshi, Gao and Rossi (2017) 3-factor model. Boons and Prado (2019)'s model has two factors, basis-momentum and average commodity market factor. Bakshi, Gao and Rossi (2017)'s model included factors are carry, momentum and average commodity market factor. t-statistics are calculated using Newey-West standard errors with lag length one. F-statistics and p-value of the joint GRS test are also provide in the last two rows. This test used full sample from January 2, 1986 to June 30, 2018 and two subsamples (Pre-2005 and Post-2005)

	Full Sample	Pre-2005	Post-2005
(1) Spreading Pressure Factor versus Boons and Prado (2019)			
α	12.91	9.71	17.83
	(2.55)	(1.46)	(2.61)
β_{BM}	1.59	-7.25	19.98
	(0.16)	(-0.56)	(2.12)
β_{Avg}	14.72	-6.24	22.79
	(1.02)	(-0.25)	(1.45)
R^2	0.006	0.009	0.064
GRS-F	3.10	1.39	2.68
p-val	0.03	0.25	0.05
(2) Spreading Pressure Factor versus Bakshi, Gao and Rossi (2017)			
α	13.06	8.64	17.2
	(2.91)	(1.57)	(2.72)
β_{Avg}	14.28	-5.31	20.18
	(1.02)	(-0.22)	(1.30)
β_C	-5.94	-19.21	19.92
	(-0.45)	(-1.13)	(1.72)
β_M	11.34	4.46	19.70
	(1.43)	(0.47)	(1.81)
R^2	0.017	0.038	0.099
GRS-F	3.27	0.95	2.68
p-val	0.02	0.42	0.05

Table 7: **Fama-MacBeth Regressions with Different Model Specificaion**

This table presents cross-sectional tests for five asset pricing factor models, nested in $R_{t,i} = \gamma_{t,0} + \lambda_{t,SP}\beta_{t,SP} + \lambda_{t,BM}\beta_{t,BM} + \lambda_{t,C}\beta_{t,C} + \lambda_{t,M}\beta_{t,M} + \lambda_{t,Avg}\beta_{t,Avg} + \epsilon_{t,i}$. We construct 17 portfolios sorted on carry (3), momentum (3), basis-momentum (3), spreading pressure (3) and sector (5). Model (1) is a single-factor model contains spreading pressure, and its specification is $\lambda_{t,BM} = \lambda_{t,C} = \lambda_{t,M} = \lambda_{t,Avg} = 0$, Model (2) is with $\lambda_{t,SP} = \lambda_{t,C} = \lambda_{t,M} = 0$ and it is Boons and Prado (2019)'s model with two factors, basis-momentum and average commodity market factor. Model (3)'s specification is Bakshi, Gao and Rossi (2017)'s model, $\lambda_{t,SP} = \lambda_{t,BM} = 0$, and factors in this model are carry, momentum and average commodity market factor. The 4th and 5th model specifications are adding spread pressure to Boons and Prado (2019)'s and Bakshi, Gao and Rossi (2017)'s models, which are with $\lambda_{t,C} = \lambda_{t,M} = \lambda_{t,Avg} = 0$ and $\lambda_{t,BM} = 0$ respectively. Panel A is full sample from January 2, 1986 to June 30, 2018. Panel B is subsample from January 2, 1986 to January 2, 2005. Panel C is subsample from January 2, 2005 to June 30, 2018

Model	γ_0	λ_{SP}	λ_{BM}	λ_C	λ_M	λ_{Avg}	R^2
Panel A: Full Sample							
(1)	3.28	8.25					0.14
	(2.90)	(1.73)					
(2)	0.48		18.10			3.25	0.56
	(0.16)		(4.22)			(1.01)	
(3)	0.76			12.04	9.07	2.75	0.41
	(0.29)			(2.97)	(2.07)	(1.01)	
(4)	0.93	7.64	17.81			2.81	0.66
	(0.21)	(1.60)	(4.53)			(0.62)	
(5)	1.04	8.53		12.86	8.07	2.51	0.53
	(0.26)	(1.92)		(2.74)	(2.07)	(0.62)	
Panel B: Sub-sample (before 2005)							
(1)	5.20	0.43					0.00
	(3.73)	(0.07)					
(2)	-0.11		19.52			5.27	0.52
	(-0.02)		(3.90)			(1.06)	
(3)	2.04			12.08	11.77	2.88	0.38
	(0.42)			(1.71)	(2.16)	(0.54)	
(4)	-1.03	2.08	19.61			6.09	0.53
	(-0.20)	(0.42)	(3.95)			(1.13)	
(5)	0.63	2.87		12.73	11.19	4.19	0.41
	(0.12)	(0.71)		(1.64	(1.92)	(0.73)	
Panel C: Sub-sample (after 2005)							
(1)	0.32	21.55					0.70
	(0.40)	(7.58)					
(2)	-1.77		19.85			4.04	0.47
	(-0.85)		(3.88)			(1.56)	
(3)	0.28			16.52	13.99	1.67	0.49
	(0.10)			(3.97)	(1.96)	(0.51)	
(4)	-0.15	19.28	13.87			2.61	0.79
	(-0.12)	(5.96)	(11.01)			(2.19)	
(5)	0.63	20.67		14.69	7.73	1.60	0.81
	(0.41)	(6.34)		(3.05)	(2.40)	(1.21)	

Table 8: **Percentage of the total spreading pressure variance explained by each principal component**

This table presents the percentage of the total spreading pressure variance explained by 1st, 2nd and 3rd components by using Pricipal Components Analysis (PCA). The left-side of the table is analysis results in sector-level and the right-side of the table is analysis results in market-level. We use full sample from January 2, 1986 to June 30, 2018.

Components	Energy	Grains	Meats	Metal	Soft	1st	2nd	3rd
1st	90.48	64.68	67.51	57.42	70.37	90.98	3.70	2.27
2nd	6.54	12.42	17.72	18.36	11.10	36.95	21.29	16.70
3rd	1.83	8.26	8.23	15.96	8.08	35.04	22.18	16.98

Table 9: **Spreading Pressure versus Future Term Structure**

The panel A of this table presents (predictive) pooled regression of 12-month average spreading pressure on 12-month average slope and curvature of commodity future term structure from January 2, 2005 to June 30, 2018, $.SP^{avg}_{i,t+k} = \alpha_k + \beta_{slope,k} Slope^{avg}_{i,t} + \beta_{curvature,k} Curvature^{avg}_{i,t} + \varepsilon_{i,t+k}$. We define the slope of the future curve as $slope_t = \ln F_t^2 - \ln F_t^0$ and the curvature of the future curve as $curvature_t = \sum_{s=t-12}^{t} \left(\ln F_s^2 - \ln F_s^1\right) - \left(\ln F_s^1 - \ln F_s^0\right)$. The Panel B presents the predictability of 12-month average spreading pressure on 12-month average slope or curvature of commodity future term structure from January 2, 2005 to June 30, 2018, $\left\{Slope^{avg}_{i,t+12}, Curvature^{avg}_{i,t+12}\right\} = \alpha + \beta_{SP} SP^{avg}_{i,t} + \varepsilon_{i,t+12}$

Panel A: $.SP^{avg}_{i,t+k} = \alpha_k + \beta_{slope,k} Slope^{avg}_{i,t} + \beta_{curvature,k} Curvature^{avg}_{i,t} + \varepsilon_{i,t+k}$

	k=0			k=12		
Model	(1)	(2)	(3)	(1)	(2)	(3)
β_{slope}	0.23		0.17	0.27		0.16
	(4.73)		(3.46)	(3.74)		(2.14)
$\beta_{curvature}$		-0.40	-0.29		-0.72	-0.62
		(-4.27)	(-2.92)		(-6.04)	(-4.85)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Commodity FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.865	0.864	0.865	0.865	0.866	0.866

Panel B: $\left\{Slope^{avg}_{i,t+12}, Curvature^{avg}_{i,t+12}\right\} = \alpha + \beta_{SP} SP^{avg}_{i,t} + \varepsilon_{i,t+12}$

	$Slope^{avg}_{t+12}$		$Curvature^{avg}_{t+12}$	
β_{SP}	0.05	0.03	-0.01	-0.01
	(11.79)	(5.79)	(-6.92)	(-2.48)
Time FE	No	Yes	No	Yes
Commodity FE	No	Yes	No	Yes
R^2	0.13	0.51	0.04	0.33

Table 10: **Spreading Pressure Factor's Relation to Changes of Real Economic Uncertainty**

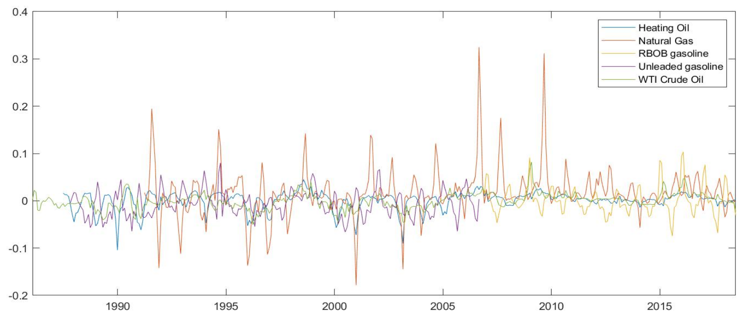
This table presents the realtionship between spreading pressure factor and changes of real economic uncertainty. We regress spreading pressure factor (and its long and short legs) on normalized changes of real economic uncercentainty ($\Delta RealUncertainty_t$), $R_{SP,t} = \beta_{RealUncertainty} \Delta RealUncertainty_t + \varepsilon_t$. We report $\beta_{RealUncertainty}$, its t-statistics and R^2 of above regression. We use sub-sample from January 1, 2005 to June 30, 2018.

	$\beta_{RealUncertainty}$	t-stat	$R^2(\%)$
Spreading Pressure Factor	-18.92	-2.66	9.46
Long, low spreading pressure commodities	-16.75	-2.45	4.80
Short, high spreading pressure commodities	2.17	0.33	2.14

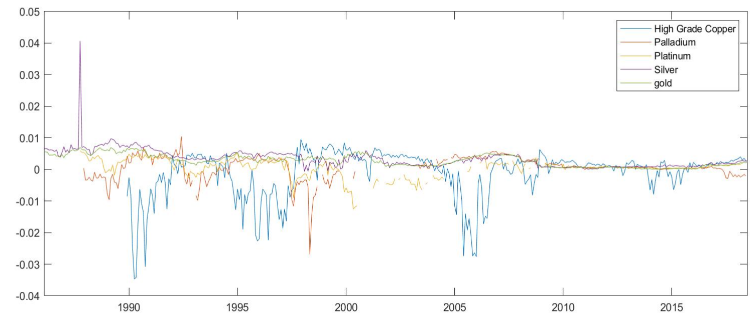
Figure 1: **Slope of Future Curve across Commodity Categories**

This table presents the future curve slope of different commodities from January 2, 1986 to June 30, 2018. We define the slope of the future curve as $slope_t = \ln F_t^2 - \ln F_t^0$.

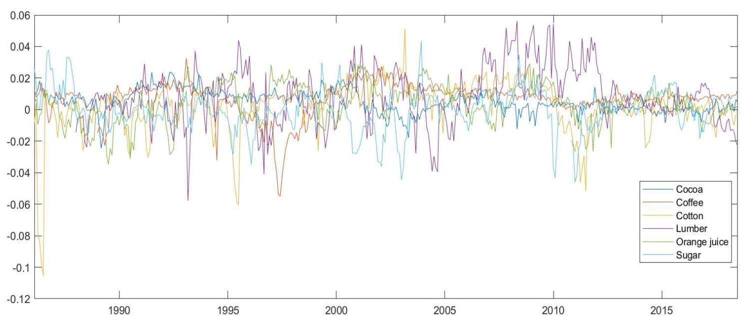
(a) Slope - energy



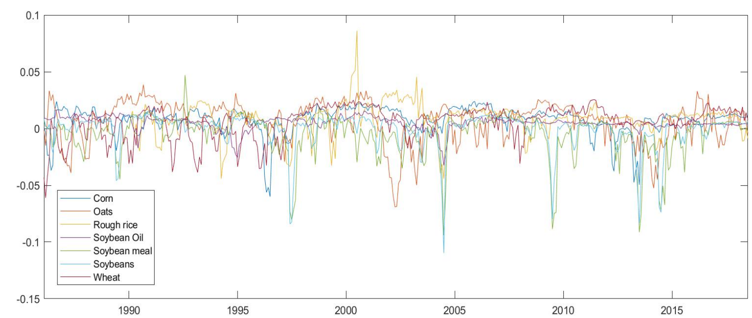
(b) Slope - metals



(c) Slope - softs



(d) Slope - grains



(e) Slope - meats

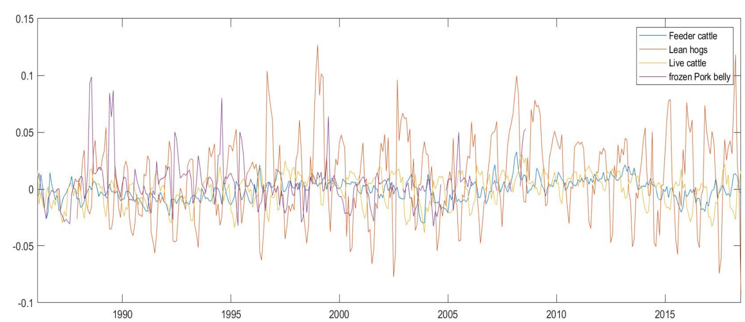
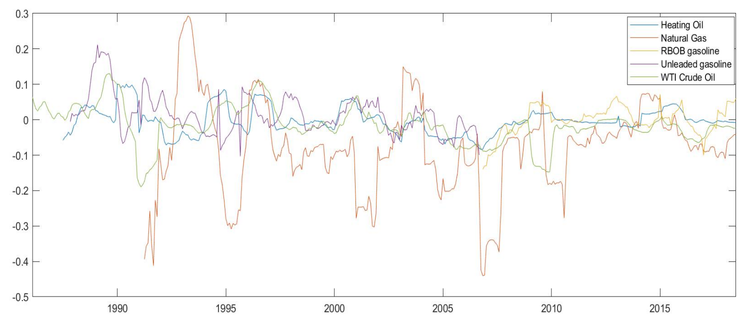


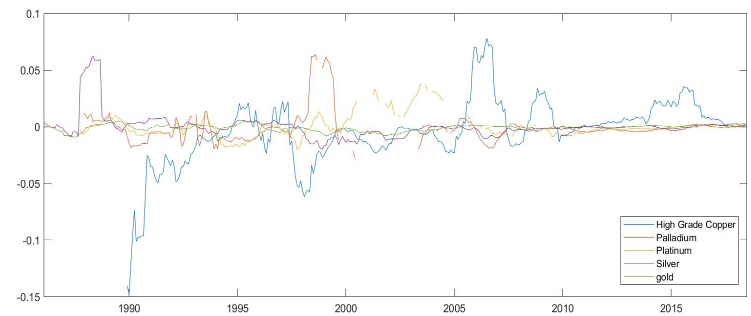
Figure 2: **Curvature of Future Curve across Commodity Categories**

This table presents the future curve curvature of different commodities from January 2, 1986 to June 30, 2018. We define the curvature of the future curve as $curvature_t = \sum_{s=t-12}^{t} \left(\ln F_s^2 - \ln F_s^1\right) - \left(\ln F_s^1 - \ln F_s^0\right)$.

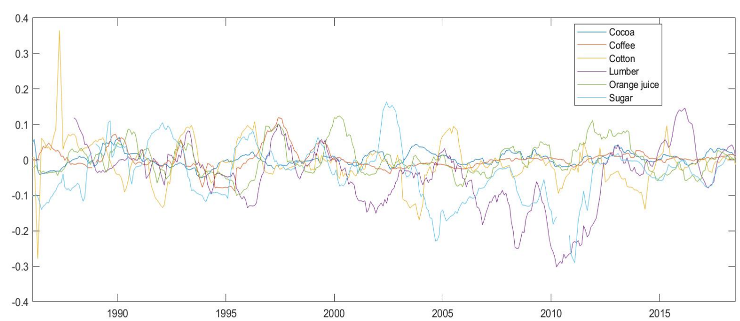
(a) Curvature - energy



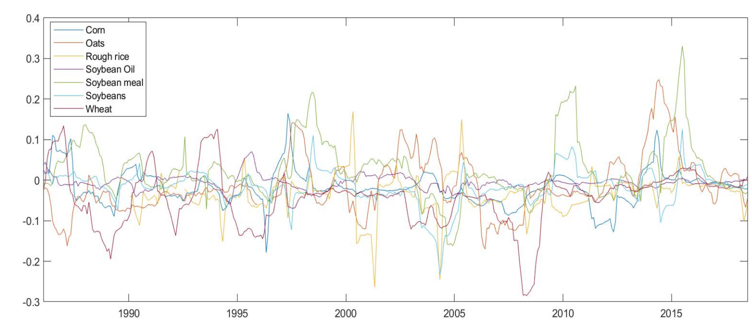
(b) Curvature - metals



(c) Curvature - softs



(d) Curvature - grains



(e) Curvature - meats

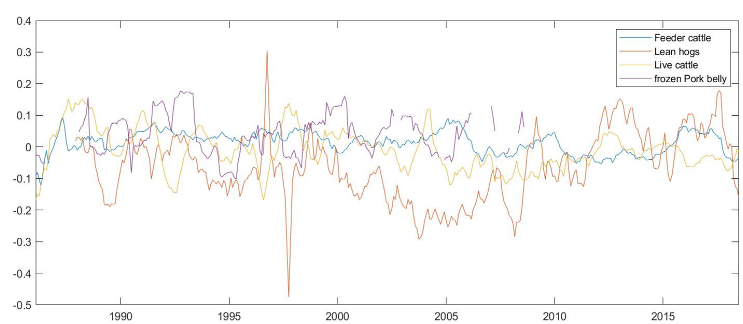
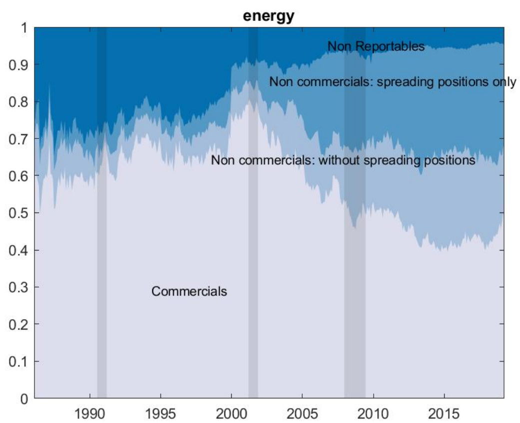


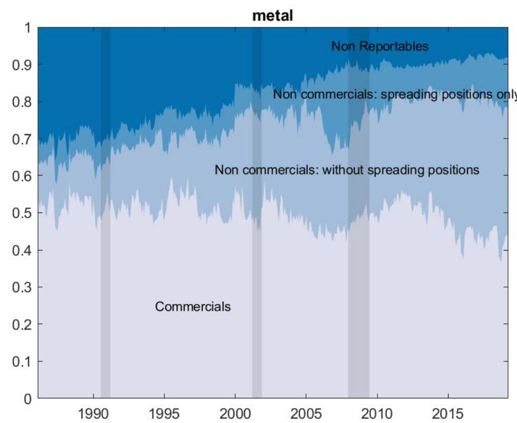
Figure 3: **Open-interest-weighted Average of Positions Hold by Trader Type**

This figure presents the percentage of total market held by different traders in sector-level. We report it for 4 trader categories: hedger, speculator without spread positions, speculators with spread positions only and Non-Reportable. The percentage of one commodity total market held by trader i is $percentage\, market\, held\, by\, trader\, i_t = \frac{Long_{i,t}+Short_{i,t}}{2\times Open\, Interest_t}$. We use full sample from January 2, 1986 to June 30, 2018.

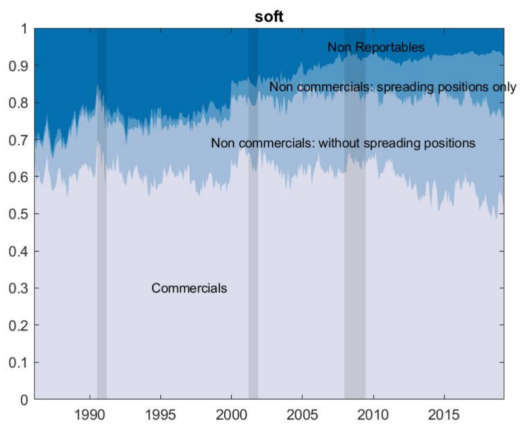
(a) Positions - energy



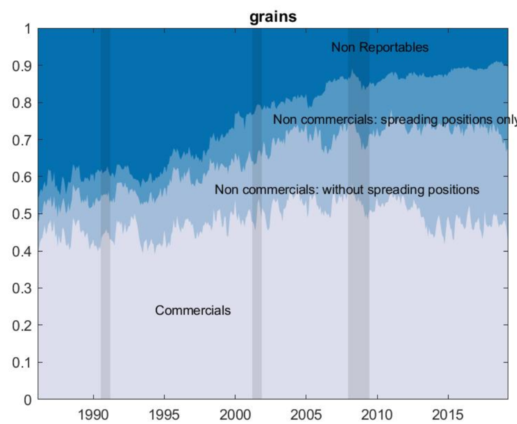
(b) Positions - metals



(c) Positions - softs



(d) Positions - grains



(e) Positions - meats

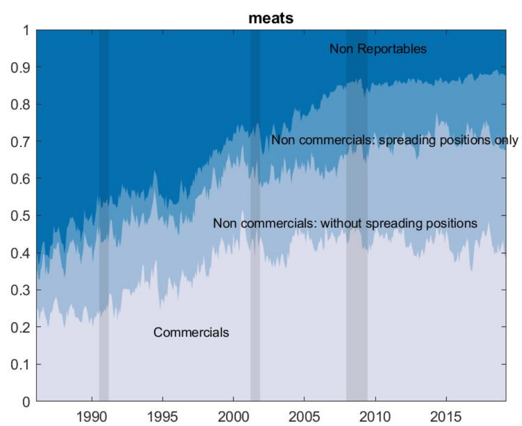
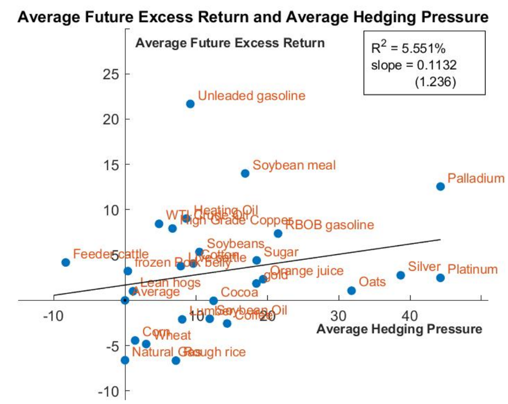


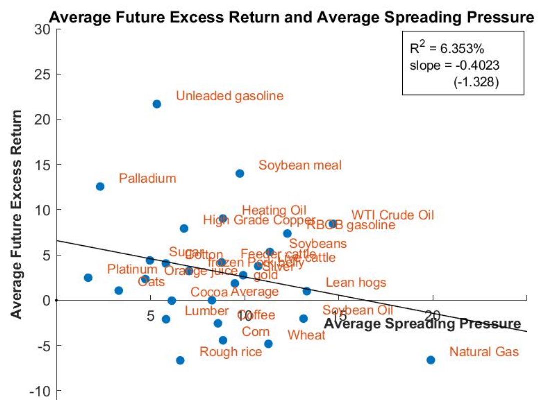
Figure 4: **Average Future Excess Return and Average Pressure from 4 Traders Categories: Full Sample**

The figure presents scatter plots and cross-sectional regression lines of the average excess futures return and average pressure from 4 trader categories for the 27 sample commodities between January 2, 1986 and June 30, 2018.

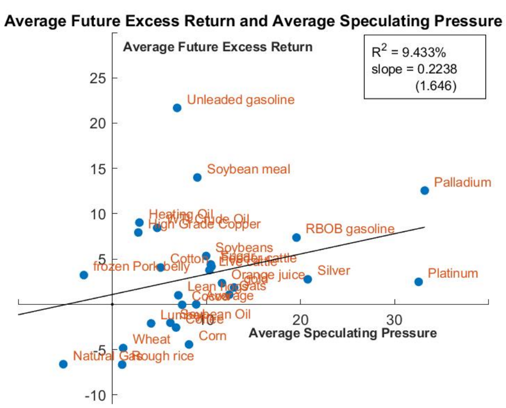
(a) Hedging Pressure



(b) Spreading Pressure



(c) Speculating Pressure



(d) Pressure from Small Speculators

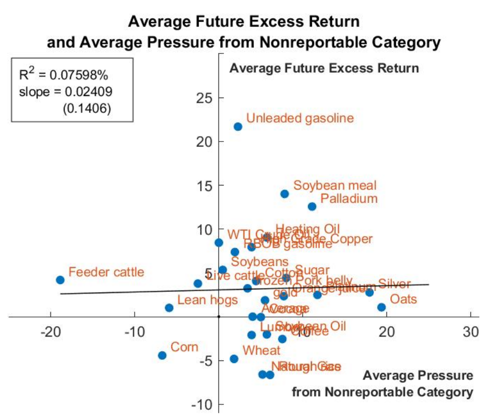
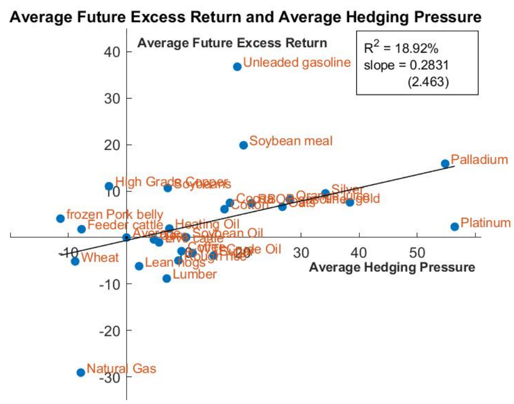


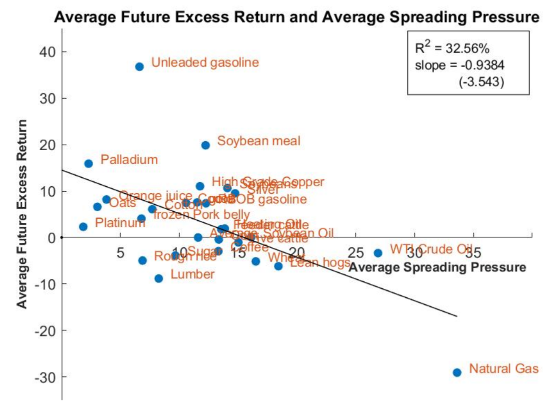
Figure 5: **Average Future Excess Return and Average Pressure from 4 Traders Categories: after 2005**

The figure presents scatter plots and cross-sectional regression lines of the average excess futures return and average pressure from 4 trader categories for the 27 sample commodities between January 2, 2005 and June 30, 2018.

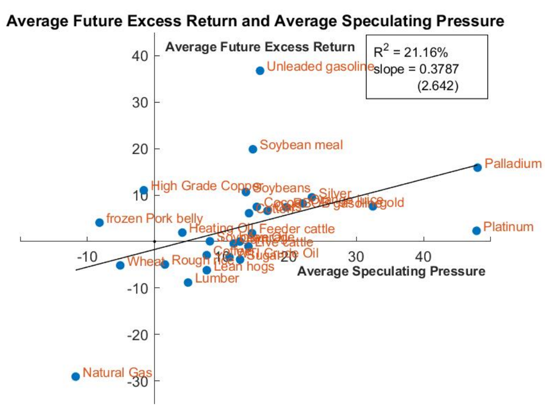
(a) Hedging Pressure



(b) Spreading Pressure



(c) Speculating Pressure



(d) Pressure from Small Speculators

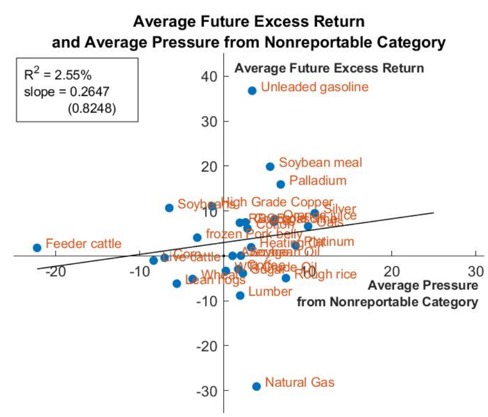
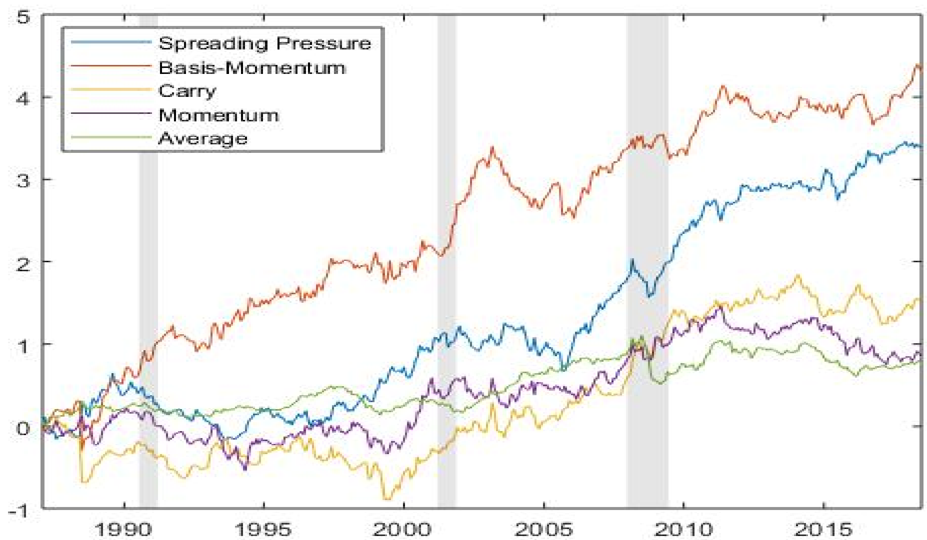


Figure 6: **Cumulative Excess Return by different trading strategy**

This figure presents cumulative returns (log scale) for carry (basis), momentum, basis-momentum and spreading pressure portfolios in full sample between January 2, 1986 and June 30, 2018 (top) and sub-sample January 2, 2005 and June 30, 2018 (bottom) respectively.

(a) Full Sample



(b) Sub-sample: After 2005

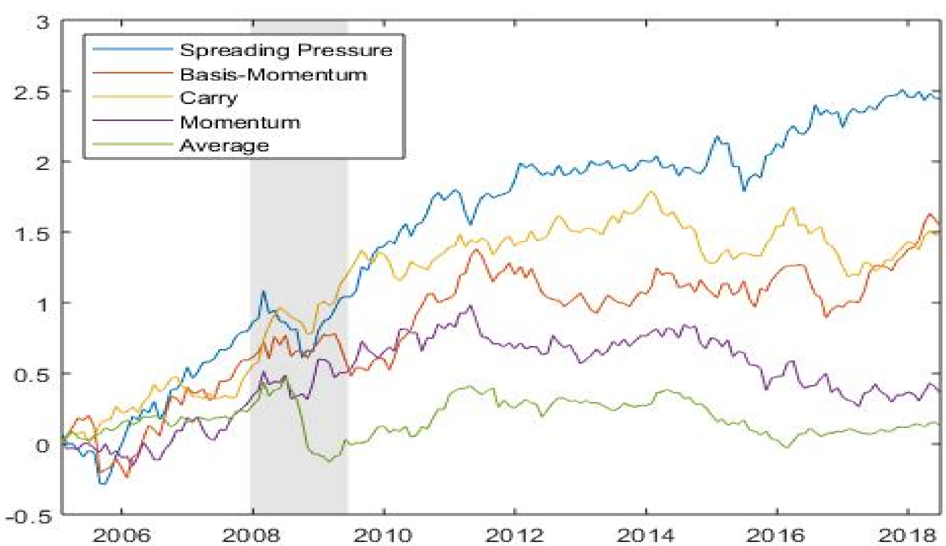


Figure 7: **Sensitivity of Commodity on Real Economic Uncertianty and Commodity Hoding Percentage in Spreading Presure Long/Short Legs**

This figure presents sensitivities of 26 commodities on real economic uncertainty and commodities holding percentage in spreading pressure portfolio long (top) and short (bottom) legs respectively (from January 1, 2005 to June 30, 2018). We denote $\Delta RealUncertainty_t$ as normalized changes of real economic and run regress $R_{i,t} = \beta_{i,RealUncertainty}\Delta RealUncertainty_t + \varepsilon_{i,t}$. $\beta_{i,RealUncertainty}$ is the measurement of sensitivity of commodity i on real economic uncertainty.The left-side y-axis (blue) is commodity holding percentage in spreading pressure portfolio long/short legs. The right-side y-axis (orange) is sensitivities of 26 commodities on real economic uncertainty