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Return Dynamics During Periods of High Speculation in a Thinly-Traded Commodity Market

Martin T. Bohl † und Martin Stefan †

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† Department of Economics, University of Münster, Germany

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Martin T. Bohl [a] Martin Stefan [b]

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Abstract

This article studies the effects of speculation in a thinly-traded commodity futures market paying particular attention to periods characterized by high speculative activity of long-short speculators. Using the speculation ratio as a daily measure for long-short speculation, we employ GARCH-regressions to study its impact on return dynamics. Our results for the CME feeder cattle futures market suggest that future returns are predominantly explained by fundamentals, but their volatility is significantly driven by the speculation ratio. This relationship holds for periods of high and low speculative activity alike.

[a]Corresponding author: Department of Business and Economics, Westfälische Wilhelms-Universität Münster, Am Stadtgraben 9, 48143 Münster, Germany, Phone: +49 251 83 25005, E-mail: martin.bohl@wiwi.uni-muenster.de

[b]Department of Business and Economics, Westfälische Wilhelms-Universität Münster, Am Stadtgraben 9, 48143 Münster, Germany, Phone: +49 251 83 22989, E-mail: martin.stefan@wiwi.uni-muenster.de

1 Introduction

The surge of commodity prices throughout the 2000s has been subject to debate both in the scientific literature and the general public. A number of public commentators have identified increasing investments in commodity futures by various financial institutions as the cause of the price hikes. Most prominently, the so-called Masters (2008) hypothesis asserts that in particular long-only positions by commodity index funds are to blame for driving up commodity prices throughout this period of time. The debate on the validity of the Masters hypothesis, however, seems mostly settled with numerous studies e.g. by Sanders, Irwin, and Merrin (2010), Irwin and Sanders (2012), Büyükşahin and Harris (2011) or Brunetti, Büyükşahin, and Harris (2016) rejecting the hypothesis' central claim.

Yet, comparatively little attention has been paid to the role of traditional long-short speculators. Büyükşahin and Harris (2011) and Alquist and Gervais (2013) use data from the Commodity Futures Trading Commission (CFTC) on trader positions and conduct Granger-tests to examine whether changes in the net long positions of non-commercial traders lead prices in the crude oil market. Neither of the two studies find evidence for such a relationship. Manera, Nicolini, and Vignati (2013a) also use CFTC data on trader positions, but consider various energy and agricultural commodity markets and measure speculation using Working's (1960) T index. The authors study the effects of speculation on returns in a DCC-GARCH framework and find speculation to either have an insignificant or significantly negative effect on returns across different markets. Similar findings are obtained by Manera, Nicolini, and Vignati (2016). Based on CFTC data and different GARCH approaches, the authors find that if significant, speculation has stabilizing, i.e. volatility-reducing, effects in four energy markets.

Some early evidence in favor of the notion that long-short speculators significantly impact the return dynamics of commodity markets is obtained by Streeter and Tomek (1992). Using the speculation ratio, which relates trading volume to open interest, the authors study the return dynamics of the soybean futures market. They find a positive relationship between the speculation ratio and volatility. Also more recent studies using the speculation ratio among other measures of speculative activity based on weekly CFTC data, e.g. Working's T or the net long position of speculative traders, conclude that speculation can exert destabilizing effects on the return dynamics of commodity markets. Robles, Torero, and von Braun (2009) demonstrate how various speculation measures can help forecast prices in the 2000s in the markets for wheat, corn, soybeans and rice. Du, Yu, and Hayes (2011) use a stochastic volatility model to study how speculation as measured by Working's T influences volatility in the crude oil market and how this market is connected to the markets for corn and wheat. The authors find that speculation significantly increases the volatility of the crude oil price and that volatility spillovers to the markets for corn and wheat have increased as of 2006.

Manera, Nicolini, and Vignati (2013b) use a variety of GARCH regressions to study the effects and interplay of various measures of speculative activity. They find a positive relationship for a number of these speculation measures and the volatility of returns in numerous agricultural and energy commodity futures markets. Lastly, Etienne, Irwin, and Garcia (2015) study how speculation explains the occurrence of periods characterized by explosive prices. They find that increases in the positions of non-commercial traders significantly increase the probability for the occurrence of positive price bubbles and significantly decrease the probability for negative price bubbles events.

Our investigation extends earlier work in three ways: First, unlike most studies, the effects of long-short speculation are analyzed using daily data. As neither scalpers nor day-traders hold positions for more than a few hours, daily observations promise to capture the effects of long-short speculation more accurately than lower frequency data. When measuring speculation we rely on the speculation ratio which has formally been proposed by Garcia, Leuthold, and Zapata (1986). The speculation ratio links trading volume to the amount of open positions in the market, an idea dating at least back to Peck (1981). The reasoning for using the speculation ratio as a measure for speculative activity is that long-short speculators, as opposed to hedgers, will prefer to hold their positions for relatively short periods of time. Long-short speculators such as day-traders take intraday positions based on expectations of how prices will move over the next minutes or hours, while scalpers open and close positions even almost instantaneously. Naturally, the profit margins of such trades are very small, which is why these traders must trade relatively large volumes to be profitable. In the process they provide liquidity and immediacy to the market, which is why such traders are said to make markets (e.g. Büyükşahin and Harris 2011; Du, Yu, and Hayes 2011).

Second, this article identifies time periods characterized by high levels of long-short speculation in order to particularly study market conditions under which one would expect to observe the most powerful effects of long-short speculation. The reason for this is that hedgers typically react more strongly to changes in fundamentals than speculators do. Consequently, increases in the relative market dominance of speculators will add to the risk of prices moving away from their fundamental level and fuel bubbles instead. To single out such time periods a Markov-switching approach (Hamilton 1989) is adopted.

Third, we focus on a rather illiquid market. Again, the idea is that speculators' impact should be greater if the number of hedgers is small and if the underlying commodity is non-storable. In this case commercial traders cannot adjust inventories to cushion against undesirable price movements. While the majority of research is focused on relatively large commodity futures markets with several hundred thousand open positions at the end of each trading day, this article considers the effects of speculation in the market for CME feeder cattle. This market is arguably the least liquid agricultural commodity market included in the CFTC's Supplemental Commitment of Traders (SCOT) reports. Moreover, livestock can unlike other commodities generally not be stored.

If despite these conditions classical long-short speculation does not significantly drive returns or volatility in this market, speculators are unlikely to influence return dynamics in more favorable market environments. In difference, if speculation is found to positively affect the market's return dynamics, regulators should be alert for allowing such unfavorable market conditions to develop. Lastly, should speculation exhibit negative, i.e. stabilizing, effects on returns and volatility, regulators should refrain from reining in speculative trading. Our results show that returns are predominantly driven by fundamentals, while the speculation ratio does exert economically and statistically significant effects on volatility. This effect is independent from the overall level of long-short speculation in the market.

The remainder of this article is structured as follows: First, we explain the econometric methodology, then the data of our analysis. Thereafter, the subsequent sections present the key results of this article and discuss several robustness exercises, after which we conclude.

2 Econometric Methodology

Our methodology comprises a two-step approach. First, weekly CFTC data is used to employ a Markov-switching model (Hamilton 1989) in order to determine periods of increased activity of long-short speculators. Second, daily data is used to assess the effects of long-short speculation on returns and volatility by employing a generalized autoregressive heteroscedasticity (GARCH) model (Bollerslev 1986) while incorporating the results of the first step in the form of a time dummy. This allows studying the impact of increased long-short speculation on future return dynamics.

Regimes of high long-short speculation are determined based on a constant-only Markov-switching regression model. A measure S_t of speculation in week t can therefore be in either of two states, namely high or low. The two states are unobservable and follow a Markov process. Hence, S_t can be described by the model:

$$S_t = \mu_{s_t} + \varepsilon_t \ , \tag{1}$$

where μ_{s_t} resembles the state-dependent intercept term and ε_t denotes random disturbances. If week t is characterized by high speculative activity, then $\mu_{s_t} = \mu_h$. Conversely, if week t is a period of low speculation, then $\mu_{s_t} = \mu_l$.

The dynamic regression model (1) allows in opposition to autoregressive models for quick changes in the level of S_t. Equation (1) is estimated using a quasi-Newton algorithm within a standard maximum-likelihood routine. Based on the estimation results we compute for each week the one-step ahead prediction for the probability of being in the state of increased speculative activity. After that, a daily regime dummy D_t is defined equal to one if in that week the predicted probability of being in the high speculation state exceeds the sample mean probability of being in this state. Otherwise the dummy is set to zero.

Given the regime dummy, the effects of long-short speculation on returns and volatility are examined using daily data and the following GARCH(1,1) model:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \sum_{i=1}^{4} \beta_i X_{i,t} + \beta_5 R_{t-1} + \beta_6 D_{t-1} + \beta_7 I_{t-1} + \varepsilon_t \ , \tag{2a}$$

$$\sigma_t^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 \sigma_{t-1}^2 + \sum_{i=1}^{4} \delta_i X_{i,t} + \delta_5 R_{t-1} + \delta_6 D_{t-1} + \delta_7 I_{t-1} \ , \tag{2b}$$

where r_t denotes returns and σ_t^2 their conditional variance. Returns are explained by previous period returns r_{t-1}, and a number of explanatory regressors. These consist of a set of macroeconomic controls contained in $X_{i,t}$, the lagged speculation ratio R_{t-1} to proxy for speculative activity, the lagged regime dummy D_{t-1} and an interaction term $I_{t-1} = R_{t-1} \cdot D_{t-1}$. Lagged terms are used to avoid an endogeneity problem due to simultaneity. Lastly, ε_t denotes random disturbances.

Our analysis includes as macroeconomic controls the oil price, the risk-less interest rate, the exchange rate and a stock return index. Rising oil prices will typically increase the production and transportation costs of a large variety of physical goods including agricultural commodities and thus curb their supply. Similarly, increases in a broad variety of stock returns will generally be reflective of economic booms which in turn are likely to boost the demand for commodities. Therefore, we expect the existence of a positive relationship between these two determinants and the future return of feeder cattle. Increases in the risk-less rate will increase producers' opportunity costs of holding inventories and thus likely be inversely related to the return of the commodity. This effect is, however, presumably lower for feeder cattle than for other commodities, as feeder cattle cannot be stored in the same way as other commodities. The exchange rate is also likely to have an inverse relationship with the concerned future contract, as an appreciation of the dollar exchange rate will cause a depreciation of the dollar denominated contract price. Empirical evidence for the inverse relationship between exchange and interest rates and the prices of food and other commodities is e.g. given by Akram (2009) and Chen et al. (2014).

The variance equation of the model consists of the ARCH term ε_{t-1}^2, the GARCH term σ_{t-1}^2 and the same explanatory regressors incorporated in the mean equation. The parameter γ_1 resembles the ARCH-effect, i.e. how strongly the conditional variance reacts to new information arriving in the market, while the GARCH-effect is described by γ_2, which measures how persistent shocks to the conditional variance are over time. For the returns process to be stationary in variance it must hold that $\gamma_1 + \gamma_2 < 1$.

As this article seeks to study the effects of long-short speculators on returns and volatility, we are particularly interested in the six parameters associated with the speculation ratio R_{t-1}, the speculation regime dummy D_{t-1} and the interaction term I_{t-1}. The interpretation of β_5 and δ_5 is straightforward. If positive, speculation exerts destabilizing effects by increasing returns respectively volatility. If negative, it decreases the two and acts stabilizing.

In opposition to the Masters hypothesis, the latter has been the main finding for the role of commodity index funds. This is in line with classical theory concerning the impact of speculation. The key argument for why speculators will exert stabilizing effects is that they are seen as arbitrageurs who buy when prices are below their fundamental value and sell if prices are above it. Otherwise, if speculators bought when prices are high or sold when prices are low, they would on average lose money and eventually exit the market (Friedman 1953). Even if noise traders (Kyle 1985; Black 1986), i.e. traders who respond to signals other than fundamentals, are present in the market, their impacts would always be offset by aggressive arbitrage trading from rational speculators (Fama 1965). However, as demonstrated by De Long et al. (1990a) and De Long et al. (1990b), the actions of noise traders need not always be perfectly balanced by opposing trades from sophisticated arbitrageurs, either because the latter are risk-averse or because they intend to profit from the actions of positive feedback traders. In theses cases, speculation bears the potential for considerably destabilizing prices and fueling bubbles.

Parameters β_6 and δ_6 respectively β_7 and δ_7 capture non-linear effects of speculation on the stability of prices. In the spirit of De Long et al. (1990a) and De Long et al. (1990b), significant estimates for these parameters would entail that sophisticated investors' risk-aversion and trading strategy depends on the level of noise-traders in the market. Parameters β_6 and δ_6 shift the constants in the two equations of the model. A positive value of β_6 suggests that returns are generally higher in periods of high speculative activity, while a positive value of δ_6 would suggest that the volatility is elevated in these periods. Parameters β_7 and δ_7 alter the slope of the mean and variance equation with respect to the speculation ratio. Positive values of β_7 and δ_7 indicate that the effects of an increase in the speculation ratio are amplified by the activities of long-short speculators, while negative values of β_7 and δ_7 suggest that price or volatility increasing effects of long-short speculation are reduced during periods of increased speculative activity.

3 Data

The CFTC issues a series of reports on trading positions of different trader types.[1] Among these are the Supplemental Commitments of Traders (SCOT) reports, which are publicly available and provide weekly data as of January 2006 on market open interest, the number and aggregate positions of different trader types for thirteen agricultural commodity future markets.[2] The SCOT reports distinguish between commercial traders, non-commercial traders, commodity index traders and traders that do no report the nature of their futures transactions. Traders classified as commercials are typically seen as hedgers, whereas non-commercial traders are typically seen as speculators.

The case of non-reporting traders is, however, less clear. On the one hand, non-reported positions typically comprise those of traders that are too small to exceed the CFTC's reporting levels. These traders are presumably mainly hedgers. On the other hand, Irwin and Sanders (2012) note that traders have incentives not to be classified as speculative traders which is why a substantial fraction of non-reported positions could also stem from speculators.

Table 1 summarizes the position data for the different markets included in the SCOT reports. The market for feeder cattle stands out for three reasons. First, it is the smallest both in terms of open interest and the amount of traders, suggesting that it is the least liquid market. Second, the market for feeder cattle features very high open interest shares of non-commercial and non-reporting traders. Note that the share of non-reported positions is almost three times higher than in the other markets.[3] Therefore, the presence of speculators is presumably rather high in this market. Third, feeder cattle is non-storable, which reduces the ability of commercial traders to cushion adverse price developments with inventory adjustments. Given this set of market characteristics, the effects of speculation should be particularly strong in the market for feeder cattle futures. Thus, we select the market for CME feeder cattle futures for our analysis.

[Table 1 about here.]

As explained above, in order to determine high speculation regimes, one must first compute an observable measure S_t for the level speculative activity in week t. Obviously, this calculation hinges on the question of which trader type actually engages in speculative activity as opposed to who engages in hedging. While the case is fairly straightforward for the positions of commercial and non-commercial traders, the literature has proposed several ways of how to allocate non-reported positions to the speculative and hedging kind. Rutledge

(1977) and Sanders, Irwin, and Merrin (2010) allocate non-reported positions to hedging and speculative positions in the same proportions that they observe for reported positions. Alquist and Gervais (2013) assume that all non-reporting traders are speculators, while Manera, Nicolini, and Vignati (2013a) assume a 30/70 split among hedging and speculative positions.

These high values for the share of speculators among non-reporting traders are, however, presumably too high for the feeder cattle market. As noted by the CME Group (2017) the US cattle farming and feedlot industry is characterized by a large number of small and often family-owned operations. Consequently, the overwhelming majority of producers in this market will fall below the CFTC's reporting levels resulting in a large number of hedgers among non-reporting traders. Therefore, we assume that only 20 percent of non-reported positions stem from speculative activity, while the remaining 80 percent is assumed to stem from hedging. Hence, S_t is defined as:

$$S_t = \frac{NCL_t + NCS_t + \alpha \cdot (NRL_t + NRS_t)}{2 \cdot MOI_t} \,. \tag{3}$$

Long and short positions of non-commercial speculators are denoted NCS_t and NCL_t, respectively. Analogously, the positions of non-reporting traders are denoted NRL_t and NRS_t. Lastly, MOI_t resembles market open interest in week t, while $\alpha = 1/5$ for the baseline regressions.

Given S_t, we follow the procedure outlined in the methodology section to obtain the daily regime dummy D_t. This yields a total of 19 different high speculation regimes, which last eleven weeks on average. The shortest of these regimes last only a single week, while the longest of them last half a year. Figure 1 displays the time series of the speculation measure S_t and the resulting high speculation regimes, which are indicated by shaded backgrounds.

[Figure 1 about here.]

We use daily data from Thomson Reuters Datastream on prices, trading volume and open interest in the market for CME feeder cattle futures as well as the macroeconomic controls, which comprise the West Texas Intermediate crude oil price, the three-month US T-bill middle rate, the US broad exchange rate index and the MSCI-USA index. Based on the availability of data for all variables, the sample consists of a total of 2523 observations ranging from 16 November 2007 to 28 December 2017. Given the data on open interest and trading volume VOL_t, the speculation ratio R_t is calculated as the quotient of trading volume to open interest:

$$R_t = \frac{VOL_t}{MOI_t} \,. \tag{4}$$

The speculation ratio has been proposed by Garcia, Leuthold, and Zapata (1986) as a measure for speculative activity. The idea behind measuring speculative activity using market open interest and trading volume is that hedgers generally hold their positions over a longer period of time, while speculators prefer intraday trade and avoid holding positions overnight. Consequently, the trading activities of the former will increase end-of-day market open interest, while the activities of speculators will increase trade volume (Rutledge 1977; Leuthold 1983; Bessembinder and Seguin 1993). The ratio of trading volume to market open interest can therefore be interpreted as a measure for the relative dominance of speculators to hedgers. Empirical evidence for the hypothesis that hedgers in futures markets prefer to hold their positions relatively longer then speculators is provided Wiley and Daigler (1998) for financial futures markets and Ederington and Lee (2002) for commodity futures markets.

Descriptive statistics for the variables included in the analysis are provided in table 2 along with the results of augmented Dickey-Fuller (ADF) (1979) tests.

[Table 2 about here.]

The test results reveal that the logarithms of prices and the macroeconomic control variables are generally not stationary. To induce stationarity this article considers the log-returns (in percent) of these variables, e.g. futures returns are defined as $r_t = (\ln(F_t) - \ln(F_{t-1})) \cdot 100$, where F_t denotes the level futures price.

4 Results

Columns (1) and (2) of table 3 report the results for two variants of the main regression. First, we exclude the regime dummy D_{t-1} and the interaction term I_{t-1} from the regressors contained in equations (2a) and (2b). Second, all of the regressors in equations (2a) and (2b) are included in the regression. Concerning the macroeconomic controls, the results show that crude oil and the MSCI returns have significantly positive effects on feeder cattle futures returns. Both estimated parameters are significant at the 1 % level. Conversely, the coefficient estimates for the T-bill and the exchange rate in the mean equation are close to zero and both not statistically significant.

[Table 3 about here.]

Regarding the effects on volatility, we find that neither crude oil nor the MSCI returns have a statistically significant effect. Instead, the T-bill and the exchange rate both have a significantly negative impact on volatility. Concerning the ARCH and GARCH terms, significantly positive estimates are obtained for both coefficients γ_1 and γ_2. While the former is in both specifications small and close to zero, the latter is rather high and close to unity suggesting that shocks to volatility die out relatively slowly. The variance stationarity constraint is met in both specifications.

Turning to the regressors pertaining to speculation, we observe that none of them is statistically significant on conventional levels in the mean equation.

Nonetheless, it is worth noting that the negative coefficient estimate for the speculation ratio becomes less negative with the introduction of the interaction term. The coefficient estimate for the speculation ratio in the variance equation is strongly positive and highly significant. This suggests that increases in the speculation ratio are the main driver of daily volatility in the market for feeder cattle futures. This finding persists when also the regime dummy and the interaction term are included in the regression, of which neither is statistically significant.

Our results imply that speculation does contribute to greater uncertainty in the market regarding short term return developments in the form of volatility clusters. This is in line with earlier findings of Streeter and Tomek (1992), Robles, Torero, and von Braun (2009) and Manera, Nicolini, and Vignati (2013b) who also find that the speculation ratio is a driver of volatility. However, as implied by the insignificant estimates for the speculation parameters in the mean equation, these effects are confined to the short term beyond which speculators do not appear to alter return dynamics. This key result is closely related to the findings of earlier studies treating the Masters hypothesis, e.g. Sanders, Irwin, and Merrin (2010), Brunetti, Büyükşahin, and Harris (2016) or Etienne, Irwin, and Garcia (2015). As with commodity index traders, long-short speculators do not appear to fuel price bubbles and permanently drive prices away from their fundamental value, lending support to the concept of stabilizing speculation developed by Friedman (1953) and Fama (1965).

It should nonetheless be noted that the speculation ratio is not a direct measure of speculation but relates trading volume to open interest as an indication for the presence of speculators in the market. Hence, increases in the speculation ratio need not be reflective of more speculative activity, but could also resemble increases in the trading volume due to increased information flows in the market. In that case of our results would fall in line with the mixture of distributions hypothesis as put forward by Clark (1973), Epps and Epps (1976) and Tauchen and Pitts (1983).

5 Robustness analysis

In this section, the robustness of the previous results is examined in three dimensions. In particular, this section discusses several alternatives for constructing the regime dummy for periods of high or low speculative activity by long-short speculators. First, the robustness of our results is explored with respect to the minimum length of any high or low level speculation regime. Second, as mentioned in the methodology section, determining the speculative activity by long-short speculators or any other trader type hinges on the question of how to deal with the positions of non-reporting traders. Therefore, this section experiments with different assumptions regarding such positions. Third, we explore how our results change depending on the use of alternative measures of speculative activity by long-short speculators.

As explained above, the way in which the regime dummy was constructed implied a number of very short regimes, some lasting only for a single week. Now, the construction of the dummy is changed by imposing a minimum length restriction on both types of regimes. In particular, we require that any regime, regardless of high or low speculative activity, lasts for at least five weeks. Hence, regimes shorter than one month are ruled out. Figure 2 demonstrates the results of this restriction graphically. If regimes are required to last at least five weeks, a total of 13 high-speculation regimes is obtained in contrast to the initial 19. Instead of eleven weeks, these regimes now last 16 weeks on average.

[Figure 2 about here.]

Column (3) of table 3 reports the results in comparison to the baseline results in column (2). The results in the mean and the variance equation are highly similar, in particular concerning those parameter estimates that are statistically significant. The most notable deviation from the baseline model occurs for the coefficient of the speculation ratio in the variance equation. This estimate is, unsurprisingly, roughly 5 percent lower in the restricted case when only longer-term regimes are considered.

Concerning the treatment of non-reported positions, three alternative ways of how to allocate these positions across hedging and speculative positions are considered in this article. While we initially assumed that $\alpha = 0.2$ of non reported positions were speculative, the regression is now repeated for $\alpha = 0$, $\alpha = 0.6$ and $\alpha = 0.8$, i.e. non-reported positions are either assumed to be all hedging, or to be mildly respectively strongly dominated by speculators. The latter values are reflective of the idea that a larger number of speculators might choose not to classify themselves as speculators (Irwin and Sanders 2012).

The results concerning the alternative speculator proportions are reported in columns (4), (5) and (6) of table 3. The results for the mean equation are again highly alike for all assumptions underlying the dummy construction. Similar results are also obtained for the variance equation.

Lastly, we consider alternatives in constructing the regime dummy with respect to the underlying measure of speculative activity. As explained in the methodology section, the baseline regression built upon a dummy that had been constructed from the total open interest share that speculators take in the market. The literature has, however, employed a number of alternative measures when assessing speculative activity using the trader positions data from the CFTC. The most common of these is Working's T index of speculative activity. Let S_t^{WT} denote Working's T, then using the same notation as above, the index is defined as

$$S_t^{WT} = \begin{cases} 1 + \dfrac{SS_t}{HS_t + HL_t} & \text{if } HS_t \geq HL_t \\ 1 + \dfrac{SL_t}{HS_t + HL_t}\,, & \text{if } HS_t < HL_t \end{cases}\,, \tag{5}$$

where SL_t, SS_t, HL_t and HS_t represent the long and short positions of speculators and hedgers, respectively. These are given by

$$SL_t = NCL_t + \alpha \cdot NRL_t\,, \tag{6}$$

$$SS_t = NCS_t + \alpha \cdot NRS_t\,, \tag{7}$$

$$HL_t = CL_t + (1 - \alpha) \cdot NRL_t\,, \tag{8}$$

and

$$HS_t = CS_t + (1 - \alpha) \cdot NRS_t\,. \tag{9}$$

The logic underlying this index is that any trade by a hedger requires a trade in the opposite direction by a speculator. If hedgers would on average like to take a short position, i.e. $HS_t \geq HL_t$, then there must be a sufficient amount of speculators taking a long position to clear the market. If, however, a large number of speculators takes a short position, SS_t, this might be seen as indication for "excessive speculation". Depending on the size of this speculative pressure, Working's T moves further and further away from its lower bound of unity.

Other measures of speculative activity, which have e.g. been used in Manera, Nicolini, and Vignati (2013b, 2016) are the long-only, the short-only, and the net-long share of speculators. We denote these three shares by S_t^l, S_t^s, S_t^{nl} and define them as

$$S_t^l = \frac{SL_t}{MOI_t} \ , \tag{10}$$

$$S_t^s = \frac{SS_t}{MOI_t} \ , \tag{11}$$

and

$$S_t^{nl} = \frac{SL_t - SS_t}{MOI_t} \ . \tag{12}$$

For each of these alternative speculation measures the regime dummy series of high speculation regimes is computed as above and the main regression is repeated accordingly. The results of these regressions are displayed in table 4.

[Table 4 about here.]

Comparing the results for these alternative speculation measures with those of the baseline regression, we again find that the results are highly consistent across the different measures in both their economic and statistical interpretation.

To sum up, this article has explored how the speculation ratio affects the return dynamics in a market environment that is particularly prone to suffer from detrimental effects due to speculation, i.e. a thinly-traded commodity market with a non-storable underlying commodity during periods of increased speculative activity. To check the robustness of our results, we have explored a number of different ways as to how to construct the regime dummy for periods of high speculation. These comprised different regime lengths, different assumptions regarding non-reported positions and a variety of alternative speculation measures. Our key finding that the speculation ratio is an important driver of volatility but does not affect the level of returns and is independent from the speculation regime has proven robust across all of these different specifications.

6 Conclusion

This article has examined how long short-speculation affects the return dynamics in a market environment where one would expect these effects to be particularly strong, i.e. when trading volume is low, the amount of speculators is high and inventories are expensive to hold. The analysis focused on the market for CME feeder cattle futures market. This market is one of the most illiquid markets included in the CFTC SCOT reports. It features by far the highest amount of non-reporting traders and is in addition to that characterized by a non-storable underlying. Within this market setting, a Markov-switching approach is used to single out periods characterized by high by high speculative activity of long-short speculators.

The results of the mean equation in the GARCH analysis reveal that speculation as measured by the speculation ratio does not significantly impact returns, while the variance equation suggests that speculation does influence volatility. The parameters of the dummy variable for periods characterized by high speculative activity are generally not significant, neither is the interaction term between the regime dummy and the speculation ratio. This implies that speculation does not arbitrarily drive returns away from levels implied by fundamentals, not even during high speculation regimes. In particular, the results do no support the idea of speculation inflating prices permanently in the form of price bubbles. Only with respect to the short term, the results support the notion that speculation impacts returns by increasing their volatility. But as the activity of long-short speculators was measured using the speculation ratio, these results can also be interpreted as a sign for increased volatility due to increased information flows that manifest themselves in higher trading volume.

While previous research largely rebutted the Masters hypothesis and found no evidence as to why commodity index traders are to blame for price hikes in commodity markets, this article reaches a similar conclusion for the case of classical long-short speculators. Most notably, this article does so for a market environment where one would expect the strongest effects of speculation. Consequently, it seems unlikely that long-short speculation would destabilize prices in more liquid markets with lower levels of speculation. Even though the evidence strongly points toward fundamentals, the question what caused the price hikes observed in numerous commodity markets during 2007-2008 remains unanswered and open for future research. The policy implications of this article are, however, rather clear. As futures speculation is not found to drive prices away from fundamental values, regulators should be wary of reining in speculation in futures markets and thereby depriving commercial traders of their ability to hedge against undesirable price movements.

References

Akram, Q. Farooq. 2009. "Commodity prices, interest rates and the dollar." *Energy Economics* 31 (6):838–851.

Alquist, Ron and Olivier Gervais. 2013. "The role of financial speculation in driving the price of crude oil." *The Energy Journal* 34 (3):35–54.

Bessembinder, Hendrik and Paul J. Seguin. 1993. "Price volatility, trading volume, and market depth: Evidence from futures markets." *The Journal of Financial and Quantitative Analysis* 28 (1):21–39.

Black, Fischer. 1986. "Noise." *The Journal of Finance* 41 (3):528–543.

Bollerslev, Tim. 1986. "Generalized autoregressive conditional heteroskedasticity." *Journal of Econometrics* 31 (3):307–327.

Brunetti, Celso, Bahattin Büyükşahin, and Jeffrey H. Harris. 2016. "Speculators, prices, and market volatility." *Journal of Financial and Quantitative Analysis* 51 (5):1545–1574.

Büyükşahin, Bahattin and Jeffrey H. Harris. 2011. "Do speculators drive crude oil futures prices?" *The Energy Journal* 32 (2):167–202.

Chen, Shu-Ling, John D. Jackson, Hyeongwoo Kim, and Pramesti Resiandini. 2014. "What drives commodity prices?" *American Journal of Agricultural Economics* 96 (5):1455–1468.

Clark, Peter K. 1973. "A subordinated stochastic process model with finite variance for speculative prices." *Econometrica* 41 (1):135–155.

CME Group. 2017. *Livestock futures and options: Introduction to underlying market fundamentals*, chap. The Beef Industry. 8–12.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldman. 1990a. "Noise trader risk in financial markets." *Journal of Political Economy* 98 (4):703–738.

———. 1990b. "Positive feedback investment strategies and destabilizing rational speculation." *The Journal of Finance* 45 (2):379–395.

Dickey, David A. and Wayne A. Fuller. 1979. "Distribution of the estimators for autoregressive time series with a unit root." *Journal of the American Statistical Association* 74 (366):427–431.

Du, Xiaodong, Cindy L. Yu, and Dermot J. Hayes. 2011. "Speculation and volatility spillover in the crude oil and agricultural commodity markets: A Bayesian analysis." *Energy Economics* 33 (3):497–503.

Ederington, Louis and Jae Ha Lee. 2002. "Who trades futures and how: Evidence from the heating oil futures market." *The Journal of Business* 75 (2):353–373.

Epps, Thomas W. and Mary Lee Epps. 1976. "The stochastic dependence of security price changes and transaction volumes: Implications for the mixture-of-distributions hypothesis." *Econometrica* 44 (2):305–321.

Etienne, Xiaoli L., Scott H. Irwin, and Philip Garcia. 2015. "Price explosiveness, speculation, and grain futures prices." *American Journal of Agricultural Economics* 97 (1):65–87.

Fama, Eugene F. 1965. "The behavior of stock-market prices." *The Journal of Business* 38 (1):34–105.

Friedman, Milton. 1953. *Essays in positive economics*, chap. The case for flexible exchange rates. The Chicago University Press, 157–203.

Garcia, Philip, Raymond M. Leuthold, and Hector Zapata. 1986. "Lead-lag relationships between trading volume and price variability: New evidence." *Journal of Futures Markets* 6 (1):1–10.

Hamilton, James D. 1989. "A new approach to the economic analysis of nonstationary time series and the business cycle." *Econometrica* 57 (2):357–384.

Irwin, Scott H. and Dwight R. Sanders. 2012. "Testing the Masters hypothesis in commodity futures markets." *Energy Economics* 34 (1):256–269.

Kyle, Albert S. 1985. "Continuous auctions and insider trading." *Econometrica* 53 (6):1315–1335.

Leuthold, Raymond M. 1983. "Commercial use and speculative measures of the livestock commodity futures markets." *Journal of Futures Markets* 3 (2):113–135.

Manera, Matteo, Marcella Nicolini, and Ilaria Vignati. 2013a. "Financial speculation in energy and agriculture futures markets: A multivariate GARCH approach." *The Energy Journal* 34 (3):1–26.

———. 2013b. "Futures price volatility in commodities markets: The role of short term vs long term speculation." *Fondazione Eni Enrico Mattei Working Paper Series* (45):1–26.

———. 2016. "Modelling futures price volatility in energy markets: Is there a role for financial speculation?" *Energy Economics* 53:220–229.

Masters, Michael W. 2008. "Testimony before the committee on homeland security and governmental affairs." *United States Senate* :1–17.

Peck, Anne E. 1981. "The adequacy of speculation on the wheat, corn and soybean futures markets." *Research in Domestic and International Agribusiness Management* 2:17–29.

Robles, Miguel, Maximo Torero, and Joachim von Braun. 2009. "When speculation matters." *International Issue Food Policy Reserach Institute Issue Brief* (57):1–8.

Rutledge, David J. S. 1977. "Estimation of hedging and speculative positions in futures markets: An alternative approach." *Food Research Institute Studies* 16 (3):205–211.

Sanders, Dwight R., Scott H. Irwin, and Robert P. Merrin. 2010. "The adequacy of speculation in agricultural futures markets: Too much of a good thing?" *Applied Economic Perspectives and Policy* 32 (1):77–94.

Streeter, Deborah H. and William G. Tomek. 1992. "Variability in soybean futures prices: An integrated framework." *Journal of Futures Markets* 12 (6):705–728.

Tauchen, George E. and Mark Pitts. 1983. "The price variability-volume relationship on speculative markets." *Econometrica* 51 (2):485–505.

Wiley, Marilyn K. and Robert T. Daigler. 1998. "Volume relationships among types of traders in the financial futures markets." *Journal of Futures Markets* 18 (1):91–113.

Working, Holbrook. 1960. "Speculation on hedging markets." *Food Research Institute Studies* 1 (2):185–220.

Notes

[1]See Irwin and Sanders (2012) for a description and comparison of the different CFTC reports.

[2]Note that CBOT Soybean Meal futures were originally not part of the SCOT reports, but were added to them in April 2013.

[3]The analysis by Sanders, Irwin, and Merrin (2010) shows that the market for feeder cattle futures has also featured such high levels of speculative positions in earlier periods.

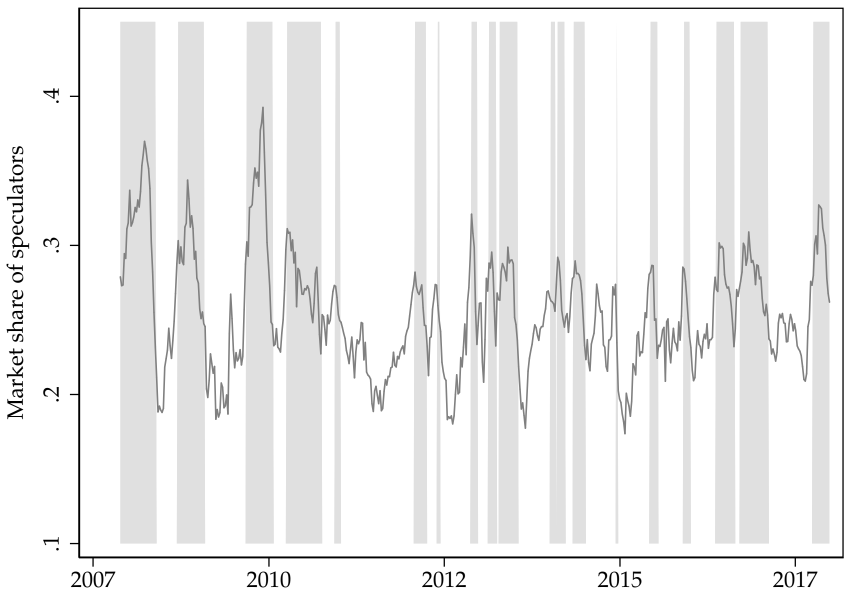

Figure 1. Open interest share of speculators and high speculation regimes

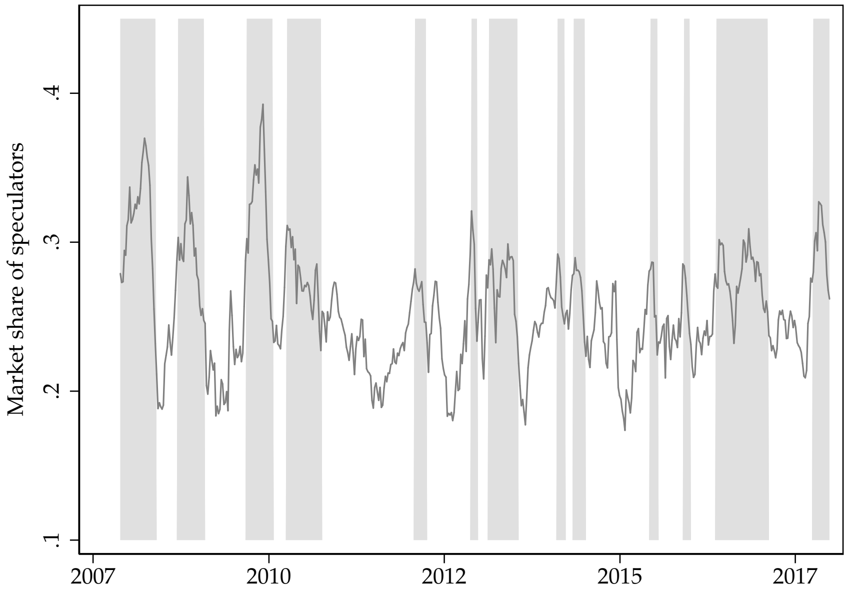

Figure 2. High speculation regimes with minimum length restriction

Table 1. Open Interest, Number of Traders and Open Interest Shares of Different Trader Types in the CFTC SCOT Reports

Future Contract	Contract Size	MOI	No. Traders	C (%)	NC (%)	I (%)	NR (%)
CBOT Corn	5,000 bu	1750031	774	66	81	27	26
ICE Sugar	112,000 lb	957932	231	85	66	32	16
CBOT Soybeans	5,000 bu	767441	550	68	84	25	23
CBOT Wheat	5,000 bu	521595	404	50	90	42	18
CBOT Soybean Meal	100 tons	405534	278	83	71	25	21
CBOT Soybean Oil	60,000 lb	369395	259	81	74	27	17
CME Live Cattle	40,000 lb	358571	395	60	83	32	25
ICE Cotton	50,000 lb	271573	277	79	77	31	12
CME Hogs	40,000 lb	257189	273	53	86	36	26
ICE Cocoa	10 mtr. t	203182	193	100	73	17	10
ICE Coffee	37,500 lb	198109	383	79	86	26	10
KCBOT Wheat	5,000 bu	173443	193	75	68	27	31
CME Feeder Cattle	50,000 lb	43885	177	37	82	22	59

Note: MOI refers to average market open interest, while C, NC, I and NR refer to the average open interest shares (in percent) of commercial, non-commercial, index and non-reporting traders, respectively. All series range from January 2006 until December 2017, except that of soybean meal futures, which starts on 2 April 2013. As these shares include both long and short positions, they add up to 200. Slight deviations result from rounding.

Table 2. Descriptive Statistics of the Variables (in Levels) Used in the Analysis and ADF Test Statistics for the Variables in Logs and Log First Differences

	Descriptive Statistics						ADF test	
	Mean	St.Dev.	Skew	Kurt.	Min	Max	Log	Log FD
Volume	7610.67	3915.20	1.22	5.01	29.00	28848.00	-19.57	-74.91
Open Interest	38677.27	9596.93	0.21	2.82	17981.00	65612.00	-1.71	-40.48
Price	143.29	36.69	0.73	2.94	86.55	242.93	-1.29	-45.73
3 Month T-bill	0.35	0.59	2.64	10.37	0.01	3.32	-4.74	-63.89
Crude Oil	76.78	24.66	-0.03	2.00	26.19	145.31	-1.86	-51.94
Exchange Rate	107.08	9.65	0.71	2.05	93.95	129.08	-0.77	-49.07
MSCI	1449.88	299.43	-0.12	2.26	688.64	2106.89	-0.42	-51.72
Speculation Ratio	0.19	0.08	0.94	4.51	0.00	0.70	-25.55	-74.92

Note: The critical values of the ADF test are -2.570, -2.860 and -3.430 for the 10 %, 5 % and 1 % level of statistical significance.

Table 3. Results of GARCH Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Mean Equation						
r_{t-1}	0.108***	0.109***	0.109***	0.109***	0.110***	0.109***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Oil_t	0.058***	0.058***	0.059***	0.058***	0.059***	0.058***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
$Tbill_t$	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Exrate_t$	0.010	0.011	0.009	0.012	0.014	0.012
	(0.058)	(0.059)	(0.059)	(0.059)	(0.061)	(0.061)
$MSCI_t$	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
R_{t-1}	−0.332	−0.262	−0.280	−0.378	−0.074	−0.185
	(0.262)	(0.314)	(0.307)	(0.296)	(0.324)	(0.331)
D_{t-1}		0.024	0.005	−0.050	0.100	0.058
		(0.105)	(0.107)	(0.117)	(0.102)	(0.102)
I_{t-1}		−0.329	−0.328	0.074	−0.604	−0.331
		(0.567)	(0.573)	(0.623)	(0.548)	(0.545)
$Constant$	0.092*	0.092	0.101*	0.110*	0.045	0.063
	(0.050)	(0.063)	(0.060)	(0.058)	(0.066)	(0.068)
Variance Equation						
Oil_t	0.034	0.024	0.037	0.032	0.037	0.047
	(0.110)	(0.104)	(0.105)	(0.107)	(0.110)	(0.108)
$Tbill_t$	−0.009***	−0.008**	−0.008**	−0.008**	−0.010***	−0.009**
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
$Exrate_t$	−1.205**	−1.216***	−1.141**	−1.165**	−1.203**	−1.150**
	(0.488)	(0.445)	(0.452)	(0.459)	(0.504)	(0.508)
$MSCI_t$	−0.080	−0.080	−0.080*	−0.078	−0.082	−0.080
	(0.049)	(0.050)	(0.047)	(0.050)	(0.053)	(0.052)
R_{t-1}	7.175***	7.933***	7.382***	7.207***	9.462***	8.256***
	(0.818)	(1.158)	(1.060)	(0.920)	(1.448)	(1.372)
D_{t-1}		0.394	0.112	0.099	0.818*	0.385
		(0.466)	(0.461)	(0.533)	(0.459)	(0.424)
I_{t-1}		−0.513	1.103	0.430	−2.523	−1.674
		(2.151)	(2.047)	(2.490)	(1.912)	(1.826)
$Constant$	−5.347***	−5.594***	−5.395***	−5.297***	−6.117***	−5.631***
	(0.257)	(0.340)	(0.330)	(0.291)	(0.491)	(0.448)
GARCH Terms						
σ^2_{t-1}	0.028***	0.027***	0.027***	0.027***	0.027***	0.027***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
ε^2_{t-1}	0.947***	0.947***	0.945***	0.945***	0.950***	0.948***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.007)	(0.008)

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Regression Results for Different Speculation Measures

	Long	Short	Net Long	W.'s T
Mean Equation				
r_{t-1}	0.108^{***}	0.108^{***}	0.108^{***}	0.109^{***}
	(0.020)	(0.020)	(0.020)	(0.020)
Oil_t	0.058^{***}	0.058^{***}	0.058^{***}	0.059^{***}
	(0.009)	(0.009)	(0.009)	(0.009)
$Tbill_t$	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$Exrate_t$	0.014	0.011	0.011	0.013
	(0.058)	(0.060)	(0.059)	(0.060)
$MSCI_t$	0.034^{***}	0.035^{***}	0.034^{***}	0.035^{***}
	(0.008)	(0.008)	(0.008)	(0.008)
R_{t-1}	-0.091	-0.380	-0.133	-0.407
	(0.372)	(0.292)	(0.401)	(0.282)
D_{t-1}	0.071	-0.046	0.064	-0.113
	(0.104)	(0.132)	(0.103)	(0.153)
I_{t-1}	-0.488	0.206	-0.305	0.491
	(0.531)	(0.664)	(0.526)	(0.789)
$Constant$	0.056	0.102^{*}	0.050	0.108^{**}
	(0.079)	(0.055)	(0.082)	(0.054)
Variance Equation				
Oil_t	0.050	0.021	0.053	0.015
	(0.107)	(0.113)	(0.111)	(0.103)
$Tbill_t$	-0.010^{***}	-0.009^{***}	-0.009^{***}	-0.008^{**}
	(0.003)	(0.003)	(0.003)	(0.003)
$Exrate_t$	-1.308^{***}	-1.233^{***}	-1.229^{**}	-1.166^{***}
	(0.502)	(0.475)	(0.503)	(0.416)
$MSCI_t$	-0.086^{*}	-0.078	-0.085^{*}	-0.075
	(0.050)	(0.052)	(0.051)	(0.051)
R_{t-1}	9.100^{***}	7.471^{***}	9.581^{***}	7.190^{***}
	(1.791)	(0.996)	(1.902)	(0.887)
D_{t-1}	0.633	0.340	0.829	0.541
	(0.527)	(0.687)	(0.546)	(0.620)
I_{t-1}	-1.494	-1.437	-2.841	-0.591
	(2.225)	(3.012)	(2.265)	(2.839)
$Constant$	-6.162^{***}	-5.412^{***}	-6.151^{***}	-5.189^{***}
	(0.580)	(0.292)	(0.599)	(0.284)
GARCH Terms				
σ^2_{t-1}	0.024^{***}	0.028^{***}	0.025^{***}	0.028^{***}
	(0.005)	(0.005)	(0.005)	(0.005)
ε^2_{t-1}	0.954^{***}	0.947^{***}	0.952^{***}	0.941^{***}
	(0.007)	(0.008)	(0.008)	(0.009)

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$