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Financial activity in agricultural futures markets: evidence from quantile regressions

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This study analyses the relationship between financial activity and price returns in 12 US agricultural futures markets. It contributes to the existing research by exploring the forecasting power of trading activity for returns from the perspective of conditional quantiles. Quantile regressions detect Granger-causal effects from positions of speculators and index traders to price returns in a wide range of commodity markets such as cocoa, coffee, corn, sugar and SRW wheat.

Key words: futures markets, Granger causality, quantile regressions, speculation.

1. Introduction

The 2005–2008 and 2010–2011 commodity price booms have raised concerns about the role of speculators and commodity index traders in the observed price bubbles and have generated calls for tighter regulation and closer supervision of speculative activity in futures markets. The US Commodity Futures Trading Commission (CFTC) proposed to revise and/or establish limits on speculative positions in 28 physical commodity futures and options contracts in November 2013. The aim was to contain excessive speculation in the agricultural, energy and metals markets (CFTC 2013).

The proposed position limits apply to different trader categories whose activity does not involve exposure to a physical commodity: money managers, commodity index traders and other reportables. Money managers are for example, hedge funds that trade in commodity derivatives or registered and unregistered funds that are engaged in organised futures trading on behalf of clients (CFTC 2009). Commodity index traders do not seek to profit from price movements of an individual commodity, but obtain a long-side exposure to a wide range of commodities for diversification purposes by tracking a broad index of commodities such as S&P GSCI and DJ-UBSCI (CFTC 2006). Other reportables are defined as ‘a wide array of other noncommercial (speculative) traders’ that are large enough to report, but cannot be classified as money managers (CFTC 2009). Other reportables may encompass individual speculative traders, market makers and firms managing their own assets (Irwin and Sanders 2012a).

Granger causality tests are statistical tests of causality between different data series. They play a very important role in the empirical research on the

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price impact of traders in agricultural markets where they are used to explore lead–lag relations between price variables and different measures of trading activity. The empirical evidence on the price impact of commodity index traders and speculators is limited. Granger causality from positions of index traders to returns is predominantly found outside the grains markets (Grosche 2014). If significant, Granger causality from positions of money managers to returns is found only in feeder and live cattle markets (Borin and Di Nino 2012), corn (Brunetti *et al*. 2011b) and maize markets (Mayer 2012). Other studies find only limited support for the claim that money managers/hedge funds have affected the price mechanism in agricultural futures markets (Brunetti and Buyuksahin 2009; Irwin *et al*. 2009; Brunetti *et al*. 2011a).

Recent empirical research highlights the nonlinearity in the causal relationship between trading activity (trading volume and open interest) and returns for both stock and futures markets (e.g. Chuang *et al*. 2009; Gebka and Wohar 2013; Pradkhan 2016). This study does not consider the total trading activity, but focuses on different trader categories and extends the traditional Granger causality approach by analysing Granger causality from changes in trader positions to subsequent price returns based on quantile regressions. Considering the impact of changes in trader positions on subsequent returns at different quantiles of the return distribution is a valuable complement to the standard approach to identify Granger causality for two reasons. First, the price impact of a single trader category may manifest itself only in periods of rising or falling prices (i.e. at high or low quantiles of the return distribution) or when returns are particularly high or low (i.e. at tail quantiles). Second, if the impact of positions on subsequent returns is positive at some quantiles and negative at other quantiles, the positive and negative causal effects may cancel each other out in the least-squares estimations (Chuang *et al*. 2009). The key finding is that quantile regressions detect significant Granger-causal effects from positions of index traders and speculators to futures returns that are not detected by standard Granger causality tests that focus only on the mean of the return distribution (the so-called tests of 'Granger causality in mean').

Consistent with most empirical studies that investigate the potential price impact of traders on agricultural price dynamics, the geographical scope of this study is restricted to the US futures markets. In this respect, it should be borne in mind that the results obtained for the US futures markets may not hold in less liquid commodity futures exchanges where the price impact of traders may be more pronounced. Identifying price impacts in futures markets has important implications for the commodity spot market. Given the link between spot and futures prices through an arbitrage channel, any distortions in futures prices induced by trading activity in futures markets may also spillover to spot prices. Moreover, if futures prices serve as important price signals for producers and if the trading activity of financial traders makes futures prices less informative about commodity demand and supply fundamentals, changes in futures prices may interfere with goods producers' expectations resulting in changes in inventories and demand of the commodity users in spot markets (Sockin and Xiong 2015). In this case, even if the trading activity of speculators and index traders may not have any direct effect on commodity supply and demand, it still has the potential to impact the spot price through the informational role of the futures price (Sockin and Xiong 2015).

The remainder of the paper presents an empirical analysis of the impact of positions of speculators and index traders on subsequent returns in agricultural futures markets. In addition to the commonly used Granger causality in mean, quantile regressions are used in order to examine the Granger-causal effects from trader positions to returns in different parts of the return distribution. Data and methodology are described in Section 2, results are presented in Section 3, and conclusions follow in the final section.

2. Data and methodology

2.1 Data

The relationship between trading activity and futures returns is examined in 12 US agricultural markets: CBOT Corn, CBOT Soybeans, CBOT Soybean Oil, CBOT SRW Wheat, ICE Futures U.S. Cotton No. 2, CBOT HRW Wheat, CME Feeder Cattle, CME Lean Hogs, CME Live Cattle, ICE Futures Cocoa, ICE Futures Coffee C and ICE Futures Sugar No. 11. Data on futures prices are collected from Datastream. Weekly returns R_t are computed as $R_t = \ln(P_t/P_{t-1})$ by switching to a second-nearby contract when the open interest of the second-nearby contract is higher than the open interest of the first-nearby contract.[1] Figure S1 reports the time-series plots of returns. The global financial crisis and the recent 2010–2011 commodity price boom are periods characterised by a comparatively high return volatility.

The Disaggregated Commitments of Traders reports that are published each Friday by the CFTC disclose the Tuesday's closing positions of money managers and other reportables. The data on positions of commodity index traders are drawn from the Supplemental Commitments of Traders report. Net long positions are computed as the difference between long and short positions and are scaled by open interest. Although both long and short positions may induce a price impact, these effects may cancel each other out once the net long positions are considered. In addition, the speculative position limits of the CFTC are determined by net long (or net short) positions. To ensure stationarity, weekly changes in net long positions are considered in all regression specifications. The sample period ranges from 13

[1] The results on the existence/absence of Granger causality may depend on the chosen rollover procedure that affects the return distribution. Given that the derivation of a continuous return series based on open interest takes place on average four weeks before the last trading day of the first-nearby contract, the tails of the return distribution are less 'fat' compared to rollover procedures that switch to the second-nearby contract on the last trading day.

June 2006 to 31 December 2013 for money market managers and 3 January 2006 to 31 December 2013 for index traders.

2.2 Methodology

Granger causality implies that information related to the trading activity S_{t-1} is crucial to the conditional distribution of the random return variable R_t (Granger 1980). According to Granger (1980), speculative activity S_{t-1} Granger causes the subsequent return R_t if:

$$F_{R_t}(.|(\tilde{\mathcal{R}},\tilde{\mathcal{S}})_{t-1}) \neq F_{R_t}(.|\tilde{\mathcal{R}}_{t-1}). \tag{1}$$

F_{R_t} is the conditional distribution of the random variable R_t. $(\tilde{\mathcal{R}},\tilde{\mathcal{S}})_{t-1}$ encompasses all information generated by random variables R and S up to time $t-1$, whereas $\tilde{\mathcal{R}}_{t-1}$ denotes the information set that is associated with the random variable R and excludes information associated with the speculative activity S. Equation (1) describes the initial concept of Granger causality, namely the Granger causality in distribution (Chuang *et al.* 2009). Given the computational difficulties related to estimating and testing conditional distributions, the corresponding necessary condition for the Granger causality, the so-called Granger causality in mean, is preferred by the existing studies (Chuang *et al.* 2009). The existing research tests Granger causality in mean based on ADL (autoregressive distributed lag) and VAR (vector autoregressive) models.

The rejection of Granger causality in mean does not necessarily imply that there is no Granger causality in other parts of the distribution or in other moments (Chuang *et al.* 2009). If $Q_{R_t}(\theta|\mathcal{F})$ denotes the θth quantile of $F_{R_t}(.|\mathcal{F})$, Granger noncausality in distribution is equivalent to Granger noncausality at all quantiles $\theta \in$ (0,1) and can be summarised as (Chuang *et al.* 2009):

$$Q_{R_t}(\theta|(\mathcal{R},\mathcal{S})_{t-1}) = Q_{R_t}(\theta|\mathcal{R}_{t-1})\forall\theta \in (0,1). \tag{2}$$

As a first step, for each of the 12 commodity markets, Granger causality in mean is tested based on the following ADL model that relates the weekly return R_t to its own lagged values, lagged weekly changes in net long positions of traders[2] (either index traders or money managers or other reportables) and control variables (CV):

$$R_t = \alpha + \sum_{i=1}^{n} \gamma_i * R_{t-i} + \sum_{j=1}^{m} \beta_j * S_{t-j} + \sum_{q=1}^{p} \delta_q^{\mathrm{CV}} * \mathrm{CV}_{t-q} + \varepsilon_t. \tag{3}$$

If the null hypothesis of no Granger causality, $\beta_j = 0 \ \forall \ j = 1, \ldots, m$, cannot be rejected, it can be concluded that speculative activity does not Granger-cause commodity returns in mean.

[2] Net long positions are computed as the difference between long and short positions (in 100 thousands). Existing research typically scales net long positions by total open interest. As a robustness check, unscaled net long positions are also considered (see Section 2.3).

CV_t is the vector of weekly changes in control variables: the USD index spot rate, the S&P 500 index, the MSCI emerging markets index and the spot oil price. Rising demand from the emerging markets, production costs (inter alia determined by the oil price) and the USD value are cited as important determinants of agricultural commodity prices (Abbott *et al.* 2011; Tang and Xiong 2012; Chen *et al.* 2014). Moreover, several studies ascertain a link between commodity and stock markets (e.g. Mensi *et al.* 2013; Silvennoin and Thorp 2013). Financial and macroeconomic variables are used to capture at least some fundamental supply and demand factors that may have an impact on price formation and, thus, are expected to mitigate the omitted variable bias that is likely to impair the validity of the causal evidence.[3]

The lag number p for the control variables is a priori set equal to the optimally chosen number of lags for the weekly growth of trader positions m. This model specification eliminates the possibility that coefficient estimates on trader positions are found to be statistically significant as a consequence of their correlation with macroeconomic and financial factors that Granger-cause commodity returns. Then, the lag structure (n; m; p) is chosen by estimating Equation (3) for different lag lengths that range from one to four and choosing the regression model that minimises the Schwarz Bayesian information criterion. The maximum number of four lags is reasonable given that weekly data are used. The optimal lag structure is $n = m = p = 1$ for all markets. Newey–West standard errors are used if the Lagrange multiplier test indicates the presence of conditional heteroscedasticity. If the White test rejects the null hypothesis of homoscedasticity at 10% significance level, heteroscedasticity-robust standard errors are used for the hypothesis testing. In the absence of any form of heteroscedasticity, OLS standard errors are reported.

As a next step, Granger-causal effects from lagged positions to returns are explored at a specified quantile range. The focus lies on tail quantiles $\theta = 0.05,\ 0.1,\ 0.9,\ 0.95$ as well as upper and lower parts of the return distribution $\theta = 0.25,\ 0.75$. The intermediate quantiles $\theta \in (0.25, 0.75)$ are not reported: the results obtained for these quantiles are similar to the OLS estimations. The estimation model for a quantile θ is specified as follows:

$$R_t = \alpha(\theta) + \sum_{i=1}^{n} \gamma_i(\theta) * R_{t-i} + \sum_{j=1}^{m} \beta_j(\theta) * S_{t-j} + \sum_{q=1}^{p} \delta_q^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-q} + \varepsilon_t. \quad (4)$$

Granger causality at a particular quantile θ would imply a statistical significance of coefficient estimates $\beta_1(\theta), \ldots, \beta_m(\theta)$. For reasons of simplicity, the optimal lag number for the return variable is set equal to the optimal lag order for the position and control variables: $n = m = p$. Then, Equation (4) is

[3] Table S1 shows that correlations between trader positions and control variables are rather moderate. Hence, our results are not contaminated by harmful collinearity.

estimated for $n = m = p = q$ beginning with $q = 1$. If $\beta_{q^*}(\theta)$ is significant, but $\beta_{q^*+1}(\theta)$ is not significant, the optimal lag order is set equal to q^*. For all trader categories and all commodity markets, there is little evidence of a lag order varying with quantiles: The optimal lag number q^* is constant across quantiles and is equal to one. Equation (4) is estimated by means of the least absolute deviations (LAD) estimator that minimises the sum of asymmetrically weighted absolute residuals (Koenker and Hallock 2001). The LAD estimator uses all available observations in estimations related to any quantile.[4] Two types of standard errors are used in quantile estimations. Buchinsky (1995) recommends the use of bootstrapped standard errors for relatively small sample sizes. Moreover, the bootstrapped standard errors are valid under very general assumptions: they do not require either an identical sampling or independence between regressors and error terms. In addition, inference based on the assumption that residuals are independent and identically distributed is reported.

2.3 Robustness checks

There are two approaches to compute the changes in net long positions of traders. First, net long positions of traders can be scaled by open interest. This procedure reflects the idea that it is the magnitude of positions relative to the total open interest that matters. An alternative approach is to consider unscaled net long positions, that is, the difference between long and short positions that are not divided by total open interest.

As an additional robustness check, lagged changes in scaled net long positions of index traders, money managers and other reportables, IT_{t-1}, MM_{t-1} and OR_{t-1} are included in the same regression specification both in the context of Granger causality in mean and Granger causality at the level of individual quantiles:

$$R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{\mathrm{IT}} * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{MM}} * \mathrm{MM}_{t-1} + \beta_1^{\mathrm{OR}} * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t, \quad (5)$$

$$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{\mathrm{IT}}(\theta) * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{MM}}(\theta) * \mathrm{MM}_{t-1} + \beta_1^{\mathrm{OR}}(\theta) * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t. \quad (6)$$

For reasons of simplicity, the lag structure is set to one for both trader categories and control variables.

Hedging pressure is an important determinant of futures returns (De Roon *et al.* 2000). In this case, disregarding changes in hedgers' positions may

[4] The number of observations at every quantile amounts to 416 (393) in regression specifications related to index traders (money managers and other reportables).

result in the omitted variable bias. However, the correlations between net long positions of money managers and net short positions of hedgers HP_t (producers/merchants/processors/users in the DCOT report) are very high (0.7–0.9). Due to multicollinearity, it is not possible to include both trader categories in the same regression specification. For other reportables and index traders, the correlations with the positions of hedgers are low,[5] and the following regression models are estimated for the three trading categories OR_t, IT_t and HP_t:

$$R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{IT} * IT_{t-1} + \beta_1^{OR} * OR_{t-1} + \beta_1^{HP} * HP_{t-1} + \delta_1^{CV} * CV_{t-1} + \varepsilon_t, \tag{7}$$

$$R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{IT}(\theta) * IT_{t-1} + \beta_1^{OR}(\theta) * OR_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{CV}(\theta) * CV_{t-1} + \varepsilon_t. \tag{8}$$

3. Results

Tables 1–4 report the coefficient estimates $\hat{\beta}_1$ and $\hat{\beta}_1(\theta)$ on the lagged changes in net long positions of traders. Robust Granger causality both in mean and at individual quantiles from the index traders' positions to returns can be observed in the cocoa market (Tables 1 and 2). For corn, negative Granger-causal effects at individual quantiles manifest themselves in both low and upper parts of the conditional return distribution (Table 2). In the soybeans market, there is also evidence of a negative Granger causality from past index traders' positions to returns at individual quantiles, but only when unscaled positions are considered (Table 2, Panel B). It should be pointed out that the derivation of the returns series based on most liquid contracts does not necessarily coincide with the rollover procedure of index traders. This may explain why significant Granger causality from positions of index traders is detected only in a few markets.

For other reportables, Granger causality in mean can be observed only for lean hogs where significant Granger-causal effects also exist at individual quantiles (Tables 1 and 4). Furthermore, robust Granger-causal effects from positions of other reportables to returns arise for coffee, SRW wheat and soybeans in the upper part of the conditional return distribution (Table 4).

Robust Granger causality in mean and at quantiles between returns and past changes in positions of money managers is detected for live cattle (Tables 1 and 3). For coffee, there is only marginally significant evidence of Granger causality in mean (Table 1), but Granger-causal effects of money

[5] Correlations between changes in net positions of various trader categories are available on demand.

Table 1 Granger causality in mean

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Live cattle	Lean hogs	Sugar	SRW wheat	HRW wheat	Soybeans	Soybean oil
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns												
Index traders: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * \mathrm{IT}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1$	0.46**	−0.02	−0.34	−0.12	−0.08	0.12	−0.03	0.21	−0.07	−0.01	0.15	0.18
Money managers: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * \mathrm{MM}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1$	−0.12	−0.14*	0.03	−0.05	−0.02	−0.11***	−0.02	0.13	0.10	0.06	0.001	0.01
Other reportables: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1$	0.32	−0.24	0.24	0.03	0.08	−0.08	−0.34***	−0.07	−0.08	0.15	−0.20	−0.02
Panel B: Granger causality from changes in unscaled net long positions to returns												
Index traders: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * \mathrm{IT}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1$	0.21	−0.06	−0.06*	0.09	−0.11	0.02	0.01	−0.02	−0.04	0.14	0.002	0.10
Money managers: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * \mathrm{MM}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1$	−0.12	−0.10*	0.004	−0.01	−0.05	−0.03**	−0.01	0.02	0.02	0.01	0.01	0.001
Other reportables: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1 * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1$	0.17	−0.18	0.02	0.01	0.25	−0.02	−0.16**	−0.02	−0.03	0.09	−0.03	−0.01
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns; index traders, money managers and other reportables included in the same regression: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{\mathrm{IT}} * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{MM}} * \mathrm{MM}_{t-1} + \beta_1^{\mathrm{OR}} * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1^{\mathrm{IT}}$	0.46**	−0.05	−0.32	−0.11	−0.08	0.16**	−0.07	0.26	−0.06	−0.01	0.15	0.20
$\hat{\beta}_1^{\mathrm{MM}}$	−0.08	−0.25***	0.06	−0.06	0.001	−0.15***	−0.11	0.11	0.10	0.07	−0.02	−0.01
$\hat{\beta}_1^{\mathrm{OR}}$	0.23	−0.54**	0.27	0.01	0.08	−0.18**	−0.40***	0.01	−0.004	0.18	−0.15	0.03
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns; index traders, other reportables and hedgers included in the same regression: $R_t = \alpha + \gamma_1 * R_{t-1} + \beta_1^{\mathrm{IT}} * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{OR}} * \mathrm{OR}_{t-1} + \beta_1^{HP} * HP_{t-1} + \delta_1^{\mathrm{CV}} * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\hat{\beta}_1^{\mathrm{IT}}$	0.52**	0.05	−0.40	−0.08	−0.09	0.24***	0.01	0.16	−0.10	−0.08	0.19	0.18
$\hat{\beta}_1^{\mathrm{OR}}$	0.32	−0.28	0.19	0.05	0.07	−0.05	−0.30**	−0.09	−0.08	0.09	−0.12	0.01

Notes: Table 1 shows the coefficient estimate on the lagged growth in net long positions S_{t-1}. In Panels A, C and D, changes in net long positions are scaled by open interest, whereas in Panel B changes in unscaled net long positions (in 100 thousands) are considered. For index traders in panels A and B, the estimation period begins on 10 January 2006. In the remaining specifications, the estimations are based on weekly observations from 20 June 2006 to 31 December 2013. OLS standard errors are used in cocoa, coffee and lean hogs markets. White standard errors are used in feeder and live cattle markets. In the remaining estimations, Newey–West standard errors are used.

***, ** and * denote significance at one, five and ten per cent, respectively.

Table 2 Granger causality at individual quantiles: Index traders

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Live cattle	Lean hogs	Sugar	SRW wheat	HRW wheat	Soybeans	Soybean oil
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * \mathrm{IT}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	−0.08	0.23	−0.62	−0.17	−0.19	0.22	−0.25	−0.54	−0.04	−0.03	0.21	0.39
$\theta = 0.1$	0.37	0.15	−0.86*(**)	−0.29	−0.13	0.12	−0.20 (*)	−0.07	−0.14	0.06	−0.19	0.28
$\theta = 0.25$	0.28	0.02	−0.65**(**)	−0.02	−0.06	0.11	−0.09	0.34	−0.20	−0.19	0.09	0.13
$\theta = 0.75$	0.43	−0.25	−0.20	0.001	−0.05	0.11	0.18	0.39	−0.19	0.06	0.40 (*)	0.21
$\theta = 0.9$	1.05**(***)	0.17	−0.21	0.02	0.04	0.03	−0.03	0.08	0.08	0.12	−0.05	0.14
$\theta = 0.95$	0.36	0.16	−0.52	−0.07	−0.01	0.09	−0.24	0.01	0.18	0.05	0.42	0.18
Panel B: Granger causality from changes in net long positions (unscaled) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * \mathrm{IT}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.03	0.26	0.03	0.20	−0.46	0.04	−0.24	−0.13	−0.03	0.43	0.16	0.24
$\theta = 0.1$	0.39*	0.21	−0.01	0.29	−0.30	0.04	−0.04	0.02	−0.09	0.29	0.08	0.19
$\theta = 0.25$	0.16	0.03	−0.06 (*)	0.24 (*)	0.09	−0.01	−0.02	0.04	−0.06	0.11	0.04	0.07
$\theta = 0.75$	0.07	−0.17	−0.06*(*)	−0.05	−0.38	0.04	0.06	−0.05	−0.04	−0.05	−0.06	0.11
$\theta = 0.9$	−0.04	−0.41 (*)	−0.15***(***)	−0.01	0.001	0.05	−0.03	−0.15 (**)	−0.08	0.26	−0.16**(*)	0.07
$\theta = 0.95$	−0.35	−0.53	−0.22*(***)	0.08	−0.07	0.02	−0.18	−0.13 (*)	−0.20	0.44	−0.22*(*)	−0.02
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{\mathrm{IT}}(\theta) * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{MM}}(\theta) * \mathrm{MM}_{t-1} + \beta_1^{\mathrm{OR}}(\theta) * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.17	0.37	−0.43	0.02	−0.10	0.07	−0.21	−0.52	−0.18	−0.09	0.10	0.09
$\theta = 0.1$	0.37	0.08	−0.71 (*)	−0.32*(**)	−0.15	0.15	−0.42	−0.31	−0.16	0.08	0.01	0.39
$\theta = 0.25$	0.17	−0.04	−0.54 (**)	0.03	−0.07	0.12	−0.20	0.35	−0.16	0.01	0.22	0.12
$\theta = 0.75$	0.41	0.001	−0.16	0.01	−0.06	0.13	−0.01	0.27	−0.06	0.05	0.15	0.20
$\theta = 0.9$	0.98*(**)	0.01	−0.30	0.04	−0.05	0.09	−0.08	0.14	−0.20	−0.12	0.00	0.25
$\theta = 0.95$	0.65	0.25	−0.06	0.22	−0.10	0.07	0.00	0.22	−0.19	−0.28	−0.14	0.17
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns, hedgers included: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{\mathrm{IT}}(\theta) * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{OR}}(\theta) * \mathrm{OR}_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.34	0.48	−0.88 (**)	−0.11	−0.25	0.16	−0.10	−0.73	−0.14	−0.13	−0.10	0.01
$\theta = 0.1$	0.36	0.17	−1.20**(***)	−0.31*	−0.20	0.10	−0.19	−0.40	−0.10	0.01	−0.13	0.34
$\theta = 0.25$	0.30	0.13	−0.50 (*)	0.07	−0.16	0.21	−0.18	0.39	−0.20	−0.14	0.19	0.08
$\theta = 0.75$	0.43	0.08	−0.21	0.13	−0.09	0.18 (*)	0.07	0.20	−0.10	−0.07	0.38	0.18
$\theta = 0.9$	1.15*(***)	0.08	−0.32	0.09	0.09	0.21 (*)	−0.03	−0.14	−0.22	−0.24	0.06	0.06
$\theta = 0.95$	1.12 (*)	0.08	−0.11	0.24	0.04	0.38 (***)	0.19	0.19	−0.23	−0.58	−0.005	0.14

Notes: Table 2 reports the coefficient estimate $\beta_1(\theta)(\beta_1^{\mathrm{IT}}(\theta))$ on the lagged growth in net long positions of index traders IT_{t-1} at different quantiles θ of the return distribution. In Panels A, C and D, net long positions are scaled by open interest, whereas in Panel B unscaled net long positions (in 100 thousand) are used.
For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten per cent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten per cent, respectively.

Table 3 Granger causality at individual quantiles: Money managers

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Live cattle	Lean hogs	Sugar	SRW wheat	HRW wheat	soybeans	soybean oil
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * \mathrm{MM}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	−0.45*(***)	−0.09	0.25	−0.11	−0.09	−0.08	−0.04	0.10	0.12	0.13	0.36	0.19
$\theta = 0.1$	−0.21 (*)	−0.08	−0.09	−0.17	−0.07	−0.09	−0.17	0.06	−0.06	−0.02	0.08	0.19
$\theta = 0.25$	−0.26**(**)	−0.23**(**)	−0.12	−0.10	0.03	−0.12*(*)	−0.06	−0.06	0.13	−0.04	0.02	0.06
$\theta = 0.75$	0.04	−0.06	0.14	−0.02	−0.005	−0.10*** (**)	−0.01	0.29	0.16	0.15	0.05	−0.04
$\theta = 0.9$	0.03	0.02	0.20	−0.08	−0.09*(*)	−0.16**(*)	0.08	0.55*(**)	0.46**(**)	0.08	−0.12	0.12
$\theta = 0.95$	−0.13	−0.34*(*)	−0.002	−0.20	−0.12*(*)	−0.14 (*)	0.14	0.15	0.43 (*)	0.29	−0.28	0.05
Panel B: Granger causality from changes in net long positions (unscaled) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * \mathrm{MM}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	−0.14	−0.09	0.04 (*)	0.14 (*)	−0.12	−0.003	−0.02	0.09	0.03	0.15	0.06	0.06
$\theta = 0.1$	−0.14 (*)	−0.04	0.002	0.06	0.03	−0.02	−0.04	0.01	−0.01	−0.11	0.04	0.06
$\theta = 0.25$	−0.14 (*)	−0.14**(*)	−0.01	−0.01	0.07	−0.02	−0.03	−0.01	0.03	−0.06	0.01	0.02
$\theta = 0.75$	−0.01	−0.07	0.01	−0.01	−0.05	−0.03**(*)	−0.01	0.03	0.03	0.01	0.01	−0.01
$\theta = 0.9$	−0.05	−0.04	0.02	−0.06	−0.34**(**)	−0.05*(**)	0.06	0.06 (**)	0.11**(**)	0.05	−0.02	0.04
$\theta = 0.95$	−0.23 (*)	−0.17	−0.02	−0.02	−0.38**(*)	−0.04	0.08	0.004	0.11	0.21	−0.06	0.01
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{\mathrm{IT}}(\theta) * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{MM}}(\theta) * \mathrm{MM}_{t-1} + \beta_1^{\mathrm{OR}}(\theta) * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	−0.38*(***)	−0.25	0.38	−0.11	−0.04	−0.17	−0.07	0.06	0.19	0.12	0.35	0.14
$\theta = 0.1$	−0.17	−0.14	0.03	−0.17	0.06	−0.14	−0.29*(*)	0.09	0.02	−0.03	0.19	0.09
$\theta = 0.25$	−0.21*(*)	−0.27**(**)	−0.09	−0.10	0.06	−0.09	−0.13	−0.10	0.17	−0.03	0.06	0.04
$\theta = 0.75$	−0.05	−0.31	0.15	−0.02	0.02	−0.11**(*)	−0.11	0.24	0.12	0.12	0.09	−0.02
$\theta = 0.9$	0.05	−0.20	0.15	−0.08	−0.08*	−0.21*** (***)	−0.13	0.53*(**)	0.11	−0.02	−0.25	0.15
$\theta = 0.95$	0.02	−0.17**(**)	−0.03	−0.20	−0.13*	−0.20*(**)	−0.24	0.32	0.07	0.29	−0.41 (*)	0.09

Notes: Table 3 reports the coefficient estimate $\beta_1(\theta)(\beta_1^{\mathrm{MM}}(\theta))$ on the lagged growth in net long positions of money managers MM_{t-1} at different quantiles θ of the return distribution. In Panels A and C, net long positions are scaled by open interest, whereas in Panel B unscaled net long positions (in 100 thousand) are used.
For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten per cent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten per cent, respectively.

Table 4 Granger causality at individual quantiles: Other reportables

	Cocoa	Coffee	Corn	Cotton	Feeder cattle	Live cattle	Lean hogs	Sugar	SRW wheat	HRW wheat	soybeans	soybean oil
Panel A: Granger causality from changes in net long positions (scaled by open interest) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.49	−0.43	1.12 (*)	0.42	0.19	−0.003	0.03	0.001	0.07	−0.24	−0.43	−0.31
$\theta = 0.1$	0.39	−0.30	1.03 (*)	0.39	0.16	−0.06	−0.14	0.30	0.35	−0.25	0.16	−0.26
$\theta = 0.25$	0.67**(**)	0.19	0.55	0.02	0.07	0.02	−0.45**(**)	−0.27	0.14	0.36	−0.0003	−0.05
$\theta = 0.75$	0.01	−0.52*** (**)	0.16	0.01	0.01	−0.09	−0.64*** (***)	−0.01	−0.16	0.14	−0.27	0.06
$\theta = 0.9$	0.21	−0.43	−0.26	−0.29	0.10	−0.04	−0.41*(*)	0.02	−0.86*(**)	0.42	−0.40	0.01
$\theta = 0.95$	0.46	−0.59 (*)	−0.89*	−0.48	0.22 (*)	−0.20	−0.24	0.02	−1.72*** (***)	0.33	−0.72*	0.12
Panel B: Granger causality from changes in net long positions (unscaled) to returns: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1(\theta) * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.15	−0.39 (*)	0.10*(*)	0.20	0.59	−0.001	0.01	0.01	0.01	−0.19	−0.05	−0.14
$\theta = 0.1$	0.21	−0.19	0.09**(**)	0.19	0.44	−0.02	−0.06	0.05	0.09	−0.15	0.03	−0.08
$\theta = 0.25$	0.38**(*)	0.15	0.04	−0.002	0.22	0.01	−0.19**(**)	0.01	0.03	0.35 (*)	−0.005	−0.01
$\theta = 0.75$	0.01	−0.36 (**)	0.01	−0.01	0.02	−0.03	−0.27*** (***)	−0.06	−0.03	0.09	−0.07	0.02
$\theta = 0.9$	0.12	−0.29**	−0.01	−0.15	0.35	−0.01	−0.19*	−0.002	−0.24**(**)	0.22	−0.02	−0.04
$\theta = 0.95$	0.22	−0.45 (*)	−0.07	−0.24	0.76*(**)	−0.06	−0.13	−0.001	−0.41**(***)	0.23	−0.14*	0.03
Panel C: Granger causality from changes in net long positions (scaled by open interest) to returns, other traders included: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{\mathrm{IT}}(\theta) * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{MM}}(\theta) * \mathrm{MM}_{t-1} + \beta_1^{\mathrm{OR}}(\theta) * \mathrm{OR}_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.21	−0.63	0.92	0.43	0.09	−0.13	−0.02	0.38	0.23	0.05	−0.05	−0.32
$\theta = 0.1$	0.70 (*)	−0.51	0.86	0.58	0.23 (*)	−0.19	−0.46*(*)	0.28	0.17	−0.23	0.40	−0.08
$\theta = 0.25$	0.66 (*)	−0.08	0.55	−0.03	0.09	−0.08	−0.43**(**)	−0.03	0.13	0.36	0.15	0.02
$\theta = 0.75$	0.04	−0.74**(**)	0.27	−0.11	0.02	−0.13	−0.58*** (***)	−0.10	−0.04	0.27	−0.32	0.04
$\theta = 0.9$	0.09	−0.52	−0.59	−0.42	0.06	−0.21**(*)	−0.50*(*)	0.14	−0.85*(*)	0.40	−0.49	0.07
$\theta = 0.95$	0.31	−0.50	−0.92	−0.62	0.07	−0.29*(**)	−0.48 (*)	0.50	−1.84*** (***)	0.56	−0.95*	0.21
Panel D: Granger causality from changes in net long positions (scaled by open interest) to returns, hedgers included: $R_t = \alpha(\theta) + \gamma_1(\theta) * R_{t-1} + \beta_1^{\mathrm{IT}}(\theta) * \mathrm{IT}_{t-1} + \beta_1^{\mathrm{OR}}(\theta) * \mathrm{OR}_{t-1} + \beta_1^{HP}(\theta) * HP_{t-1} + \delta_1^{\mathrm{CV}}(\theta) * \mathrm{CV}_{t-1} + \varepsilon_t$												
$\theta = 0.05$	0.85 (*)	−0.38	0.63	0.38	0.10	−0.003	−0.02	0.16	0.43	−0.26	0.20	−0.42
$\theta = 0.1$	0.86 (**)	−0.33	0.83 (*)	0.54 (*)	0.15	−0.08	−0.25	0.27	0.19	−0.33	0.40	−0.12
$\theta = 0.25$	0.90*(***)	0.21**(**)	0.68*(*)	0.004	0.05	0.03	−0.33*(*)	0.08	−0.07	0.27	0.18	−0.05
$\theta = 0.75$	0.04	−0.57	0.11	−0.07	−0.02	0.01	−0.52*** (***)	−0.09	−0.12	0.11	−0.24	0.11
$\theta = 0.9$	−0.27	−0.34	−0.74	−0.34	0.11	0.05	−0.40*(*)	−0.16	−0.96**(**)	−0.01	−0.47	−0.14
$\theta = 0.95$	0.39	−0.53	−1.00	−0.58	0.17	0.01	−0.10	0.21	−1.87*** (***)	−0.17	−0.90*(*)	0.23

Notes: Table 4 reports the coefficient estimate $\beta_1(\theta)(\beta_1^{\mathrm{OR}}(\theta))$ on the lagged growth in net long positions of other reportables OR_{t-1} at different quantiles θ of the return distribution. In Panels A, C and D, net long positions are scaled by open interest, whereas in Panel B unscaled net long positions (in 100 thousand) are used.
For the inference based on bootstrapped standard errors, ***, ** and * denote significance at one, five and ten per cent, respectively. For the inference under the assumption of independent and identically distributed residuals, (***), (**) and (*) denote significance at one, five and ten per cent, respectively.

managers' positions on returns can be observed at tail quantiles ($\theta = 0.95$) and in the lower part of the return distribution ($\theta = 0.25$). In addition, quantile Granger-causal effects arise at quantiles in cocoa, feeder cattle, sugar and SRW wheat markets (Table 3). The results on money managers are potentially contaminated by the omitted variable bias. Given the high correlation between positions of money managers and hedgers, it has not been possible to include the hedging pressure as one of the control variables as it has been done for index traders and other reportables. Table S2 summarises the estimation results for Equations (7) and (8) where the relationship between changes in net short positions of hedgers and subsequent futures returns is estimated. The results are very similar to those on money managers: Granger causality in mean arises in coffee and live cattle markets, whereas quantile Granger-causal effects are observed in markets for cocoa and sugar. The SRW wheat is the only market where we observe Granger-causal effects at individual quantiles only for money managers, but not for hedgers. As it is not possible to infer which trader type (money managers or hedgers) triggers significant coefficient estimates on lagged trader positions, the results for money managers should be treated with caution in all but the SRW wheat market.

In general, there is some evidence that the relationship between trader positions and returns is nonlinear in different parts of the conditional return distribution in the sense that the sign of the slope coefficient $\hat{\beta}_1(\theta)$ changes across different quantiles (e.g. soybeans for index traders, cocoa for money managers and SRW wheat for other reportables). In these cases, nonlinearity may be one of the reasons why the null hypothesis of no Granger causality in mean cannot be rejected, but Granger-causal relationships exist at individual quantiles: positive and negative $\hat{\beta}_1(\theta)$ in different parts of the distribution appear to cancel each other out when the mean distribution is considered. The forecasting power of past returns and the used control variables varies across commodities and quantiles. In general, the evidence obtained is consistent with the existing research that finds that USD, oil price, stock market development and the emerging markets growth influence commodity returns.

As a final robustness check, it is examined whether Granger-causal effects from trader positions to returns persist in different sample specifications, that is, during the global financial crisis and the more tranquil noncrisis period (Table S3). The documented Granger causality from positions of index traders to corn and cocoa returns can be observed only in the crisis period. By contrast, Granger-causal effects from positions of money managers (other reportables) to cocoa, coffee, live cattle and sugar (lean hogs) returns manifest themselves only in the noncrisis period. Granger causality from positions to returns is robust to different sample specifications in the SRW wheat market for other reportables and money managers as well as in cocoa and coffee markets for other reportables.

The direction of Granger causality is heterogeneous across markets and trader categories. It is positive in sugar and SRW wheat markets for money managers and in the cocoa market for index traders and other reportables. This evidence is, at least theoretically, consistent with concerns that rising demand drives up prices: rising (falling) net long positions that reflect positive (negative) private information about the fundamental value of a commodity are supposed to result in higher (lower) contemporaneous returns and in rising (falling) subsequent futures returns as positive (negative) information disseminates in the market. Trades based on private information are most likely to be expected in case of money managers who are perceived as professional speculators who conduct research on commodity fundamentals. By contrast, negative Granger-causal effects from trader positions to returns are observed for index traders in the corn market, for money managers in case of coffee, cocoa and live cattle as well as for other reportables in coffee, SRW wheat and soybeans markets. A negative Granger causality may indicate price reversals: in case of noninformational trades, prices may temporarily adjust to accommodate increases or decreases in net long positions of traders, but quickly bounce back once market participants realise that noninformational trades are not related to the fundamental values. The case of noninformational trades is most likely to apply to index traders who typically do not take a view on individual commodities and adjust their positions for hedging and diversification purposes.[6] In addition, if the trading strategy of some money managers is not based on fundamentals, but on technical tools such as trend identification algorithms, the trades of money managers will be, at least partially, noninformational (Mayer, 2012). Trading activity of other reportables (individual speculative traders, firms managing their own assets) may become noninformational, for example if they 'copy' trades of professional speculators such as money managers.[7]

It is rather unlikely that liquid markets take one week to readjust to noninformational trades or that it takes more than a few days for private information to disseminate in the market. However, if noninformational trades are misinterpreted as valuable private information by other market participants or fundamentally based trades of speculators are copied by less informed investors and the triggered positive feedback trading is sufficiently strong, rational arbitrageurs may not be able to quickly correct the mispricing that arises as a consequence of noninformational trades (De Long *et al.* 1990). Therefore, it may take one week or more to readjust to noninformational trades and bring prices back to their fundamental values. If the triggered positive feedback trading of other market participants is not strong enough and the readjustment takes place within a week, we should expect a negative Granger causality from past position changes to returns. If the price

[6] However, commodity index investors may equally pursue an active investment strategy if they trade based on their expectations about returns on commodities as an asset class relative to returns on other assets such as bonds or equities (Gilbert and Pfuderer 2014).

[7] However, the 'other reportables' category also encompasses market makers who are unlikely to 'copy' any trading strategies of other traders.

effects become persistent, a positive causality between changes in net long positions and returns would result.

Interestingly, most significant Granger-causal effects are observed in the upper part of the conditional return distribution. The upper part of the conditional return distribution (especially the tail quantiles) is associated with positive returns, that is, price increases. In this case, the positive coefficient estimates on past changes in net long positions of index traders in the cocoa market and money managers in sugar and SRW wheat markets may indicate that increases in net long positions are associated with rising prices within the next days. By contrast, a negative slope coefficient on past changes in net long positions, which is observed for other reportables in coffee, soybeans and SRW wheat markets and for money managers in live and feeder cattle markets in the upper part of the return distribution, may imply that price reversals are linked to falling net long positions: Tuesday's decreases in net long positions may trigger a contemporaneous decline in prices and falling prices in the next few days, but the next Tuesday's price increases as the noninformational content of the position changes is realised. By contrast, the negative direction of Granger causality from index traders' positions to corn returns and from money managers' positions to coffee returns at low quantiles of the return distribution would be consistent with the idea that price reversals follow price increases as a consequence of rising net long positions.

4. Conclusion

This study examines the information content of the positions of speculators and index traders in agricultural futures markets. In addition to the commonly used Granger causality in mean, it uses quantile regressions in order to examine the Granger-causal effects from trader positions to returns in different parts of the return distribution. There is robust evidence of Granger causality in mean from positions to returns for money managers in coffee and live cattle markets, for other reportables in the lean hogs market and for index traders in the coffee market. Quantile regressions detect significant Granger-causal effects from positions to returns at individual quantiles even in those markets where no Granger causality in mean is detected. This is the case for index traders in the corn market, for money managers in the cocoa and SRW wheat market and for other reportables in coffee, SRW wheat and soybeans markets.

Although there is evidence that changes in trader positions forecast returns, in terms of policy implications (i.e. imposing limits on speculative positions), one should be cautious while interpreting the detected Granger-causal effects as *prima facie* causal evidence of a price impact (Grosche 2014) or as an explanation of the observed commodity price booms. If trader positions are at least partially driven by market fundamentals that influence both the return and trading activity variables, a significant (insignificant) coefficient estimate on changes in trader positions cannot be interpreted as the existence (absence) of a price influence of traders due to the omitted variable bias. To mitigate this problem, control variables have been introduced that ensure that the significance of coefficient estimates does not arise as a consequence of omitted relevant macroeconomic or financial variables. However, it has not been possible to include important fundamentals such as inventory and storage costs as these data are not available on a weekly basis. Therefore, the omitted variable bias problem disturbs the interpretation of the observed Granger-causal effects as a price impact.

Moreover, this study relies on a comparatively low-frequency Tuesday-to-Tuesday weekly data. In this case, the absence of Granger causality either in mean or at quantiles in markets such as cotton, HRW wheat and soybean oil simply indicates semi-strong information efficiency, but should not be interpreted as evidence that trader positions do not have any price impact in these markets (Grosche 2014). According to both the market microstructure theory and the efficient markets hypothesis, an impact of position changes on the next week's returns cannot be expected in liquid markets (Gilbert and Pfuderer 2014). In order to obtain more convincing results with respect to the potential of traders to affect the price mechanism, future research may focus on combining the quantile analysis with (not publicly available) daily data and investigate contemporaneous price effects, for example via impulse-response analyses or instrumental variables.

References

Abbott, P.C., Hurt, C. and Tyner, W.E. (2011). What is Driving Food Prices in 2011? Farm Foundation Issue Report.

Borin, A. and Di Nino, V. (2012). The Role of Financial Investments in Agricultural Commodity Derivatives Markets. Banca D'Italia Working Paper No. 849.

Brunetti, C. and Buyuksahin, B. (2009). Is Speculation Destabilizing? SSRN Working Paper.

Brunetti, C., Buyuksahin, B. and Harris, J. (2011a). Speculators, Prices and Market Volatility. SSRN Working Paper.

Brunetti, C., Buyuksahin, B. and Harris, J. (2011b). Do Institutional Traders Predict Bull and Bear Markets?. SSRN Working Paper.

Buchinsky, M. (1995). Estimating the asymptotic covariance matrix for quantile regression models. A Monte Carlo Study, *Journal of Applied Econometrics* 68, 303–338.

Chen, S.-L., Jackson, J.-D., Kim, H. and Resiandini, P. (2014). What drives commodity prices?, *American Journal of Agricultural Economics* 96, 1455–1468.

Chuang, C.-C., Kuan, C.-M. and Lin, H.-Y. (2009). Causality in quantiles and dynamic stock return-volume relations, *Journal of Banking and Finance* 33, 1351–1360.

Commodity Futures Trading Commission. (2006). Commission Actions in Response to the Comprehensive Review of the Commitments of Traders Reporting Program.

Commodity Futures Trading Commission. (2009). Disaggregated Commitments of Trader Reports: Explanatory Notes.

Commodity Futures Trading Commission. (2013). Position Limits for Derivatives. Federal Register No. 78.

De Long, J., Shleifer, A., Summers, L. and Waldmann, R. (1990). Noise trader risk in financial markets, *Journal of Political Economy* 98, 703–738.

De Roon, F.A., Nijman, T.E. and Veld, C. (2000). Hedging pressure effects in futures markets, *Journal of Finance* 55, 1437–1456.

Gebka, W. and Wohar, M. (2013). Causality between trading volume and returns: evidence from quantile regressions, *International Review of Economics and Finance* 27, 144–159.

Gilbert, C. and Pfuderer, S. (2014). The role of index trading in the price formation in the grains and oilseeds markets, *Journal of Agricultural Economics* 65, 303–322.

Granger, C.W.J. (1980). Testing for causality: a personal viewpoint, *Journal of Economic Dynamics and Control* 2, 329–352.

Grosche, S. (2014). What does granger causality prove? A critical examination of the interpretation of granger causality results on price effects of index trading in the agricultural commodity markets, *Journal of Agricultural Economics* 65, 279–302.

Irwin, S.H., Sanders, D.R. and Merrin, R. (2009). Devil or angel? The role of speculation in the recent commodity price boom (and bust), *Journal of Agricultural & Applied Economics* 41, 377–391.

Koenker, R. and Hallock, K.F. (2001). Quantile regression, *Journal of Economic Perspectives* 15, 143–156.

Mayer, J. (2012). The growing financialization of commodity markets: Divergences between index investors and money managers, *Journal of Development Studies* 48, 751–767.

Mensi, W., Beljid, M., Boubaker, A. and Managi, S. (2013). Correlations and volatility spillovers across commodity and stock markets: Linking energies, food and gold, *Economic Modelling* 32, 15–22.

Pradkhan, E. (2016). Information content of trading activity in precious metals futures markets, *Journal of Futures Markets* 36, 421–456.

Silvennoin, A. and Thorp, S. (2013). Financialization, crisis and commodity correlation dynamics, *Journal of International Financial Markets, Institutions and Money* 24, 24–65.

Sockin, M. and Xiong, W. (2015). Information frictions and commodity markets, *Journal of Finance* 70(5), 2063–2098.

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

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1 Agricultural futures returns.

Table S1 Correlations between changes in net long positions of traders and control variables.

Table S2 Granger causality at individual quantiles: Hedgers.

Table S3 Granger causality at individual quantiles: Different sample specifications.