DOES FUTURES SPECULATION DESTABILIZE COMMODITY MARKETS?

Abby Kim[*]

U.S. Securities and Exchange Commission

Abstract

This paper examines how increased speculator participation in the commodity futures market affects market outcomes, including trades' price impacts, price volatility, and market quality. Contrary to the popular belief that speculators are responsible for the recent commodity price fluctuation, my analysis finds no evidence that speculators destabilize the commodity spot market. Instead, speculators contribute to lower price volatility, enhanced price efficiency, and better liquidity in the commodity markets. More importantly, I show that speculators either have no effect or stabilize prices during periods of large price movement. My findings suggest speculators have had a significant and in fact positive influence on the commodity market during the recent "financialization" period, implying that restricting speculative trading in the futures market is not an efficient way to stabilize the commodity market.

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1. Introduction

The recent fluctuation of commodity prices accompanied by a substantial increase in trading activity in the futures market has led to a renewed interest in the effect of commodity futures trading on the spot market. Fig. 2.1 displays the time series of crude oil prices, open interest in oil futures, and the ratio of speculative positions in the crude oil futures market. The perception of the general public, policy makers, and practitioners is that increased participation of speculators in the futures markets has made an important contribution to commodity price fluctuations.[1] Consistent with this view, several regulatory changes under the Dodd–Frank Wall Street Reform and Consumer Protection Act (Dodd–Frank Act) aim to stabilize the asset market by restricting speculative trading activity in the futures market. In the academic literature, debate continues over whether commodity price fluctuation is due to futures speculation or economic fundamentals.[2]

Motivated by recent regulatory changes and renewed academic interest in understanding the effect of futures speculation, I provide empirical evidence to assess whether speculators' trading in the futures market has a destabilizing effect on the commodity market. Using 21 commodity futures that are widely traded in the U.S. futures market, I investigate whether futures speculation relates to large price changes. More specifically, I assess whether futures speculation explains the movement of commodity prices during periods of substantial price increases or decreases. Next, I examine the effect of futures speculation on spot price volatility and market quality. For

[1] For example, Joseph Kennedy II, a former U.S. representative from Massachusetts, expressed concern over speculative trading in the oil market. He claimed that speculators drive commodity price fluctuation and futures trading should be limited. ("The High Cost of Gambling on Oil," April 10, 2012, *The New York Times*). Masters (2008) also argues that the commodity price spikes were the result of price bubble created by speculators in the commodity futures markets.

[2] Fattough et al. (2012) and Cheng and Xiong (2013) provide a comprehensive literature review of the debate over whether commodity price fluctuation is due to futures speculation or economic fundamentals.

this analysis, I use 14 agricultural and energy commodities: crude oil, heating oil, gasoline, natural gas, wheat, corn, soybeans, Kansas wheat, cocoa, coffee, cotton, sugar, lean hogs, and live cattle. These commodities have experienced a substantial increase in speculators' participation in the futures market and a recent boom-and-bust cycle in prices. Additionally, these commodities are contained in the Standard & Poor's Goldman Sachs Commodity Index (S&P−GSCI) and the Dow Jones−UBS Commodity Index (DJ−UBSCI), the most popular commodity price indices. Passive index investors tend to hold long positions in commodity indices, using strategic asset allocations between commodities and other traditional assets. Tang and Xiong (2012) note that such trading patterns can create large price impacts and volatility spillovers across commodities.

I use the Commitments of Traders (COT) report provided by the U.S. Commodity Futures Trading Commission (CFTC) to construct speculators' positions in the commodity futures. The COT report separates traders into commercial (hedgers) and noncommercial traders (speculators). To mitigate the limitations of relying on the COT data set, I also use the CFTC's Disaggregate Commitments of Traders (DCOT) report and the Supplemental Commodity Index Traders (CIT) report to construct the futures positions that are held by various types of traders. The DCOT report separates traders into the following four categories: producer/merchant/processor/user, swap dealer, managed money, and other reportables. The managed money trader type includes hedge funds and professional managers, which are *de facto* speculators to whom I pay special attention in my analysis. The CIT report is available for selected agricultural commodity futures and divides traders into index traders, nonindex speculators, commercial traders, and nonreportables. The long-only index traders have become the center of debate among politicians and practitioners as their speculative buying is believed to create bubbles in commodity prices (Irwin et al., 2009). I provide detailed information regarding these reports in the Data section.

I study periods during which prices rose or fell substantially and assess in a cross-sectional analysis whether the magnitude of price changes is related to changes in speculative positions. If speculators destabilize the markets, the effects of speculators should be most notable during periods where price changed substantially, ex post. Therefore, examining the periods with substantial price changes provides a relatively powerful test compared to other empirical methods that focus on return predictability. I find that speculative trading in general is not related to large price changes over the 5-, 10-, and 20-week intervals. More importantly, the long positions of speculators are not related to large price increases and even help suppress extreme price increases. This finding provides clear evidence that futures speculation is irrelevant to the large increase in commodity prices. I employ a novel approach, distinct from the existing studies that primarily depend on the Granger (1969) causality tests. In competitive markets, past trading is not a reliable predictor of future price changes. In addition, weekly returns have fat tails; therefore, Granger causality tests tend to be misspecified.

My analysis reveals that futures speculation contributes to reducing spot price volatility. This result holds when I construct speculative positions using either the COT or the DCOT report. The stabilizing effect is dominant during the post-2003 period, during which increased participation by speculators in the commodity futures market is considered responsible for the substantial spot market price fluctuation. My empirical results also indicate that financialization does not relate to increased commodity price volatility, which is consistent with the findings of recent papers (Buyuksahin and Harris, 2011; Irwin and Sanders, 2012c; Aulerich et al., 2013; Brunetti et al., 2013).[3] Furthermore, I document how different types of traders in the futures market affect commodity price volatility. For example, among speculators, traditional speculators (e.g., hedge funds or floor traders) appear to stabilize spot prices and provide liquidity to the commodity markets. Using the CIT report, I show that commodity index traders do not destabilize the prices of agricultural commodities, contrary to the concerns raised by policy makers and practitioners.

I also assess the effect of futures speculation on market quality using liquidity and price efficiency measures. When liquidity increases, information is better incorporated into prices, thus enhancing information efficiency. I use the Roll (1984) liquidity measure to assess whether futures speculation contributes to enhanced information efficiency in commodity prices. In addition, I conduct a variance ratio test to assess how the futures trading activity of speculators relates to short-term efficiency in the spot market. Efficiency implies an approximate random walk in prices over short horizons, which in turn implies that the variance ratio should be very close to 1. To be more specific, if the price is very close to random walk over 1 week, the ratio of daily return variance to the return variance over 1 week should be very close to 1. A variance ratio above or below 1 indicates a deviation from the random walk; therefore, I use the absolute value of (1−variance ratio) to measure deviations from the random walk in either direction. My analysis shows that futures speculation either has no effect or improves liquidity and

[3] The process of commodity futures having become a popular asset class for portfolio investors is referred to as the financialization of commodity markets (Cheng and Xiong, 2013).

short-term efficiency in the commodity market. Combined with an analysis of volatility, the analysis of liquidity and price efficiency provides strong evidence that speculators in the futures market contribute to an improvement in market quality in the commodity market.

A growing number of studies examine the effect of speculation on prices and how it alters the relation between equity markets and the futures market. In addition to supporting the findings of these studies, my paper provides strong evidence for the stabilizing effect of speculation by employing empirical methods that are distinct from existing studies. Instead of focusing on the effect on the futures prices, I show that the presence of speculators in the futures market lowers price volatility and prevents extreme price movement in the spot market. Moreover, I find that futures speculation contributes to short-run price efficiency and liquidity, which has been neglected in the existing literature. Finally, by employing comprehensive data on speculators' positions in the futures markets, I provide robust empirical evidence that futures speculation stabilizes the commodity market.

In the next section, I provide a through literature review and discuss how my findings differ from the existing studies. Section 2.4 describes the data sets that are employed in my analysis. Section 2.5 discusses the empirical methods. Section 2.6 reports the empirical findings and Section 2.7 concludes.

2. Literature Review and Contributions

In theory, the futures market contributes to market completion, an increase in market depth, and information dissemination (Danthine, 1978; Kyle, 1985; Grossman, 1988;

Froot and Perold, 1995). These theoretical studies predict that trading in the futures market stabilizes the spot market. Peck (1976) shows that the commodity futures market dampens price fluctuations by facilitating the markets for storage. Silber (1985) discusses the economic benefits of speculators such as risk sharing and price discovery in agricultural commodity futures. These models suggest the crucial role of speculative trading in stabilizing spot prices. Futures trading attracts speculators, who trade on future expectations and information about assets. These expectations are incorporated into the spot prices, which makes spot prices more informative about economic fundamentals. In addition, the presence of speculators makes it possible for hedgers to transfer their risk, which is the most important function of the futures market.

Other models argue that once badly informed speculators trade in the futures market to take advantage of lower transaction costs and higher leverage, the benefits of futures markets diminish. Hart and Kreps (1986) and Stein (1987) document that rational speculators can destabilize the spot market for storable commodities. De Long et al. (1990b) argue that noisy traders' beliefs can move prices away from their fundamental value. Chari et al. (1990) show that the introduction of the futures market can destabilize the spot market when there is no information friction in the market. Shalen (1993) argues that futures trading can increase volatility because uninformed traders cannot identify fundamental information and liquidity needs. Harris and Raviv (1993) share a similar prediction that the positive relation between volume and volatility is stronger when there are more disagreements among traders.

A large number of empirical studies examine the impact of futures trading on the cash market (Figlewski, 1981; Bhattacharya et al., 1986; Edwards, 1988a, 1988b;

Schwert, 1990; Weaver and Banerjee, 1990; Bessembinder and Seguin, 1992; Chang et al., 1997; Kocagil, 1997; Chatrath and Song, 1999; Fleming and Ostdiek, 1999; Kyriacou and Sarno, 1999; Gulen and Meyhew, 2000; Kim et al., 2004; Bohl et al., 2011; Chen et al., 2012). Most of these studies focus on how the introduction of the futures market affects spot prices, using various futures products and futures markets in different countries. The results are inconclusive. This may imply that futures products differ in their characteristics, and it may imply that different model specifications prompt conflicting conclusions. In addition, as pointed out by Bessembinder and Seguin (1992), a crucial reason for the differing conclusions may be the confounding effects of other economic events surrounding the introduction of the futures market. Similar to my study, some studies assess the effect of futures trading on spot market volatility, but they do not distinguish the effects of different types of traders, nor do they examine the recent surge in speculation.[4] Moreover, no studies assess the effect of speculation on short-run price efficiency or liquidity.

With the rapid growth in index investment in commodity futures and the financialization of commodity futures, several papers study the comovement between commodity futures and other assets and across different commodity futures (Buyuksahin at el., 2009; Tang and Xiong, 2012). Other studies also look at how different types of investor positions are related to price changes. Irwin and Sanders (2012a) discuss current empirical findings on the effect of index traders and conclude that index trading in the futures market is unrelated to a futures price bubble. Using detailed individual positions taken by traders, Brunetti and Buyuksahin (2009) show that financial investors' flow

[4] Daigler and Wiley (1999) and Wang (2003) investigate the effect of speculators and hedgers, but they test the relation between futures volume and volatility.

does not affect price volatility in the oil futures market. Stoll and Whaley (2010) test whether index fund trading causes commodity futures price changes. Singleton (2014) argues that information friction and its associated speculative activity can lead to commodity price fluctuation. Brunetti at el. (2013) and Buyuksahin and Harris (2011) find no evidence that speculators destabilize financial markets and find instead that speculative trading reduces volatility in the futures market. Hamilton and Wu (2013) document that there is no relation between the notional value of commodity futures contracts held by index traders and the expected returns on futures contracts for 12 agricultural commodities. Several papers provide a theoretical explanation for the effect of speculative trading on prices using the model of feedback trading (Sockin and Xiong, 2013), supply and demand (Knittel and Pindyck, 2013), or quantity competition (Banerjee and Jagannathan, 2013). Basak and Pavlova (2013) and Cortazar et al. (2013) integrate financialization into the asset pricing model.

The empirical analysis of how speculative futures trading affects the spot market provides additional insights into the role of speculation. Studies that investigate the effects of speculators' futures trading on price destabilization do exist, but most of the recent studies focus on futures prices (Brunetti and Buyuksahin, 2009; Stoll and Whaley, 2009; Gilbert, 2010; Buyuksahin and Harris, 2011; Hamilton and Wu, 2013; Henderson et al., 2013; Brunetti et al., 2013).[5] When futures speculation is blamed for destabilizing prices, the concern is most typically with regard to the spot price for the commodity. Also, even though futures prices and spot prices are closely related through convenience

[5] One exception is Bohl and Stephan (2013), who analyze how expected and unexpected speculative open interest affects conditional volatility in six heavily traded futures markets. My study is closely related to their study, though my analysis is more comprehensive. I also test how futures speculation relates to price changes, which their study does not analyze.

yield and storage costs, the no-arbitrage condition need not hold as precisely in commodity futures as in equity index futures (see Knittel and Pindyck (2013) for detailed discussion). Futures speculation leads to changes in futures prices, which in turn leads to price changes in the spot market. However, the effects can be altered by changes in inventory or production levels. Because activities in the market for storage vary, futures speculation can affect spot price changes and volatility differently from how it affects futures prices.

Recent studies investigate the effect of speculative trading in the futures market on the changes in commodity prices (Stoll and Whaley, 2010; Buyuksahin and Harris, 2011; Aulerich et al., 2013). Using the Granger causality test, these studies examine how speculators' positions in the futures markets affect the magnitude of price changes. However, in competitive markets, past trading would unlikely forecast price changes; therefore, it is not clear that a conclusion can be drawn using the lead-lag variable relationship. Instead, I focus on the periods during which prices rose or fell substantially and assess in a cross-sectional analysis whether the signed price changes are related to changes in speculative positions, controlling for futures volume and other economic factors that would affect prices. I document that speculative trading in general is not related to large price changes over the 10- and 20-week intervals.

In addition to examining whether futures speculation induces increased spot volatility, I analyze whether futures trading contributes to improved short-term market efficiency and liquidity. Existing studies have neglected the analysis of market quality in the spot market so far. The finding that futures speculation contributes to maintaining short-run price efficiency and liquidity is clear evidence that futures speculation benefits the commodity market. Moreover, in my analysis of energy and agricultural markets, I control for several economic variables that are important to the spot price and its volatility. I include information on commodity inventory as well as other macroeconomic variables to mitigate concerns about omitted variables relevant to spot volatility.

3. Data

I use 21 commodity futures that are traded in the U.S. futures market with reliable spot price data in the analysis on the relationship between price changes and speculative trading activity. I obtain daily spot prices, the total open interest, and the futures trading volume from the Commodity Research Bureau (CRB). “Open interest” refers to the number of outstanding futures contracts that are not yet offset by a transaction. Futures volume reflects the overall trading activity in the futures market and is measured in the number of futures contracts. In assessing whether futures speculation affects volatility and market quality, I use 14 widely traded agricultural and energy commodities and their futures contracts: wheat, soybean, corn, Kansas wheat, cotton, cocoa, coffee, sugar, lean hogs, and live cattle for agricultural commodities and crude oil, heating oil, gasoline, and natural gas for energy commodities. These commodities experienced large price fluctuations and a substantial increase in open interest over the entire period in the analysis, especially during the later period of my sample. Additionally, production and inventory data are available for these commodities.

To construct the positions that are held by each trader type, I use several position data sets available from the CFTC. In constructing speculators’ positions, I use the weekly COT report. Since 1986, the CFTC has provided the outstanding positions of traders. The weekly reports, which start in October 1992, are released on Fridays and reflect positions as of the preceding Tuesday. If trade size exceeds certain thresholds set by the CFTC, each trader is required to report the positions that they hold. The traders' reported positions are categorized as either commercials (hedgers) or noncommercials (speculators). If futures contracts are primarily used for hedging purposes, the trader is classified as commercial; otherwise, traders are categorized as noncommercial. The CFTC staff evaluates the trader classifications and can reclassify the trading entity if necessary. If trade size does not exceed the threshold set by the CFTC, the trade is classified as the nonreportable position. Following Irwin and Sanders (2010), I calculate the total futures positions held by each trader type as following:

(i) Gross speculative positions = long noncommercial open interest + short noncommercial open interest + 2 × spread[6]

(ii) Gross hedging positions = long commercial open interest + short commercial open interest

(iii) Gross nonreportable positions = long nonreported open interest + short nonreported open interest

Table 1 provides information on commodities and their futures contracts that are used in my analysis. I use data from October, 1992, when the weekly open interest data became available from the CFTC, to July, 2012. Panel A displays futures contract specifications such as contract size, the exchanges on which the futures contracts are traded, and their expiration months. Panels B and C provide information on prices and

[6] For more detailed information, refer to COT Explanatory Notes, available at the CFTC's webpage, http://www.cftc.gov/MarketReports/CommitmentsofTraders/ExplanatoryNotes/index.htm. Spread is the amount each noncommercial trader holds in equal long and short futures positions. For example, if a noncommercial trader holds 2,000 long contracts and 1,500 short contracts, 500 contracts will appear in the long position. Spread is 1,500 in this case. Spread is reported only for noncommercial traders.

speculators' market shares in commodity futures that have inventory data. As shown in Panel B, the commodity prices substantially increased over time, and they are more volatile in the later period in the sample. Panel C indicates that the increases in the commodity price level and volatility are accompanied by a large increase in speculators' market share in the commodity futures market.

I also use the DCOT report that has been available since June, 2006. The DCOT report separates traders into the following four categories: producer/merchant/processor /user, swap dealers, managed money, and other reportables. The first two groups of traders are comparable to the commercial traders in the COT report. The producer/merchant/processor/user trader type consists of traditional hedgers, such as the producers and consumers of the commodities who primarily use futures markets for hedging purposes. Swap dealers use the futures market to hedge the risk from swap trading. Because their trading counterparts include speculators, swap dealers can bring speculative activity to the market. In addition, swap dealers often take positions for index funds, whose herding behavior and tendency to hold long-only positions in commodity futures can affect the futures market and hence the spot market. Money managers and other reportables are comparable to the noncommercial traders in the COT report. Specifically, money managers are the classical types of speculators, such as hedge funds or floor traders, who trade on behalf of their clients. The analysis using these data sets provides additional information on how different types of traders' trading activity affect the spot market.

Studies have raised concerns about solely relying on the COT report. Those who claim to have a cash position in the underlying assets can report themselves as being commercial traders; therefore, a commercial position can include speculators' positions. Several researchers also argue that this limitation is one of the reasons why hedging pressure measures, which are constructed from the weekly COT data, produce different results among studies (Ederington and Lee, 2002; Buyuksahin and Harris, 2011; Gorton et al., 2012; Acharya et al., 2013; Dewally et al., 2013).

One advantage of using the DCOT report is that the distinction between speculators and hedgers is clearer than in the COT report. The DCOT data are available since mid-2006, which overlaps with the financialization period in which I am interested. They also provide a more distinct classification of hedgers and speculators, which helps me to produce robust results in my analysis. The CFTC also acknowledges that this data set is more transparent about trader classification.[7]

I also employ the CIT report to construct the futures positions that are held by index traders for agricultural commodities. The CIT report is available from 2006 for selected agricultural futures. The CIT report divides traders into index traders, nonindex speculators, commercial traders, and nonreportables. The “index trader” category of the CIT report includes swap dealers as well as pension and other investment funds that place their index investment directly into the futures markets. According to Irwin and Sanders (2010), the majority of index trader positions come from the long positions of commercial traders. In the agricultural futures market, the positions taken by swap dealers from the DCOT report are very close to the positions taken by index traders from the CIT report; however, this is not the case for energy futures (CFTC, 2008; Irwin and

[7] Buyuksahin and Harris (2011) and Brunetti et al. (2013) use nonpublic position data and report similar results for the effects of speculators’ trading on futures prices.

Sanders, 2010). The use of this data set reduces the limitations of relying on the COT report, and it allows me to assess the effect of index traders on the commodity market.

I collect several variables that are known to influence commodity price changes and volatility. The quarterly and monthly inventory data on agricultural commodities are obtained from the United States Department of Agriculture (USDA) Economic Research Service. For cocoa, coffee, cotton, and sugar futures contracts, I collect inventory data from the historical certified warehouse stocks available from the Intercontinental Exchange (ICE). The weekly inventory data on energy commodities are from the U.S. Energy Information Administration (EIA) website. Inventories act as buffers that absorb shocks to demand and supply, thus affecting spot prices. Deaton and Laroque (1992) show that at low inventory levels, both the risks of a stock-out and spot price volatility increase. Gorton et al. (2012) document that commodity inventory is an important economic factor that determines futures prices.

To control for the supply effect on price volatility, I obtain U.S. production data for each commodity from the USDA Economic Research Service and EIA energy production database. One might argue that because commodities are traded in multiple parts of the world, I should use production and inventory data at the global level. The primary reason for using U.S. data is the data quality, which reduces noise in my estimation. In addition, the center of debate is the speculative trading activity in the U.S. futures market. Frankel (2013) and Knittel and Pindyck (2013) also discuss the validity of using U.S. data instead of global data in terms of crude oil. Moreover, Kilian and Murphy (2013) use global data and find results that are similar to those obtained using U.S. data in other studies.

I include macroeconomic indicators to capture the effect of supply and demand shocks, which are shown to be important determinants of commodity prices during the past decade (Kilian, 2009; Kilian and Murphy, 2012). I use the quarterly gross domestic product (GDP) growth rate and changes in the monthly production growth and inflation rate. These variables are constructed by using the data available from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis website.

4. Empirical Methods

4.1 The Effect of Futures Speculation on Commodity Prices

I study periods when prices rose or fell substantially and assess whether the signed price changes are related to changes in speculative positions. I use a cross-sectional analysis to assess whether futures speculation is related to extreme, signed price changes and whether speculators' long or short position is driving commodity price changes. The sample period starts in October, 1992 when the weekly COT report became available.

I divide the daily time series of commodity prices into nonoverlapping 5-, 10-, and 20-week intervals and construct speculators' total positions and speculators' long and short positions using the COT report. I use Tuesday-to-Tuesday price changes because of the weekly frequency of the COT data. For each interval, I calculate the percentage changes in commodity prices and the percentage changes in speculators' total, long, and short positions. I pool all commodities with at least 10% and 20% changes in prices over 5-, 10-, and 20- week intervals and conduct the following cross-sectional regression with commodity fixed effects. Following Petersen (2009), the standard errors are clustered by time:

$$\%\Delta P_{it} = \alpha + \beta\%\Delta \text{Speculation}_{it} + \delta_1\%\Delta TFV_{it} + \delta_2\%\Delta INV_{it} + \delta_3\%\Delta INF_{it} \quad (2.1)$$

$$+ \delta_4\%\Delta GDP_{it} + \delta_5\%\Delta PROD_{it} + \sum_{j=1}^{3}\varphi_j s_{jt} + (\text{commodity fixed effects})_i + \varepsilon_{it}$$

ΔP denotes the commodity price changes over the 5-, 10-, and 20-week intervals and *ΔSpeculation* is the changes in futures positions held by speculators: the aggregate, long, and short positions of speculators in each commodity futures contract. *ΔTFV* is the changes in futures trading volume, *ΔINV* is the changes in inventory, *ΔINF* is the changes in inflation rate, *GDP* is the GDP growth rate, and *PROD* is changes in the production growth rate. For inventory data, I first deseasonalize them by regressing the inventory level on each month (or quarter) and use the residuals as a measure of inventory changes. The three macroeconomic variables are included to control for commodity demand and aggregate economic conditions that would affect the commodity price changes. s_{it} is the seasonal dummy variable. I provide a separate analysis for the 15 commodities that have available inventory data. I also conduct a separate analysis for energy and agricultural commodities, considering that commodity futures are distinct among sectors, and more attention has been paid to the price changes in energy and agricultural commodities.

The coefficient on *Speculation (β)* indicates whether futures speculation is related to the signed changes in commodity prices. The dependent variables are the price changes in both directions; therefore, when the dependent variables are positive (negative) price changes, the negative (positive) or insignificant sign of β implies that on average speculators' position in commodity futures is unrelated to large spot price increases (decreases).

4.2 The Effect of Futures Speculation on Spot Volatility

I adopt a generalized autoregressive conditional heteroskedasticity (GARCH) model to investigate the effect of futures trading activity by speculators and hedgers on spot volatility.[8] The conditional mean is constructed as a first-order auto-regressive (AR) process with various control variables. Hong and Yogo (2012) and Gorton et al. (2012) document open interest and inventories are strong predictors of commodity price changes. Therefore, I include the changes in open interest and inventories in the conditional mean equation. Following Gallant et al. (1992), I control for day-of-the-week effects to capture the daily shocks to returns and volatility. I also control for inflation to capture the effects of interest rate on price changes. In the conditional variance equation, I include open interest held by speculators and hedgers, noncategorized trades, and total trading volume. This is similar to Bessembinder and Seguin (1993), who control for aggregate trading activity in the futures market. Although my analysis focuses on the effect of speculators, I provide a separate analysis on the effect of hedgers to see if their position in the futures market has a distinct effect on the spot market. I interpret the coefficient of each trader type as the partial effect of each trader type on the spot volatility.

Unlike most existing studies, which include only trading activity variables in the analysis, I employ a wide set of variables that are known to be related to spot price changes. I include the changes in total U.S. production to control for the supply shocks

[8] Compared to more complicated models, the GARCH (1,1) model is shown to work well in describing financial time series. Hansen and Lunde (2005) report that among various GARCH models, nothing outperforms GARCH(1,1). I also use the exponential GARCH (EGARCH) and The Glosten–Jagannathan–Runkle GARCH (GJR-GARCH) (Glosten et al., 1993) models to capture the asymmetric volatility clustering in the commodity prices. The results are similar across different model specifications. I report the estimation results using the GARCH (1,1) model.

in the commodity markets. Motivated by the theory of storage, I also control for changes in inventory level for each commodity. Moreover, I include macroeconomic variables to capture the aggregate economic conditions and demand effects on spot volatility. To control for the effect of the contract life cycle, I include days to expiration in the conditional volatility equation. As the Samuelson hypothesis (1965) states, for certain commodity futures, volatility increases near the time of contract expiration dates. As a contract is approaching its expiration date and investors adjust their positions to roll over their contracts or close them for portfolio balancing, more futures trading takes place, increasing volatility. Some commodities are in high demand or low in inventory during certain seasons. To capture the daily and seasonal variations, I include daily and seasonal dummy variables in the conditional volatility equation.

The analysis on spot volatility is based on the following GARCH (1,1) model:

$$\begin{aligned} \mathrm{r}_{it} &= a_0 + a_1 r_{t-1} + \sum_{i=1}^{4} b_i d_{it} + c_0 \Delta OPEN + c_1 \Delta INV_t + c_2 INF_t + e_t \\ h_t &= \omega + \alpha r_{t-1}^2 + \beta h_{t-1} + \sum_{i=1}^{N} \theta_i (\text{decomposed positions}_{it}) + \gamma_1 NCR_t + \gamma_2 TFV_t + \delta_1 \Delta INV_t \\ &\quad + \delta_2 \Delta SUP_t + \delta_3 GDP_t + \delta_4 INF_t + \delta_5 PROD_t + \delta_6 DTE_t + \sum_{i=1}^{4} \phi_i d_{it} + \sum_{i=1}^{3} \varphi_i s_{it} \end{aligned} \quad (2.2)$$

Eq. (2) is estimated using the maximum likelihood method with robust standard errors. I calculate continuously compounded daily returns as $r_t = \log(P_t / P_t) \times 100\%$. *ΔOPEN* refers to the changes in total open interest, *ΔINV* to the changes in inventories, and ΔSUP to the changes in the commodity production level. *GDP* is the quarterly GDP growth rate, *INF* is the monthly inflation rate, and *PROD* is the monthly production growth rate. d_i is a dummy variable for each trading day, and s_i is a seasonal dummy variable. *NCR* is the noncategorized traders, and *TFV* is the natural log of total futures trading volume. *DTE* is the square root of days to expiration. Whenever necessary, I first remove the time trend from the control variables and use the detrended data in the estimation.

The main variables of interest are $\sum_{i=1}^{N}\theta_i(\text{decomposed positions}_{it})$, the decomposed positions of speculators and hedgers. The sign of θ_i reflects the directional effect of the partitioned position of each trader type. Following Bessembinder and Seguin (1992), I partition each trader's position into three components: expected, unexpected, and long-term variation. Trading variables have a strong time trend in the futures market; therefore, I first detrend the logged trading activity variables by deducting a 100-day moving average for positions held by speculators and hedgers as well as for nonreportables. Then, I partition the detrended data into expected and unexpected data using the following multivariate vector autoregression (VAR) model:

$$V_t = a + \sum_{j=1}^{p} b_j V_{t-j} + \text{Controls}_t + e_t \quad (2.3)$$

where V_t is the transpose of a vector, [Speculators' position, Hedgers' position, Nonreportables, Futures volume]. Control variables include daily effects, *GDP*, *INF*, *PROD* and *DTE*.

The above detrending procedure generates the expected, unexpected, and long-run variation (MA) components for speculators and hedgers. The fitted value is the expected value for each trader type, and the residuals from the multivariate *VAR* model are the unexpected portion. The 100-day moving average series are the long-term shifts, the expected position is the forecastable short-run time-varying position, and the unexpected part reflects the information shock. Therefore, in the conditional volatility equation from

Eq. (2), $\sum_{i=1}^{N}\theta_i(\text{decomposed positions}_{it})$, is specified as,

$$\theta_1 ESP_t + \theta_2 USP_t + \theta_3 MASP_t + \theta_4 EH_t + \theta_5 UH_t + \theta_6 MAH_t \qquad (2.4)$$

where ESP (EH) is the expected speculators' (hedgers') position, USP (UH) is the unexpected speculators' (hedgers') position, and MASP (MAH) is the long-term variation component in speculators' (hedgers') position.

I confirm that each trading activity variable is stationary using the modified Dickey–Fuller test proposed by Elliott et al. (1996), and I use the first-differenced data when the detrended variable is not stationary. Instead of using the univariate autoregressive integrated moving average (ARIMA) model used in previous studies, I estimate expected and unexpected trading activity conditioning on its own past trading activity and that of its correlated market. In the process, I control for daily effects, time to expiration, and macroeconomic variables. The reason for this partition method is that both futures volume and open interest respond to the same information shock; therefore, past volume and open interest have predictive ability in the current trading activity variables. The optimal lag was chosen by the Bayesian information criterion (BIC). I employ a similar decomposition method when using the DCOT and the CIT reports in the volatility analysis.

In assessing the effect of trading activity on spot volatility, I calculate the net effect of each trader type. I multiply each estimated coefficient of the decomposed position by the average value of each component of open interest and sum up the resulting products. To be more specific, the net effect of speculators on spot volatility is

Speculators' net effect on spot volatility (5)

= (θ_1 × mean of ESP) + (θ_2 × mean of USP) + (θ_3 × mean of MASP)

The negative or insignificant net effect implies that the speculative position does not increase conditional spot volatility, controlling for the aggregate trading activity in the futures markets and economic variables that are used in Eq. (2). The negative or insignificant net effect also supports the stabilizing theory of futures speculation: speculators' trading in the futures market lowers price volatility in the spot market via increased information diffusion from the futures market to the spot market. Hedgers' net effect on volatility is similarly defined as

$$\text{Hedgers' net effect on spot volatility} \quad (6)$$
$$= (\theta_4 \times \text{mean of EH}) + (\theta_5 \times \text{mean of UH}) + (\theta_6 \times \text{mean of MAH})$$

I split the sample into two periods, pre- and post-2003. The later period overlaps with the financialization period, when speculators' trading activity is believed to be responsible for the fluctuations in the spot price of the major commodity markets. If destabilizing effects dominate the later period, my analysis would support the recent regulatory changes that limit speculative trading in the commodity futures market. However, if speculators' increased participation in the futures market helps lower spot volatility, this would indicate that futures speculation stabilizes the spot market. If this is the case, the regulatory changes to restrict speculators will not be effective in stabilizing the commodity market.

4.3 The Effect of Futures Speculation on Market Quality

In addition to analyzing the effect of speculation on spot volatility, I investigate the contemporaneous relation between futures speculation and market quality. I use liquidity and short-term price efficiency as market quality measures. If speculators not only lower the spot volatility but also contribute short-term market efficiency and liquidity, the result would provide strong evidence that speculators stabilize the spot market.

4.3.1 The Effect of Futures Speculation on Liquidity

I assess how futures speculation affects liquidity in the spot market. I use Roll's (1984) liquidity measure by employing daily spot price data. Roll's liquidity measure uses the serial covariance of the price changes as estimates of spreads, and it is useful when intradaily price or trading volume data are not available.

Following Goyenko et al. (2009), I construct the Roll's liquidity measure as the following way:

$$\text{Roll}_t = \begin{cases} 2 \times \sqrt{-Cov(\Delta P_t, \Delta P_{t-1})} & \text{when } Cov(\Delta P_t, \Delta P_{t-1}) < 0 \\ 0 & \text{when } Cov(\Delta P_t, \Delta P_{t-1}) \geq 0 \end{cases} \tag{2.7}$$

Using the following equation, I assess how futures speculation affects liquidity:

$$\begin{aligned} \text{Roll}_t = & \hat{\theta}_0 + \hat{\theta}_1 ESP_t + \hat{\theta}_2 USP_t + \hat{\theta}_3 MASP_t + \hat{\theta}_4 EH_t + \hat{\theta}_5 UH_t + \hat{\theta}_6 MAH_t \\ & + \sum_{i=1}^{5} \hat{c}_i \text{controls}_t + e_t \end{aligned} \tag{2.8}$$

ESP (EH) is the expected speculators' (hedgers') position, *USP (UH)* is the unexpected speculators' (hedgers') position, and *MASP (MAH)* is the long-term variation in speculators' (hedgers') position. I partition each trader's position using the multivariate VAR model (Eq. (3)) that I used in the previous analysis. *Controls* include futures trading volume, nonreported position, changes in inventory and production level, GDP growth, production growth, inflation, and seasonal dummy variables. The control variables are defined identically from the data I used in the analysis on spot volatility in section 2.4.2.

Newey–West standard errors are used to control for autocorrelation and heteroskedasticity.

A higher Roll's measure means lower liquidity, and thus the positive sign of each $\hat{\theta}$ indicates that each component of the trader's position has a negative effect on liquidity. The liquidity measure is detrended whenever strong time trends are observed; that is, I regress the liquidity measure on time trend and use the residual as the dependent variables.

I calculate the net effect of speculators' position as

$$\text{Speculators' net effect on liquidity} \quad (9)$$
$$= (\hat{\theta}_1 \times \text{mean of ESP}) + (\hat{\theta}_2 \times \text{mean of USP}) + (\hat{\theta}_3 \times \text{mean of MASP})$$

The net effect of hedgers is defined similarly. The positive net effect implies that future speculation has a negative effect on liquidity in the commodity market. I divide my sample into pre- and post-2003 periods, paying special attention to the later period.

4.3.2 The Effect of Futures Speculation on Short-term Price Efficiency

I analyze how speculators' futures trading is related to short-term price efficiency using a variance ratio test. Efficiency implies an approximate random walk over short horizons, and variance ratio tests can indicate whether price changes have deviations from random walk.

Several empirical studies use the variance ratio test to capture market liquidity and information efficiency (Bessembinder, 2003; Chordia et al., 2008; Griffin et al., 2010).[9] If futures trading activity helps information to be reflected in the spot market more

[9] Time-varying expected return can cause autocorrelation. The use of nonoverlapping weekly measures in my study reduces this concern.

efficiently and increases its market depth, spot returns would behave close to random walk. In contrast, if trading activity in the futures market attracts poorly informed traders and hinders information transfer and price discovery, the variance ratio would move away from the benchmark. For example, if a large number of momentum traders trade on unexpected price changes, positive autocorrelations will occur, which will cause price continuation. Alternatively, if less informed traders trade on nonfundamental information, prices will move away from the equilibrium path. As traders learn fundamental information, prices will move back to the equilibrium level, leading to a price reversal.

Specifically, the variance ratio (*VR*) is defined as

$$VR_t(q) = \frac{Var[r_t(q)]}{q \times Var[r_t]} \tag{2.10}$$

where r_t is the return series, q is the number of lags in returns, and *Var* stands for the variance estimate. For example, the variance ratio on Tuesdays is defined as the ratio of weekly variance to five times the daily variance. I calculated the variance ratio using the Wednesday-to-Tuesday interval because the futures positions are reported to the CFTC every Tuesday. Also, the nonoverlapping weekly measure can mitigate the fact that the variance ratio is persistent over time. I follow Lo and MacKinlay (1988) and Campbell et al. (1997) to produce a heteroskedasticity-consistent estimator.

To assess the effect of futures speculation on short-term price efficiency, I use the following regression for each commodity:

$$|1\text{-}VR_t| = \tilde{\theta}_0 + \tilde{\theta}_1 ESP_t + \tilde{\theta}_2 USP_t + \tilde{\theta}_3 MASP_t + \tilde{\theta}_4 EH_t + \tilde{\theta}_5 UH_t + \tilde{\theta}_6 MAH_t + \sum_{i=1}^{5} \tilde{c}_i \text{controls}_t + e_t \tag{2.11}$$

ESP (EH) is the expected speculators' (hedgers') position, *USP (UH)* is the unexpected speculators' (hedgers') position, and *MASP (MAH)* is the long-term variation in speculators' (hedgers') position. I partition each trader's position using the multivariate VAR model (Eq. (3)) that I used in the previous analysis. *Controls* include futures trading volume, nonreported positions, changes in inventory and production level, GDP growth, production growth, inflation, and seasonal dummy variables. The control variables are identical to those in the previous analysis. I use Newey–West standard errors to control for autocorrelation and heteroskedasticity.

The dependent variable, *(1−variance ratio)*, captures deviations from the benchmark in either direction because both negative and positive autocorrelation implies departure from the random walk benchmark. The positive sign of the $\tilde{\theta}$s implies that each component of the trader's position lowers the short-term price efficiency measure in the short term. I focus on the net effect of futures speculative activity in assessing whether futures speculation relates to short-term price efficiency in the spot market.

The speculators' net effect on price efficiency is calculated as

$$\text{Speculators' net effect on short-term efficiency} \quad (12)$$
$$= (\tilde{\theta}_1 \times \text{mean of ESP}) + (\tilde{\theta}_2 \times \text{mean of USP}) + (\tilde{\theta}_3 \times \text{mean of MASP})$$

The net effect of hedgers is defined similarly for each measure. Similar to the previous analysis, I focus on the post-2003 period.

5. Empirical Results

5.1 The Effect of Futures Speculation on Price Changes

I examine whether large price changes are related to speculation in the futures market. Table 2 reports the estimation results using the cross-sectional test described in Eq. (1). I test separately the effect of speculators' total positions, long positions, and short positions in commodity futures. I divide the time series of commodity price changes into nonoverlapping 5-, 10-, and 20-week intervals, and consider only periods with minimum 10% price movements. To conserve space, only the coefficients of the changes in speculator positions are reported.[10]

Panel A of Table 2 reports the cross-sectional analysis of the 5-, 10-, and 20-week intervals for all commodities when prices increase by at least 10% and 20%. The second, fourth, and sixth columns present the results when prices go up by at least 10% during the 5-, 10-, and 20-week intervals, respectively, and the third, fifth, and seventh columns present the results when prices go up by at least 20% for each given interval. The results indicate that there is a negative or no cross-sectional relation between large price increases and changes in the speculative positions in commodity futures. Additionally, when prices increase by at least 20%, the relation between increase of prices and changes in the speculators' positions is more negative and statistically significant than in those cases where prices increase by at least 10%. For example, in the cross-sectional analysis of the 20-week interval, the estimated coefficient of the changes in speculative position is −2.389 for the 10% price changes, whereas the estimated coefficient is −7.180 for the 20% price changes, a three-fold increase. This result indicates that speculation has more prominent stabilizing effects when there are larger commodity price movements. The estimated coefficients for speculators' long and short positions are either negative or statistically insignificant, which suggests that there is no evidence that speculators' long and short positions accentuate large price increases. The estimated result also shows that the coefficients on speculative long positions are either negative or insignificant, implying price increases tend not to occur during periods when speculators are buying.

[10] The entire estimation results are available upon request.

This result is in contrast to opinions among policy makers and practitioners that speculators accumulate long positions in commodity futures and therefore substantially affect prices. In terms of control variables, inflation has the most significant effect on commodity price increase; however, the effect is modest.

Panel B reports the cross-sectional analysis during the 5-, 10-, and 20-week intervals for all commodities when prices decrease by at least 10% and 20%. The second, fourth, and sixth column present the estimation result when prices go down by at least 10%, during the 5-, 10-, and 20-week interval, respectively, and the third, fifth and seventh columns present the result when prices decrease by at least 20% for each interval. The results indicate that there is no significant cross-sectional relation between large price decreases and the changes in the speculative position in commodity futures: when prices go down substantially, it seems that speculators in the future market do not intensify large decline in the commodity prices. Compared to the results reported in Panel A, the stabilizing effect is less significant during periods of price increases. Instead, the changes in macroeconomic conditions have a stronger relation with price decline. Moreover, relative to price increases, there are fewer incidences of price decreases during the sample period.

At the bottom of Panel A and B, I also report the analysis for the 15 commodities with available inventory data. The results are similar to the results for all the commodities: speculators either have no effect or stabilize the commodity prices during periods of large price changes. In the process, I expected that inventory changes would have significant effects because, according to the theory of storage in commodity markets, inventory is directly related to price levels. However, I find that inventory changes generally are not significantly related to large price changes, and estimated coefficients on inventory changes are statistically significant only when the commodity prices continue to decline during each interval. Additionally, the relation between price decline and inventory changes is negative, indicating that prices decrease as more inventories are built up during the intervals.

Much attention has been paid to studying price changes in the energy and agricultural sectors (Brunetti and Buyuksahin, 2009; Irwin and Sanders, 2012b; Aulerich et al., 2013; Brunetti et al., 2013). Although the sample size decreases, I provide additional analysis for these two sectors in the rest of Table 2. Panel C reports the analyses for energy and agricultural commodities when prices change by at least 10% during each interval. The left-hand side of Panel C reports the regression results when price goes up by at least 10% during each interval, and the right-hand side presents the results when prices go down by at least 10% in each interval. The estimated coefficients of the speculative positions indicate that there is no evidence that speculators' positions are related to the extreme price movements for energy commodities. Similar to what is reported in Panel A and Panel B, speculation seems to have stronger stabilizing effects when prices increase. Moreover, macroeconomic variables have more significant effects on price changes in case of price increases. Additionally, inflation has the most significant effect on price changes of energy commodities. Compared to the energy commodities, the seasonal effect, although not reported, is more important for the price changes of the agricultural commodities.[11]

[11] I also estimate the effect of futures speculation on commodity prices using the 20-week interval, obtaining similar conclusions.

The results imply that futures speculation is not related to large price changes in the commodity markets. My analysis also indicates that extreme price increases tend not to occur during periods when speculators are buying, which is consistent with the interpretation that speculators' trades alleviate rather than accentuate price increases. Additionally, economic fundamentals, such as inflation, are an important factor that influences commodity price changes, suggesting it is necessary to include marketwide information when studying the commodity market.

5.2 The Effect of Futures Speculation on Spot Volatility

I assess whether speculators' trading in the futures market destabilizes the commodity market using the conditional volatility model described in Eq. (2). In addition to analyzing the effect of speculators' trading, I also examine how hedgers' trading activity in the futures market affects spot volatility.[12] Table 3 reports the estimation results. To conserve space, I only report the net effect of speculators' and hedgers' on spot volatility.[13] I calculate the net effect of speculators and hedgers on spot volatility by multiplying the coefficient of each partitioned trading activity variable by its mean and sum up the resulting products. A negative or insignificant net effect implies that futures trading activity does not destabilize the spot market price. The net effect in bold indicates that it is significantly different from zero. For each trader type, *F*-tests are performed to

[12] The recent working paper by Bohl and Stephan (2013) studies a similar question. However, they include only speculators' trading activity and do not control for other variables that are relevant to spot volatility. In addition, the speculators' position is part of total open interest; therefore, Bohl and Stephan's estimation controls for two redundant variables in the conditional variance equation. My method is different in that I do not include total open interest but instead include aggregate trading activity by speculators, hedgers, and small traders. Trading volume captures total trading activity in the futures market in my estimation. Last, by providing an analysis of market quality, I find stronger results, consistent across commodities.
[13] The complete estimation results for Crude oil and Soybeans are reported in the Appendix 2.C. The entire results are available upon request.

test whether the coefficients of each partitioned trading activity are jointly zero. The bold numbers in Table 3 indicates the statistical significance of the net effect of each trader type at 1%, 5%, or 10%.

The net effects reported in Table 3 indicate there is no evidence that futures speculation destabilizes the spot price. For the full sample period, except for live cattle, the net effect of speculative trading is negative or insignificant. For energy commodities, the net effect of speculative trading is negative for the full sample period and for the two subsample periods. For all agricultural commodities except wheat, the net effect of speculators' trading is negative during the post-2003 period. During the pre-2003 period, the net effect of speculative trading is negative or insignificant, except for soybean and live cattle. This finding is contrary to the view that speculators' increased participation in the commodity futures market is the reason for the price fluctuations in the energy and agricultural markets in the last decade. Instead, speculators seem to stabilize the price volatility in the commodity market, especially during the most recent decade. In particular, speculators in the futures market are the center of a policy debate on the crude oil prices. I show that speculators actually help lower the volatility in oil prices. In terms of hedgers' effects in energy commodities, the patterns are less clear than for those of speculators. In agricultural markets, the trading activity of hedgers seems to be more destabilizing than that of speculators.

The empirical analysis in this section suggests there is no evidence that speculators in the futures markets destabilize the spot market. Speculators in the agricultural and energy futures markets have been blamed for making pricing more volatile and unsustainable. In contrast, at least for the commodities I study, I show that speculators stabilize the commodity prices. These commodities are mostly liquid and are included in the two major commodity indices that reflect most speculative trading in futures markets. Particularly during the post-2003 period, there is no evidence that speculators are responsible for increasing commodity price volatility. My empirical findings indicate that futures speculation has a stabilizing effect, especially during the recent period, when commodities have become financial assets that have attracted diverse types of speculators.

5.3 The Effect of Futures Speculation on Market Quality

In this section, I examine how futures speculation affects spot market quality using Eqs. (2.8) and (2.11). The dependent variables are the Roll (1984) liquidity measure and the absolute value of (1-variance ratio). They are constructed using the spot price in nonoverlapping weekly frequency to mitigate the fact that they are persistent over time. In addition, the weekly measure coincides with the reporting frequency of the COT reports. To save space, I report only the net effect of each trader type.[14] There is a strong time trend in the liquidity measure. Therefore, I regress the Roll measure on the time trend and use the residual as the dependent variable.[15]

Table 4 reports how futures speculation affects liquidity in the commodity market. The Roll measure gauges illiquidity; a higher Roll measure indicates lower liquidity. Therefore, the negative net effect implies that speculators' trading in the futures market increases spot market liquidity.

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[14] The full estimation result is available upon request.

[15] It is possible that increasing speculation causes the time trend. I use the Roll measure without filtering the time trend and obtain qualitatively identical results. In fact, when I use the Roll measure without detrending, I obtain stronger results.

The net effect of futures speculation is either insignificant or negative, indicating that speculative trading either has no effect or has a positive effect on liquidity. The same results are found regardless of the sample period. Clearly, speculative trading in the futures market does not lower liquidity in the commodity market; in fact, for some commodities, futures speculation improves liquidity in the commodity market. There is no clear pattern in the hedgers' net effect. In contrast to the net effect of speculators' trading, during the post-2003 period, the net effect of hedgers, whenever significant, tends to be positive.

Using the variance ratio test, I conduct a similar analysis to assess the effect of futures speculation on short-term price efficiency. Table 5 displays the result. The dependent variable measures deviations from the random walk benchmark over short horizons. Therefore, the positive net effect implies that futures trading by each trader type is negatively associated with the short-term price efficiency. Most of the net effect is insignificant, implying that the weekly variance ratio is a noisy measure. Although I do not find strong statistical power to establish a clear conclusion, during the post-2003 period, it seems that speculative trading does not decrease the price efficiency, at least. This is important because it is during the post-2003 period that policy makers believe speculators harmed the market. For other periods, I do not find any clear pattern for the effect of futures speculation on market quality. Relative to speculators, the net effects of hedgers tend to be more positive. For example, for heating oil and live cattle, the net effect is significant and positive during the entire sample periods.

The analysis of liquidity and short-term price efficiency suggests that speculators in the commodity futures market not only stabilize the spot market, but also help maintain market quality. The results are consistent with stabilizing theory of futures speculation, supporting Working (1960) who argue that speculators benefit the market by providing liquidity and risk-bearing capacity for hedgers.

5.4 Analysis Using the DCOT and CIT Reports

In this section, I provide additional analysis on how the trading activity of speculators affects spot volatility and market quality using the DCOT report. Instead of classifying traders as commercials and noncommercials as in the COT report, this data set provides more detailed information on the trader types. Although the data are available from mid-2006, the sample period is long enough to produce a stable GARCH estimation. Also, this period includes the time during which commodity markets experienced substantial increases in speculators' participation as well as price fluctuations. The more detailed information on trader type can provide additional information on which types of traders destabilize the commodity markets. Using the DCOT report, I repeat a similar exercise on volatility and market quality. Each trader type's position is partitioned into expected, unexpected, and long-term variation via the multivariate VAR model that I used previously. The control variables are also identical to those of previous analysis.

Table 6 reports the net effect of each trader type on spot volatility using the GARCH (1,1) model. Money managers and other reportables are comparable to speculators in the previous volatility analysis; among speculators, money managers hold

greater positions in the commodity futures than do the other trader type. Product merchant and swap dealer groups are comparable to hedgers in the previous analysis. In all commodities, traders labeled as money managers have a negative or insignificant net effect on spot volatility. These types of traders are hedge funds or commodity trading advisers, representing the traditional class of speculators (Irwin and Sanders, 2010). In contrast, there is no clear pattern for the other type of speculators: the speculators who are categorized as “nonreportables,” it seems, are distinct from the traditional type of speculators in the futures market.

Among commercial traders, I do not find a systematic pattern for the product merchant trader type; for agricultural commodities, however, the net effect of this trader type is negative or insignificant, indicating that traditional hedgers in agricultural markets do not increase commodity price volatility. In terms of swap dealers, the net effect is significant and positive in all energy commodities, implying that these trader groups increase price volatility in this market. Swap dealers include (i) dealers who trade with speculators and use the futures market to hedge their risk and (ii) index traders who hold long-only positions in commodity futures. It is shown that index traders compose most of the swap dealers in agricultural commodity markets, but this distinction is not clear in energy futures markets (CFTC, 2008; Irwin and Sanders, 2010). There is no clear pattern for the effect swap dealers have on the agricultural markets. For wheat and sugar, the result indicates that swap dealers destabilize the spot market; for corn, however, swap dealers have a significant stabilizing effect on price volatility.[16]

In Table 7 and Table 8, I report the net effect of each trader type on liquidity and short-term price efficiency, respectively. Much as the previous analysis, the dependent variables are the Roll's liquidity measure and the absolute value of (1-variance ratio),

[16] Brunetti et al. (2013) report that swap dealers do not have a significant effect on market volatility in crude oil, natural gas, and corn using unique position data over 2005 to 2009. When I use the same period, I also obtain an insignificant effect on volatility for swap dealers.

both are at nonoverlapping weekly frequency. For the managed money trader type, I find negative or insignificant net effects on liquidity and short-term price efficiency for all commodities. For other reportables, I again find a negative and insignificant effect for energy commodities, but no systematic pattern for agricultural commodities. For commercial traders, I cannot reach a clear conclusion about their effect on liquidity and price efficiency, although I find weak evidence that the net effect is positive in terms of the product merchant group. For swap dealers, there is no clear pattern, either.

Overall, the analysis using the DCOT report suggests that the classical type of speculators, such as hedge funds or floor traders, stabilize commodity markets and improve market quality. These traders seem to be informed traders, who provide liquidity and risk-bearing capacity for hedgers. Furthermore, the analysis partially indicates that swap dealers are the type of traders who destabilize the spot market. Swap dealers usually offer their clients an over-the-counter (OTC) product that mimics some futures-based index. The swap dealers are thus implicitly short in futures contracts arranged by an OTC, and hedge with an offsetting long position on organized exchanges that are reported to the CFTC. If the swap dealer trader type destabilizes the commodity markets, it is possible that index traders similarly destabilize the commodity markets. To assess this possibility, I conduct additional analysis using the CIT report.

The CIT report is available only for selected agricultural commodities beginning in 2006. In Panel A of Table 9, I report the effects of futures trading on spot volatility for index traders, nonindex speculators, and commercial traders (hedgers) groups. The net effects of index traders on spot volatility are all negative or insignificant, indicating that the futures trading of this trader type does not destabilize the spot price. Instead, the destabilizing effect of swap dealers reported in the previous section seems to be driven by the nonindex traders included in the swap dealer category.

In Panels B and C of Table 9, I report the effect of index traders on market quality using methods similar to those I have used in the previous analysis. The net effects of index traders on liquidity and short-term price efficiency are all negative or insignificant, indicating that index traders in the futures market do not lower market quality in the agricultural commodity market. This result is consistent with the findings of recent studies that document that index traders do not cause price effects in the agricultural commodity market (Stoll and Whaley, 2010; Irwin and Sanders, 2012b; Irwin and Sanders, 2012c; Brunetti et al., 2013). The findings that index traders do not destabilize the commodity markets seem to be robust to different methods among studies, including mine.

The analysis using the DCOT and CIT reports suggests that certain types of speculators, such as hedge funds and floor traders, have a stabilizing effect on the commodity market. Additionally, I find no evidence that index traders in the agricultural market destabilize commodity prices. Instead, I find that index traders in the futures market lower volatility and sustain market quality. This finding is important because it is popular perception that index traders make commodity prices too volatile.

Overall, using several publicly available position data from the CFTC, I find strong evidence that speculators lower price volatility in the commodity market. In addition, I show that speculators do not lower price efficiency, nor do they reduce liquidity, supporting the stabilizing theories of futures speculation. The results presented here are consistent with the analysis on price changes in the previous section that futures speculation is not related to large price changes. In addition, my empirical findings suggest that more detailed data on commodity futures trading can provide useful information about the effects of different types of traders on the commodity market.

6. Conclusion

In this paper, I assess whether futures speculation destabilizes the commodity market. I study periods during which prices rose or fell substantially, and assess in a cross-sectional analysis whether the magnitude of price changes is related to changes in speculative positions. As a sharp contrast to the public perception that speculators cause higher commodity prices, I find no such evidence. My analysis indicates that speculators either have no effect or dampen prices during periods of large price movement. Speculators seem to sell during periods of large price appreciation, consistent with the interpretation that speculators' trades dampen rather than accentuate price increases.

I show that speculators in the futures market contribute to reducing spot price volatility, supporting the results of existing literature that futures trading activity stabilizes the spot markets. Contrary to the popular belief that increased futures speculation has been destabilizing the commodity market in the most recent decade, my findings show that speculators have a stronger stabilizing effect on commodity markets during the financialization periods.

In the analysis on market quality, I find that speculators provide liquidity and support short-term price efficiency in the commodity market, providing strong supporting evidence that speculators in the futures market benefit the commodity market. In addition, using detailed position data available from the CFTC, I document that more traditional types of speculators and index traders have a stronger stabilizing effect on the commodity market during the recent decade.

Finally, my study details useful policy implications. Recent policy changes aim to regulate speculative trading in the futures market to bring order to the commodity markets. My analysis suggests that these regulatory changes would not effectively reach the goal. In future research, I plan to extend my analysis to investigate the fundamental forces that drive commodity price fluctuations.

Appendix

In this section, I discuss in detail the results of GARCH (1,1) estimation reported in Section 4.2, and provide the complete estimation result for Crude Oil. The results reveal that the effects of futures trading activities and other conditioning variables on spot volatility are heterogeneous among the commodities, which is consistent with previous studies documenting that commodity futures are distinct from each other (Erb and Harvey, 2006; Gorton and Rouwenhorst, 2006). There are some common features, though. In the conditional mean equation, changes in the open interest are significant and positive in almost all commodity markets in all sample periods. Karpoff (1987) documents a positive relation between price changes and trading volume changes. Hong and Yogo (2012) also report the growth in open interest as a strong predictor of commodity returns. Inflation has significant effects for energy markets; however, these effects are not significant for most of the agricultural commodities. The changes in inventory are not significant in most cases, either.

In the conditional volatility equation, the estimated coefficient for future volume is positive for almost all commodities, consistent with the findings in Bessembinder and Seguin (1993). Also, the coefficients on nonreportables are always negative or insignificant for all commodities. I expected the changes in supply and inventory to lower spot volatility, but there is no clear pattern in these variables across commodities. Compared with agricultural commodities, macroeconomic variables are more significant for energy commodities, but this is expected because energy commodities are inputs for production, which is closely related to the overall economic condition. The negative sign of the macroeconomic variables implies that lower demand for commodities is negatively related to spot volatility in the commodity market. Although not reported, the seasonable dummy variables are significant for most energy and agricultural commodities that have different seasonal demand and harvest cycles.

In Table 10, I report the GARCH estimation result for Crude oil for the full sample periods and two-subsample periods.

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Table 1 Information on Commodity Prices and Commodity Futures

This table provides information on commodities and their futures contracts. Panel A presents futures contract specifications, Panel B reports commodity price information for the full sample period and two subsample periods, and Panel C display the market share for each commodity futures contract. Panel B and Panel C display 15 commodities that have inventory data. The data span from October, 1992 to July, 2012. For natural gas futures, price data are available from November, 1993, and for lean hogs futures, the COT report starts in April, 1996. In Panel A, * indicates commodities with inventory data. The market share of speculators in the commodity futures market is calculated as the gross speculative position divided by twice the total open interest.

Panel A: Futures contract specifications

Contract	Contract Size	Contract Months	Exchange
Energy			
Crude Oil*	1,000 Bbl	All	CME
Heating Oil*	42,000 Gal	All	CME
Gasoline*	42,000 Gal	All	CME
Natural Gas*	10,000 Mmbtu	All	CME
Grain			
Wheat*	5,000 Bushels	3,5,7,9,12	CME
Soybean*	5,000 Bushels	1,3,5,7,8,9,11	CME
Corn*	5,000 Bushels	3,5,7,9,12	CME
Kansas Wheat*	5,000 Bushels	3,5,7,9,10	CME
Soybean Oil	60,000 Pounds	1,3,5,7,8,9,10,12	CME
Soybean Meal	100 Tons	1,3,5,7,8,9,10,12	CME
Soft			
Cocoa*	10 Metric tons	3,5,7,9,12	ICE
Coffee*	37,500 Pounds	3,5,7,9,12	ICE
Cotton*	50,000 Pounds	3,5,7,10,12	ICE
Sugar*	112,000 Pounds	3,5,7,10	ICE
Livestock			
Feeder Cattle*	50,000 Pounds	1,3,4,5,8,9,10	CME
Lean Hogs*	40,000 Pounds	2,4,5,7,8,10,12	CME
Live Cattle*	40,000 Pounds	2,4,6,8,10,12	CME
Metal			
Gold	100 Troy oz.	2,4,6,8,10,12	CME
Silver	5,000 Troy oz.	1,3,5,7,9,12	CME
Copper	25,000 Pounds	3,5,7,9,12	CME
Platinum	50 Troy oz.	1,4,7,10	CME

Table 1 Continued

Panel B: Information on Commodity Prices

	Full Sample		Pre-2003		Post-2003	
	Mean	Stdev	Mean	Stdev	Mean	Stdev
Crude Oil	44.01	29.71	21.22	5.22	68.97	25.05
Heating Oil	1.25	0.87	0.58	0.15	1.96	0.76
Gasoline	1.24	0.83	0.61	0.15	1.93	0.71
Natural Gas	4.34	2.44	2.75	1.30	5.87	2.31
Wheat	404.41	156.68	325.96	82.18	488.56	173.09
Soybean	738.36	278.95	580.29	113.64	907.84	303.14
Corn	318.92	142.27	254.10	64.36	373.53	166.40
Kansas Wheat	472.32	176.56	375.72	88.02	575.81	188.59
Cocoa	1.966.62	741.23	1,487.17	318.85	2,480.77	720.05
Coffee	137.38	61.74	122.97	52.12	153.45	67.14
Cotton	64.53	24.49	62.74	17.16	67.08	30.30
Sugar	13.16	6.56	10.13	2.40	16.41	7.92
Feeder Cattle	98.45	20.08	84.62	11.59	113.21	16.37
Lean Hogs	56.78	15.48	46.93	10.17	67.27	13.08
Live Cattle	80.11	15.64	68.20	5.64	92.81	12.60

Panel C: Speculators Market Share in Commodity Futures

	Full Sample	Pre-2003	Post-2003
Crude Oil	0.24	0.13	0.35
Heating Oil	0.17	0.11	0.24
Gasoline	0.18	0.13	0.23
Natural Gas	0.30	0.11	0.48
Wheat	0.32	0.27	0.36
Soybean	0.29	0.25	0.32
Corn	0.25	0.19	0.30
Kansas Wheat	0.20	0.13	0.28
Cocoa	0.23	0.18	0.29
Coffee	0.31	0.24	0.35
Cotton	0.26	0.22	0.31
Sugar	0.20	0.15	0.26
Feeder Cattle	0.35	0.31	0.38
Lean Hogs	0.34	0.28	0.39
Live Cattle	0.31	0.24	0.38

Table 2 The Effect of Futures Speculation on Commodity Price Changes

This table reports the effect of futures speculation on commodity price changes (β in Eq. (1)). Panel A reports the cross-sectional analysis of the 5-, 10-, and 20-week intervals for all commodities when prices increase by at least 10% and 20% for all commodities and commodities with inventory data. Panel B reports the cross-sectional analysis of the 5-, 10-, and 20-week intervals for all commodities when prices decrease by at least 10% and 20% or all commodities and commodities with inventory data. Panel C reports the analyses for energy and agricultural commodities when prices change by at least 10% during the 5-, 10-, and 20-week intervals. %ΔTotal position is the % changes speculators aggregate futures position, %ΔLong position is the % changes of the speculators' long position, and %Δ Short position is the % changes of the speculators' short positions.

Panel A: The Effect of Futures Speculation on Price Increases

	5-week intervals		10-week intervals		20-week intervals	
	10% increase	20% increase	10% increase	20% increase	10% increase	20% increase
All Commodities						
%ΔTotal Position	−0.083	−3.356**	−0.052	−2.716*	−2.389***	−7.180***
%ΔLong Position	−0.035	−4.221**	0.312	−0.282	−0.110	−2.868***
%ΔShort Position	0.376	0.516	0.804	3.802	−0.986	2.686
Commodities with Inventory Data						
%ΔTotal Position	−0.317	−7.746	−0.006	−2.944	−2.396***	−8.708**
%ΔLong Position	−0.233	−3.763*	0.397	0.438	−1.316	−2.698*
%ΔShort Position	0.549	4.036	0.836	2.927	−0.893	0.605

Table 2 Continued

Panel B: The Effect of Futures Speculation on Price Decreases

	5-week intervals		10-week intervals		20-week intervals	
	10% decrease	20% decrease	10% decrease	20% decrease	10% decrease	20% decrease
All Commodities						
%ΔTotal Position	0.719	−0.633	1.021	2.371	1.957	3.604
%ΔLong Position	−0.345	3.404	0.826	2.480	0.698*	1.499
%ΔShort Position	0.292***	−2.159	0.005	−0.018	−0.106	0.119
Commodities with Inventory Data						
%ΔTotal Position	−0.125	−1.834	0.543	1.575	−1.070	−0.298
%ΔLong Position	−0.947	0.736	1.166	0.942	1.140	−0.914
%ΔShort Position	0.382*	0.947	−0.034	−0.021	−0.095	0.737

Panel C: The Effect of Futures Speculation on Price Changes for Commodity Specific Regression

	10% increase			10% decrease		
	5-week	10-week	20-week	5-week	10-week	20-week
Energy						
%ΔTotal Position	−1.013*	−1.126**	−2.705*	0.654	1.715	2.823
%ΔLong Position	−0.830	−1.363*	−0.227	1.432	1.826	5.520
%ΔShort Position	−0.329	3.405	1.457	0.344	−0.172	−0.074
Agriculture						
%ΔTotal Position	−0.166	0.021	−0.187**	1.122	1.138	2.030
%ΔLong Position	−0.382	−0.075	−0.141	0.934	0.649	1.398
%ΔShort Position	2.089	0.446	−0.441	0.147	0.724	0.758

Table 3 The Effect of Futures Speculation on Spot Volatility

This table reports the net effect of futures speculation on spot volatility. The sample period is from October, 1992 to July, 2012, except for natural gas, for which the data start in November, 1993; lean hogs, for which the Commitments of Traders (COT) report starts in April, 1996; and coffee, for which the inventory data start in 1997. The net effect of speculators' and hedgers' positions is calculated by multiplying the coefficient of each partitioned trading activity by its mean value. The bold numbers indicate the statistical significance of the net effect for each trader type.

	Speculators			Hedgers		
	Full Sample	Pre-2003	Post-2003	Full Sample	Pre-2003	Post-2003
Crude Oil	**−12.348**	**−5.213**	**−22.360**	−0.423	**2.432**	4.414
Heating Oil	**−11.491**	**−6.905**	**−18.184**	-3.334	**10.557**	**−7.359**
Gasoline	**−8.574**	**−6.423**	**−14.130**	−0.145	3.816	−5.354
Natural Gas	**−1.055**	**−24.358**	**−23.792**	**12.128**	**13.017**	36.999
Wheat	**−5.767**	**−12.369**	**12.679**	1.812	**8.412**	1.565
Soybeans	**−7.768**	**4.648**	**−22.650**	−6.526	**−11.214**	5.601
Corn	**10.816**	**−10.174**	**−22.946**	**8.463**	8.739	**17.434**
Cotton	**−3.712**	−0.580	**−9.310**	**1.961**	0.336	**7.357**
Kansas Wheat	**−2.033**	**−4.048**	−1.001	3.707	5.382	**14.995**
Cocoa	**−4.375**	**3.736**	**−9.000**	−1.636	0.725	−5.140
Coffee	**−9.431**	**−5.092**	**−17.059**	−2.723	6.727	−4.341
Sugar	−2.017	−2.086	**−24.864**	−5.223	4.111	**21.353**
Lean Hogs	6.472	6.607	−0.069	−5.920	**−11.494**	9.220
Live Cattle	**15.189**	**12.885**	−9.214	**−26.396**	**−18.729**	**−13.994**

Table 4 The Effect of Futures Speculation on Liquidity

This table reports the effect of futures speculation on liquidity. Weekly nonoverlapping Roll's (1984) liquidity measure is used to calculate liquidity. The sample period is from October, 1992, to July, 2012, except for natural gas, for which the data start in November, 1993; lean hogs, for which the Commitments of Traders (COT) report starts in April, 1996; and coffee, for which the inventory data start in 1997. The net effect of speculators' and hedgers' positions is calculated by multiplying the coefficient of each partitioned trading activity by its mean value. The bold numbers indicate the statistical significance of the net effect.

	Speculators			Hedgers		
	Full Sample	Pre-2003	Post-2003	Full Sample	Pre-2003	Post-2003
Crude Oil	**−3.256**	0.883	−0.715	4.952	**−0.439**	0.897
Heating Oil	0.044	−0.062	0.116	**−0.148**	−0.024	−0.188
Gasoline	−0.032	−0.193	0.020	0.000	**0.187**	0.047
Natural Gas	0.288	−4.401	−6.489	−0.238	**1.502**	15.174
Wheat	1.174	**−26.235**	−0.971	−5.529	19.470	−3.735
Soybeans	−6.834	−1.929	**−19.574**	4.293	−1.124	**21.221**
Corn	**−3.798**	−1.531	0.610	3.431	**−1.005**	**9.152**
Cotton	**−3.874**	−2.137	−3.196	5.197	0.448	**12.667**
Kansan Wheat	**0.678**	0.622	0.634	−1.070	−1.550	**−0.338**
Cocoa	**9.684**	**9.044**	2.582	**−2.285**	−7.051	**−4.002**
Coffee	**−2.392**	−1.625	**−2.865**	**2.889**	1.373	**4.155**
Sugar	−1.637	−0.639	−3.614	**1.945**	−0.399	**5.361**
Lean Hogs	0.327	2.722	0.893	**0.133**	**−2.953**	0.091
Live Cattle	2.019	0.914	**−11.607**	−2.073	−3.411	9.338

Table 5 The Effect of Futures Speculation on Short-term Price Efficiency

This table reports the effect of futures speculation on liquidity. The absolute value of (1-variance ratio) is used to calculate the short-term price efficiency. The sample period is from October, 1992, to July, 2012, except for natural gas, for which the data start in November, 1993; lean hogs, for which the Commitments of Traders (COT) report starts in April, 1996; and coffee, for which the inventory data start in 1997. The net effect of speculators' and hedgers' positions is calculated by multiplying the coefficient of each partitioned trading activity by its mean value. The bold numbers indicate the statistical significance of the net effect.

	Speculators			Hedgers		
	Full Sample	Pre-2003	Post-2003	Full Sample	Pre-2003	Post-2003
Crude Oil	0.288	0.883	−0.715	−0.232	**−0.439**	0.897
Heating Oil	0.229	**0.978**	−1.155	**0.624**	**0.085**	**0.889**
Gasoline	0.064	−0.980	−1.315	0.205	**1.633**	1.096
Natural Gas	0.288	**−0.450**	−0.615	−0.226	−0.445	0.897
Wheat	**1.070**	1.510	0.676	**−0.798**	**−0.912**	−0.984
Soybeans	0.840	1.072	8.670	−0.481	−0.106	−0.618
Corn	**−0.137**	0.353	−0.345	−0.172	**−1.641**	1.173
Cotton	**0.603**	**1.017**	1.161	−0.545	−0.850	−0.217
Kansan Wheat	1.031	0.102	**−2.634**	−2.643	−3.353	−5.251
Cocoa	0.505	**0.356**	0.034	−0.356	0.047	0.144
Coffee	−0.732	0.676	−0.586	1.105	0.731	1.522
Sugar	−0.138	0.277	−1.446	1.462	−0.280	1.537
Lean Hogs	0.338	0.139	0.893	0.287	0.047	0.091
Live Cattle	−0.261	**−0.768**	0.036	**1.722**	**2.828**	**1.546**

Table 6 The Effect of Futures Trading on Spot Volatility by Trader Type

This table reports the net effect of futures speculation on spot volatility by trader type. The sample period is from June, 2006, to July, 2012. The net effect of each trader type is calculated by multiplying the coefficient of each partitioned trading activity by its mean value. The bold numbers indicate the statistical significance of the net effect.

	Product Merchant	Swap Dealers	Money Managers	Other Reportables
Crude Oil	**−12.682**	**30.103**	**−26.626**	**−7.665**
Heating Oil	0.828	**11.214**	**−51.588**	−3.984
Gasoline	**−0.543**	**21.088**	−7.481	**−9.520**
Natural Gas	**109.850**	**56.231**	−26.941	**7.231**
Wheat	3.785	**3.739**	**−11.032**	**−24.121**
Soybeans	−0.323	1.960	−22.207	**54.232**
Corn	**−81.368**	**−139.119**	**143.098**	**91.567**
Kansas Wheat	**−20.011**	1.296	**−5.854**	**−9.969**
Cocoa	**−1.984**	9.773	**−44.646**	**−30.043**
Cotton	−6.184	7.575	**−26.152**	**4.937**
Coffee	16.417	−4.905	**−1.177**	**−14.305**
Sugar	14.319	**33.587**	**−48.546**	−11.410
Lean Hogs	0.747	4.323	**−13.152**	13.296
Live Cattle	0.060	8.515	−21.994	**2.156**

Table 7 The Effect of Futures Trading on Liquidity by Trader Type

This table reports the net effect of futures speculation on liquidity by trader type. Weekly nonoverlapping Roll's (1984) liquidity measure is used to calculate liquidity. The sample period is from June, 2006, to July, 2012. The net effect of each trader type is calculated by multiplying the coefficient of each partitioned trading activity by its mean value. The bold numbers indicate the statistical significance of the net effect.

	Product Merchant	Swap Dealers	Money Managers	Other Reportables
Crude Oil	−11.291	**46.130**	**−5.445**	**−16.882**
Heating Oil	**0.647**	0.000	0.055	−0.268
Gasoline	0.321	−0.231	0.146	−0.020
Natural Gas	**18.176**	**−6.738**	0.346	**−8.442**
Wheat	5.526	16.565	**−8.466**	−5.563
Soybeans	74.157	−44.668	−13.213	**−17.167**
Corn	**10.979**	−10.172	24.771	−13.653
Kansas Wheat	3.682	5.542	−8.402	−8.800
Cocoa	3.287	−3.154	**−6.655**	−3.046
Cotton	12.227	−9.406	−5.199	−0.350
Coffee	21.727	13.131	−6.732	**−21.013**
Sugar	−6.505	**13.417**	**−10.280**	−1.022
Lean Hogs	**12.323**	**−19.651**	8.697	**9.688**
Live Cattle	**−2.323**	**5.465**	−4.358	**−17.694**

Table 8 The Effect of Futures Trading on Price Efficiency by Trader Type

This table reports the net effect of futures speculation on liquidity by trader type. The absolute value of (1-variance ratio) is used to calculate the short-term price efficiency. The sample period is from June, 2006, to July, 2012. The net effect of each trader type is calculated by multiplying the coefficient of each partitioned trading activity by its mean value. The bold numbers indicate the statistical significance of the net effect.

	Product Merchant	Swap Dealers	Money Managers	Other Reportables
Crude Oil	1.405	0.096	0.919	0.286
Heating Oil	**5.715**	**−2.016**	**−0.419**	−0.915
Gasoline	1.198	0.121	0.382	−0.737
Natural Gas	−8.641	−2.595	**−10.127**	21.803
Wheat	−6.487	−5.591	4.846	13.098
Soybeans	0.970	−2.940	1.471	−0.485
Corn	**11.253**	6.314	−5.370	−12.644
Kansas Wheat	−2.356	0.874	0.921	0.884
Cocoa	0.624	1.615	**−3.322**	0.122
Cotton	−1.602	1.570	−0.848	**1.071**
Coffee	−2.017	1.628	−1.562	2.026
Sugar	−1.243	**0.732**	0.335	1.592
Lean Hogs	−0.023	0.055	−0.776	**3.390**
Live Cattle	**2.693**	−0.208	0.812	**−3.123**

Table 9 Analysis Using the CIT Reports

The table reports the effect of futures trading activity by trader types on volatility, liquidity, and short-term efficiency using the CIT report. The sample period is from January, 2006, to July, 2012.

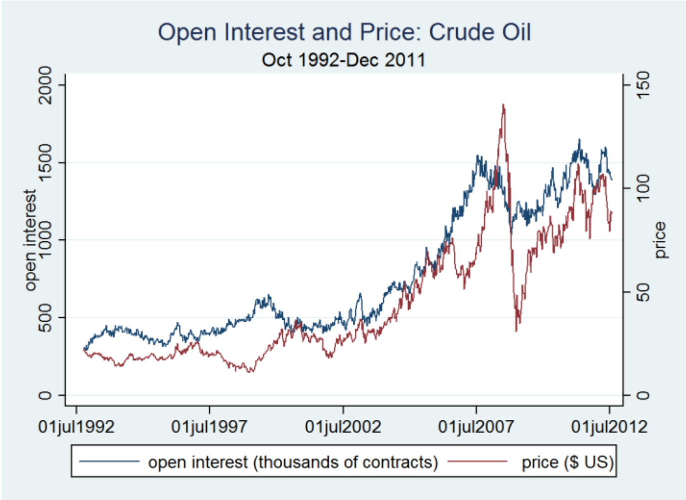
	Index Traders	Speculators	Hedgers
Panel A: The Effect on Spot Volatility			
Wheat	−5.193	**13.587**	**−11.369**
Soybeans	**−14.668**	17.179	−4.822
Corn	−10.351	−1.806	2.619
Kansas Wheat	1.436	**−18.600**	**17.825**
Cocoa	−9.031	18.934	−4.038
Cotton	**−42.646**	8.723	15.983
Coffee	**−2.600**	**−6.802**	5.408
Sugar	**−3.046**	**56.621**	**−29.744**
Lean Hogs	**−5.157**	3.691	4.683
Live Cattle	4.226	−20.034	6.175
Panel B: The Effect on Liquidity			
Wheat	18.906	1.148	**−9.697**
Soybeans	−1.513	**6.577**	**−3.571**
Corn	2.347	16.288	−1.714
Kansas Wheat	**−1.336**	−3.709	−4.139
Cocoa	0.069	2.587	−4.371
Cotton	**−3.394**	0.629	**1.961**
Coffee	7.659	**−32.627**	34.496
Sugar	−1.011	**27.084**	**−25.514**
Lean Hogs	−4.039	5.300	**10.028**
Live Cattle	1.159	**−18.053**	**23.158**
Panel C: The Effect on Short-term Price Efficiency			
Wheat	−2.065	−3.200	−0.012
Soybeans	**−1.064**	0.013	−1.656
Corn	1.147	1.481	0.084
Kansas Wheat	1.132	1.033	**0.954**
Cocoa	**−2.533**	**−4.176**	1.521
Cotton	1.657	1.493	**−2.292**
Coffee	0.173	0.941	−1.361
Sugar	0.227	1.087	−0.203
Lean Hogs	1.301	**3.011**	−0.418
Live Cattle	**−1.253**	−0.623	2.220

Table 10 GARCH (1,1) Estimation Result for Crude Oil

In this table, I report the GARCH (1,1) estimation results for Crude Oil. *MA* stands for long-term variation in the positions of each trader type. *ΔOpen Interest* is the daily change in open interest. *ΔInventory* and *ΔSupply* are the changes in the commodity inventory and commodity production level, respectively, using available data with the highest frequency. *Futures Volume* is the natural log of daily future volumes, and *Nonreportables* is the natural log of nonreportable positions. Inflation and Production Growth are monthly measures, and *GDP* is quarterly growth rate calculated with data obtained from the Federal Reserve Economic Data (FRED). *DTE* is the square root of days to expiration. ***, **, and * stand for statistical significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample	Pre-2003	Post-2003
Conditional mean			
AR(1)	-0.077^{***}	-0.087^{***}	-0.097^{***}
ΔOpen interest	0.187^{***}	0.120^{***}	0.245^{***}
ΔInventory	−0.010	-0.037^{*}	0.086^{**}
Inflation	0.344^{***}	−0.013	0.402^{**}
Constant	0.073	0.081	0.118
Conditional variance			
Arch	0.111^{***}	0.131^{***}	0.088^{***}
Garch	0.093^{*}	0.146^{***}	0.286^{***}
Speculators			
Expected	-4.292^{**}	−0.490	−0.755
Unexpected	-1.388^{*}	−0.600	-4.822^{*}
MA	-0.986^{***}	-0.449^{**}	-1.657^{***}
Hedgers			
Expected	-4.292^{***}	−0.442	−0.854
Unexpected	−0.031	-5.306^{***}	−1.258
MA	−0.423	0.183	0.315
Futures Volume	1.562^{***}	2.262^{***}	1.529^{***}
Nonreportables	-0.554^{***}	−0.160	-0.815^{***}
ΔSupply	0.010^{*}	0.015^{*}	0.013^{*}
ΔInventory	0.022	0.049	−0.013
GDP	−0.043	0.410^{***}	-0.508^{***}
Production Growth	-0.320^{***}	-0.186^{*}	-0.292^{***}
Inflation	-0.385^{***}	0.059	−0.029
DTE	0.137^{***}	0.213^{***}	0.081
Constant	0.947	-22.019^{***}	9.347^{**}

Panel A



Panel B

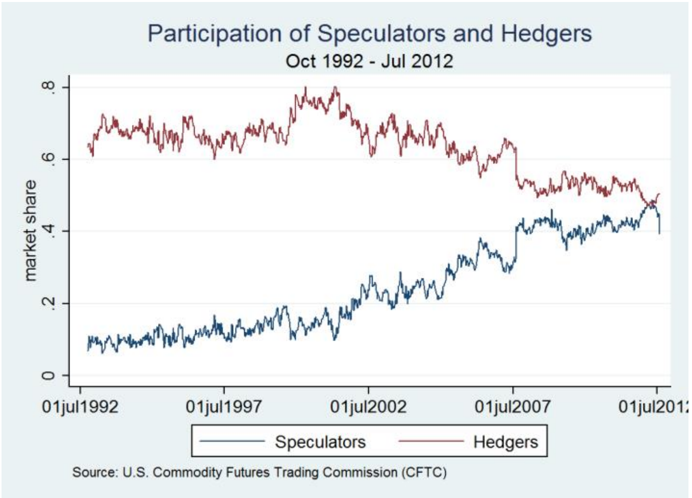


Figure 1 Market Structure for Crude Oil

Figure 2.1 describes the market structure for crude oil spot price and crude oil futures. Panel A displays the time series of spot price and total open interest. Panel B presents the time series of market share of speculators and hedgers in the crude oil futures market.