Convective Risk Flows in Commodity Futures Markets

Ing-Haw Cheng[†], Andrei Kirilenko[‡], and Wei Xiong[§]

December 2012

Abstract

This paper analyzes the joint responses of commodity futures prices and traders' futures positions to changes in the VIX before and after the recent financial crisis. We find that while financial traders accommodate the needs of commercial hedgers in normal times, in times of distress, financial traders reduce their net long positions in response to an increase in the VIX causing the risk to flow to commercial hedgers. By exploiting a cross-section of traders, we provide micro-level evidence for a convective flow of risk from distressed financial traders to commercial hedgers. The presence of such risk convection confirms the market impact of financial traders conditional on trades initiated by them and motivates an extension of the long-standing hedging pressure theory of commodity futures markets to incorporate time-varying risk capacities of financial traders.

JEL Classification: G12, G01, G20, G14

For helpful comments and encouragement, the authors would like to thank Bob Hodrick, Michael Johannes, Uday Rajan, Ken Singleton, Moto Yogo, and seminar participants at Columbia University, European Central Bank, the Federal Reserve Board, Fordham University, NBER Summer Institute, and Princeton University for helpful comments and discussions. We thank Matt Baron and Philip Yan for research assistance. We are especially grateful to David Hirshleifer and two anonymous referees for constructive comments and suggestions. Xiong acknowledges financial support from Smith Richardson Foundation grant #2011-8691. The views expressed in this paper are our own and do not constitute an official position of the Commodity Futures Trading Commission, its commissioners or staff.

[†] Ross School of Business, University of Michigan, Ann Arbor, MI 48103, e-mail: ingcheng@umich.edu, http://webuser.bus.umich.edu/ingcheng.

[‡] Commodity Futures Trading Commission (CFTC), Washington, DC 20581, e-mail: akirilenko@cftc.gov.

[§] Department of Economics and Bendheim Center for Finance, Princeton University, Princeton, NJ 08540, e-mail: wxiong@princeton.edu, http://www.princeton.edu/~wxiong.

Commodity futures markets have a long history of facilitating the needs of producers and users of physical commodities to hedge commodity price risk in their commercial activity. The long-standing hedging-pressure theory, which was initially proposed by Keynes (1930) and Hicks (1939) and further developed by Hirshleifer (1988), emphasizes that commercial hedgers, who are typically net short in the commodity futures market, offer premia to attract other participants to take the long side. However, Figure 1 offers a striking observation regarding the open interest of futures contracts written on corn, soybeans, live cattle and cotton during the recent financial crisis—open interest collapsed by as much as 50% just when the VIX Volatility Index was spiking.[1] This suggests that just when the uncertainty in the economy was rising, the number of futures contracts used by commercial hedgers to hedge their risks was going down. Furthermore, after September 2008, open interest in the commodity futures fluctuated like the reverse image of the VIX. A full account of this puzzling phenomenon requires not only understanding hedging behavior, but also the behavior of financial traders, who take the other (long) side.

The traditional hedging pressure theory takes the capacity of financial traders as given. However, a growing body of theoretical work (e.g., Shleifer and Vishny 1997; Kyle and Xiong 2001; Gromb and Vayanos 2002; Brunnermeier and Pedersen 2009; He and Krishnamurthy 2009; and Danielsson, Shin, and Zigrand 2010) highlights that at times, especially during financial crises, funding and risk constraints may force financial traders to unwind positions across their holdings. The liquidation can exacerbate a crisis and cause synchronized price fluctuations across different asset markets. According to this distressed financials theory, financial distress can cause financial traders to reduce their positions in commodity futures, which, in turn, forces hedgers to reduce their hedging positions.

This paper examines whether risk was systematically re-allocated among participants of commodity futures markets in response to changes in VIX during the recent crisis. Our analysis builds on a simple theoretical framework that integrates the traditional hedging pressure theory with the aforementioned distressed financials theory. The former theory emphasizes that an increase in the VIX may incentivize hedgers to increase their short hedging positions, while the latter highlights that the VIX increase induces financial traders to reduce their long positions. In

[1] The VIX, a commonly used measure of the implied volatility of S&P 500 index options, is widely recognized as an important forward-looking indicator of uncertainty faced by financial market participants.

equilibrium, the direction of the resulting risk flow reflects which side has the greater exposure. Like the convection of a current of air that flows from a high-pressure area to a low-pressure area, a "risk convection" makes the risk flow from the more distressed groups to the less distressed groups. We test the direction of the convective risk flow by examining the joint dynamics of commodity futures prices and the traders' positions in response to changes in the VIX.

We identify account-level data on each trader's positions in commodity futures markets by making use of the Commodity Futures Trading Commission's (CFTC's) Large Trader Reporting System (LTRS) database. By regulation, when a trader's position in a commodity futures contract becomes larger than a certain threshold, clearing members are obligated to report the trader's end-of-day positions in the commodity to the CFTC. The reportable traders in the LTRS account for 70%-90% of open interest in any given commodity futures contract. Based on each trader's registration with the CFTC and its positions in the LTRS database, we classify the trader as a commercial hedger, a hedge fund, a commodity index trader (CIT), or another category. Hedge funds and CITs are the two major groups of financial traders. Hedge funds typically exploit price divergences across different futures contracts for the same commodity or among multiple commodities; while CITs, a new class of traders that emerged during the mid-2000s, tend to be long-only portfolio investors who treat commodity futures as a new asset class among more traditional asset classes, such as stocks and bonds.

Our baseline analysis examines the aggregated position response of CITs, hedge funds, and commercial hedgers to changes in the VIX. We find that after September 2008, both CITs and hedge funds displayed immediate significant and negative position responses to increases in the VIX in a large number of commodity futures markets. Commercial hedgers took the other side and displayed a positive position response to increases in the VIX, meaning they tended to reduce their net short positions just as uncertainty was rising. The increases in the VIX were also accompanied by significant price drops in almost all commodity futures. The pattern of position changes indicates a convective flow of risk from financial traders towards commercial hedgers and thus greater exposures of financial traders to the VIX. In contrast, prior to September 2008, neither financial traders nor commercial hedgers exhibited significant responses to the VIX.

By exploiting the cross-section of traders within different trader groups, we also provide additional empirical evidence in support of the greater exposures of financial traders. First, we find that CITs with larger CDS spreads were more sensitive to changes in the VIX. We interpret this finding as further direct support of the link between the financial distress of CITs and reductions in their futures positions. Second, we find that in response an increase in the VIX net short hedgers bought commodity futures, while net long hedgers did not reduce their positions or even bought commodity futures. We interpret this evidence as confirming that the VIX increase did not drive greater incentives for hedgers to hedge than for financial traders to reduce their positions. Taken together, the empirical evidence shows that during the financial crisis, in response to a spike in the VIX, financial traders consumed liquidity from commercial hedgers instead of providing liquidity to facilitate the hedging needs of commercial hedgers.

We also provide evidence to show that the trades induced by the VIX changes between financial traders and hedgers were not due to potential informational advantage of financial traders. Our results are robust to including various controls. To show our results do not rely on our use of the CFTC's proprietary LTRS data, we also reconfirm similar convective flows in positions of different trader groups covered by the CFTC's public Commitment of Trader reports.

Our analysis contributes to the ongoing debate on the financialization of commodity futures markets. The growing presence of financial traders in these markets together with episodes of large price volatility stimulated a heated, ongoing debate regarding whether the trading of financial traders affects commodity futures prices (e.g., Tang and Xiong 2010; Buyuksahin and Robe 2010; Stoll and Whaley 2010; Hamilton and Wu 2011; Irwin and Sanders 2011; and Singleton 2011). In particular, a commonly test used in the extant literature is to examine whether the correlation between financial traders' futures position change and futures price change is positive. This test, while intuitively appealing, ignores the different reasons for financial traders to trade in commodity futures markets. When they trade to accommodate hedgers (as posited by the traditional hedging pressure theory), their position change is negatively correlated with futures price change. On the other hand, when they trade in response to their own financial distress (as emphasized by the distressed financials theory), their position change is positively correlated with futures price change. By netting out these two offsetting effects, the unconditional correlation between their position change and price change has an ambiguous sign, which helps explain the lack of any significant correlation between the position changes of CITs and futures prices in the data. By conditioning on VIX shocks during the recent crisis, our analysis sorts out trades initiated by CITs and hedge funds and demonstrates their price impacts as a result of their own financial distress.

Our results also add to the broader finance literature on the market impact of distressed financial institutions. This literature offers limited micro-level evidence. Mitchell, Pedersen, and Pulvino (2007) describe two episodes in which specialized arbitrageurs lost significant amounts of capital in convertible bond markets and, as a result, turned from liquidity providers to liquidity consumers. Adrian and Shin (2009) document cyclical leverage and balance sheets of financial brokers and dealers. He, Khang, and Krishnamurthy (2010) document the reallocation of mortgage-backed securities during the recent financial crisis from institutions dependent on repo financing, such as hedge funds and broker-dealers, to institutions with more secured financing, such as commercial banks. Equipped with detailed end-of-day position data for almost all participants in the commodities futures markets, we not only examine the position changes of financial institutions, but simultaneously examine position changes of commercial hedgers, who, we find, facilitated the reduction in positions of financial institutions. The latter establishes a channel for distressed financial institutions to transmit systemic risk to the commodity markets and impact the real economy.

Taken together, our results motivate the need to expand the long-standing hedging pressure theory of commodity futures markets with additional considerations of potential financial distress of financial traders. This theme echoes that of several earlier studies. Tang and Xiong (2010) argue that the increasing presence of index traders in commodity futures markets improves risk sharing in these markets at the expense of having volatility spillover from outside markets. Etula (2010) emphasizes the risk-bearing capacity of securities brokers and dealers as an important determinant of risk premia and return volatility in commodities markets. Acharya, Lochstoer, and Ramadorai (2010) show that decreases in financial traders' risk capacity lead to increases in hedgers' hedging cost.

The paper is organized as follows. Section 1 introduces a theoretical framework and discusses our empirical designs. Section 2 describes the data. In Section 3, we provide summary information on participation of different trader groups across different commodity futures markets. Section 4 examines the joint responses of futures prices and traders' positions to VIX changes across a set of commodity futures markets. Section 5 concludes the paper. We also provide an Online Appendix to report additional data description and empirical results.

1. Theories and Empirical Designs

This section provides a theoretical framework to highlight convective risk flows in commodity futures markets by integrating the longstanding hedging pressure theory with the distress financials theory. We then discuss designs of our empirical analysis.

1.1 A theoretical framework

The hedging pressure theory emphasizes that hedgers short sell commodity futures to hedge the inherent commodity price risk in their business operations. By taking the other side of hedgers' short positions, financial traders share their risk and dampen the impact of their risk exposures on commodity futures prices. The distressed financial institution theory highlights that at times, and especially during financial crises, funding and risk constraints may cause financial traders to voluntarily or involuntarily liquidate their futures positions. As hedgers now need to take the other side of financial traders' liquidation, risks flow back to hedgers. Our analysis focuses on testing such convective risk flows during the recent financial crisis. This section provides a simple, theoretical framework to integrate the hedging pressure theory and the distressed financials theory, and, in particular, to highlight convective risk flows.

Consider a futures market with 2 groups of participants, a group of hedgers and another group of financial traders. The two groups trade a futures contract written on a commodity. We consider only one period (possibly out of many periods in a more general model), during which random shocks cause the two groups of traders to change their positions. In particular, we specify the following demand curves for the two groups:

$$dx_h = -\beta_h dF - \gamma_h z - u_h,$$

$$dx_f = -\beta_f dF - \gamma_f z,$$

where dx_h and dx_f are the futures position changes of the hedgers and financial traders across the period. dF is the futures price change. The coefficients $\beta_h \geq 0$ and $\beta_f \geq 0$ are the slopes of the two groups' demand curves with respect to the price change dF. These slopes also represent the two groups' capacities to absorb each other's trades. u_h is an idiosyncratic shock that causes the hedgers to increase their short position in the futures contract. We also introduce another shock z, which motivates the financial traders to reduce their position. One can think of the z shock as a shock to VIX during the financial crisis, which induced financial stress to financial traders. $\gamma_f > 0$ measures the financial traders' exposure to the shock. We also allow the z shock to affect the hedgers although with a smaller degree. In other words, financial traders have a greater exposure than hedgers to the z shock (i.e., $\gamma_f > \gamma_h$.)

Market clearing imposes an add-up constraint on dx_h and dx_f:

$$dx_h + dx_f = 0.$$

That is, one group has to absorb the position bought or sold by the other group. The price acts as the key mechanism to balance the two groups' net demand. Simple algebra gives that the futures price has to change by

$$dF = -\frac{1}{\beta_h + \beta_f}\left[u_h + \left(\gamma_h + \gamma_f\right)z\right], \qquad (1)$$

which is accompanied by the following position changes:

$$dx_h = -\frac{\beta_f}{\beta_h + \beta_f}u_h + \frac{\beta_h\gamma_f - \beta_f\gamma_h}{\beta_h + \beta_f}z, \qquad (2)$$

and

$$dx_f = -dx_h = \frac{\beta_f}{\beta_h + \beta_f}u_h - \frac{\beta_h\gamma_f - \beta_f\gamma_h}{\beta_h + \beta_f}z. \qquad (3)$$

Equation (1) nests the hedging pressure theory in the sense that the presence of financial traders dampens the price impact of the hedgers' idiosyncratic shock u_h. That is, a higher value of β_f leads to a smaller exposure of the futures price to u_h due to the financial traders' greater capacity to share the hedgers' shock (e.g., equations (2) and (3)).

Equations (2) and (3) also highlight the convective risk flow induced by the z shock from the financial traders to the hedgers. For illustration, consider the simple case with $\gamma_h = 0$ (i.e., the z shock does not affect the hedgers.) In this case, the z shock nevertheless causes the hedgers to increase their futures position by $\frac{\beta_h \gamma_f}{\beta_h+\beta_f} z$. This is because the shock causes the futures price to drop by $\frac{\gamma_f}{\beta_h+\beta_f} z$, which in turn induces the hedgers to buy back their short position. More generally, as long as $\beta_h \gamma_f - \beta_f \gamma_h > 0$ (i.e., the financial traders' exposure to the z shock after adjusting for the groups' capacities is greater than the hedgers'), the hedgers buy back some of their futures position in response to the shock. As a result, a convective risk flow emerges. Our empirical analysis anchors on documenting such a convective flow in the commodity futures markets during the recent financial crisis.

This simple framework also shows a subtle relationship between the futures price change and traders' position changes. In the ongoing debate among the academic and policy circles regarding whether the large inflows of investment capital into commodity futures markets affect commodity prices, a commonly used test of price impacts of commodity index traders (CITs) is to examine whether their position changes are correlated with futures price changes (e.g., Stoll and Whaley (2010), Singleton (2011), and Hamilton and Wu (2012)). The premise of the test is that if CITs' trading affects futures prices, there must be a positive correlation between their position change and price change. Despite its intuitive appeal, this test ignores that CITs might trade for different reasons.

It is convenient to interpret the financial traders in our model as CITs. Equations (1) and (3) show that hedgers' shock u_h and financial traders' shock z induce opposite correlations between the futures price change dF and financial traders' position change dx_f. When financial traders trade to accommodate hedgers' shock u_h, they provide liquidity and their position change is negatively correlated with the price change. On the other hand, when they trade in response to their own shock, they consume liquidity and their position change is positively correlated with the price change. The unconditional correlation of their position change and the price change nets out these two offsetting effects:

$$Correl(dx_f, dF) = \frac{1}{\sqrt{Var(dx_f)Var(dF)}} \left[-\frac{\beta_f}{\left(\beta_h+\beta_f\right)^2} Var(u_h) + \frac{\left(\beta_h \gamma_f - \beta_f \gamma_h\right)\left(\gamma_h+\gamma_f\right)}{\left(\beta_h+\beta_f\right)^2} Var\,(z) \right].$$

The sign of this unconditional correlation is ambiguous and depends on the relative magnitudes of the two terms in the bracket. The ambiguous sign helps explain why the extant literature often fails to find a significant correlation between the trading of CITs and futures price change. At the same time, it also motivates more systematic tests of price impacts of CITs and other financial traders after conditioning on trades initiated by them or accommodated by them. Our analysis of convective risk flows exactly serves as such a conditional test.

1.2 Empirical designs

In our empirical analysis we focus on using the change of the VIX as a proxy for the *z* shock and analyzing the convective risk flows induced by the VIX change in different commodity futures markets. As noted in the introduction and in Figure 1, open interest in many commodity markets collapsed around the time of the financial crisis just as the VIX was rising. During this time, the observed correlation of commodity prices with the VIX also increased dramatically. Figure 2 plots the return correlations of the GSCI and the GSCI Agriculture Index with the VIX Index, with a vertical line marking Monday, September 15, 2008, the day Lehman Brothers collapsed. Evidently, during the post-Lehman period, both the GSCI and the GSCI Agriculture Index were more synchronized with the VIX Index than during historical periods.[2]

The distressed financials theory emphasizes that financial institutions may become consumers rather than providers of liquidity when they suffer large losses or when they face severe funding risk. As commonly recognized by the extant literature, the VIX directly affects the funding liquidity of both of these financial institutions. As the VIX spikes, these institutions may face more stringent funding requirements from their lenders and thus have to reduce the leverage of their risky holdings. In particular, the theory predicts that this effect is non-linear and is particularly strong during a crisis after financial institutions suffer large losses and are vulnerable to any additional funding shock. As a result, during the recent crisis they could have responded to increases in the VIX by reducing their commodity exposures. As we shall discuss in the next section, this theory is applicable to both CITs and hedge funds, two major groups of financial traders in the commodity futures markets, during the financial crisis. Thus, we expect a spike in VIX during the crisis to reduce their willingness to hold positions in commodity futures.

[2] The highly synchronized price movements were commonly observed during the financial crisis in other asset markets. It is also possible that the observed rolling correlation rises because the volatility in both markets rise even though the underlying correlation remains the same. For our purposes, this poses isomorphic research questions: Why does volatility rise in both markets simultaneously, and which, if any, groups of traders were driving this market volatility?

The hedgers' incentives to hedge may also vary during a financial crisis. Froot, Scharfstein, and Stein (1993) develop a model for corporate hedging under the premise that external sources of capital are more costly than internally-generated funds. This funding wedge motivates firms to hedge their cash flow risk so that they have sufficient cash to finance future profitable investment opportunities. As an increase in the VIX raises the funding wedge, they should have greater incentives to hedge. Acharya, Lochstoer, and Ramadorai (2010) argue that hedging commodity price risk allows a commercial hedger with leverage to reduce default risk and thus the subsequent default cost. An increase in the VIX exposes all leveraged firms to greater default risk, which, in turn, also gives commercial hedgers greater incentives to hedge their commodity price risk. Thus, regardless of the reasons for hedging, an increase in the VIX gives commercial hedgers greater incentives to hedge, and more specifically, for short hedgers to take greater short positions in commodity futures and long hedgers to take greater long positions. As commercial hedgers are mostly on the short side, the hedging pressure hypothesis implies that, during the financial crisis, commercial hedgers are expected to increase their net short positions in commodity futures in response to an increase in the VIX.

To the extent that an increase in the VIX might have affected the incentives of both financial traders and hedgers in taking positions in the commodity futures markets, our theoretical framework indicates that the direction of the convective flows depends on the relative magnitudes of the VIX impacts on the two sides. If the financial traders had greater incentives to reduce their long positions than hedgers' incentives to increase their net short hedging positions, the model implies that both hedgers and financial traders cut down their net short and net long positions, respectively, resulting in a reduction in the open interest of the futures market. In this way, the risk flows back to hedgers together with a drop in the futures price. The joint dynamics of the position flow and the price change allow us to test the convective risk flow from financial traders to hedgers against the alternative hypothesis of the flow in the opposite direction caused by the hedgers' greater incentives to increase their hedging positions.

2. The Data and Market Participants

The CFTC publishes weekly reports on long and short positions of trader groups: the Commitments of Traders (COT) and the Supplemental COT on Commodity Index Traders. The data underlying these public reports comes from the CFTC's proprietary LTRS database. As described in detail below, the LTRS data, which we use in this study, includes disaggregated end-of-day positions for each large trader in all commodity futures and options markets subject to the jurisdiction of the CFTC.

Our data spans January 1, 2000 to June 1, 2011. We first apply a sequence of data-cleansing steps, described in detail in the Online Data Appendix. We focus on large traders with positions in the 19 U.S. commodity futures included in the Standard & Poor's-Goldman Sachs Commodity Index (SP-GSCI Index) and the Dow Jones-UBS Commodity Index (DJ-UBSCI). Table 1 lists these commodities and their respective index membership.

2.1 The LTRS data

The CFTC's Large Trader Reporting System (LTRS) compiles daily data of traders' long and short end-of-day positions in individual commodity futures contracts [e.g., a Chicago Board of Trade (CBOT) corn futures contract expiring in December 2001], as well as futures equivalents of commodity options contracts subject to the jurisdiction of the CFTC. Every day, positions in excess of a specified reporting threshold, which varies by commodity, are reported to the CFTC by exchange clearing members, futures commission merchants, and foreign brokers for market oversight purposes. Aggregate positions in LTRS account for 70%-90% of open interest in any given market.

Based on the LTRS data, we construct a weekly time series from 2001 to 2011 that matches the timing of the Tuesday-to-Tuesday COT reports. As a matter of convention, for a weekly time series, when we refer to a time period as September 15, 2008 to June 1, 2011, we are referring to the week ending in the first Tuesday after September 15, 2008 through the week ending the first Tuesday before June 1, 2011.[3] We focus on a weekly frequency, as it allows us to examine position responses at an intermediate frequency and facilitates comparison with existing COT reports.

Although we have data on positions for each individual futures contract expiration, we aggregate the number of contracts across commodities to gain a total picture of a trader's

[3] Thus, two periods of September 15, 2008 to January 1, 2009 and January 1, 2009 to January 1, 2010 are non-overlapping.

exposure to that commodity. To facilitate interpretation, we normalize positions to a notional dollar value using fixed-index contract prices as of December 15, 2006. As our empirical tests focus on each individual commodity separately, this ad hoc choice of date is innocuous as it is simply a scaling factor on the number of contracts.

We define excess returns in a commodity as the returns from holding a generic futures contract that tracks the currently indexed contract. This is the return to a position that is always invested in the currently indexed contract. It accounts for a roll return where the position in the currently indexed contract is liquidated and reinvested in the next indexed contract at the end of the day before the generic contract begins tracking the next indexed contract. During a month in which the index calls for the generic contract to switch underlying contracts, we roll contracts on the fifth business day of that month.[4] We roll contracts according to the S&P GSCI roll schedule, which generally rolls out of shorter-dated contracts in the month before expiration (when delivery is close and liquidity drops) and into the next liquid longer-dated contract.[5] Tracking the indexed contract also ensures that our generic contract is always liquid. To facilitate outside replication, we construct this rolling return from the settlement price data of underlying futures contracts in Bloomberg.

In addition to end-of-day exposure information, each trader in the LTRS database has a number of specific attributes that identify its registration, designation or reporting status (e.g., a commodity pool operator or a commercial distributor). In our analysis, we make use of both the disaggregated positions and the registration/designation/reporting status of large traders. We use this information, as well as the prior year's position patterns, to classify each trader in any given year. We give a rough outline of our classification below; full details are in the Appendix.

2.2 Major groups of market participants

Commercial hedgers such as farmers and producers regularly trade commodity futures to hedge

[4] The GSCI rolls smoothly over the fifth through ninth business days; for simplicity we switch contracts on the fifth day. The monthly roll schedule for the GSCI is provided in the Data Appendix. We define the fifth business day as the fifth trading day of the month, where a trading day is a day in which all 19 commodities have positions.

[5] The DJ-UBSCI switches contracts on a more infrequent schedule. We use the S&P GSCI schedule for most commodities as it rolls more frequently. When switching to the longer-dated contract, the GSCI will occasionally skip certain expirations for liquidity reasons (e.g., October gold is skipped). For soybean oil and copper, we use the DJ-UBSCI roll schedule, since soybean oil is not in the GSCI and the GSCI tracks copper contracts traded in London (for which we have no data) rather than the CME.

commodity price risk inherent in their commercial activities. For example, farmers enter into short positions in grains futures contracts to lock in prices on crops that are yet to be harvested. That way, if cash prices for grains go down, the farmers make less by selling their crop to a local elevator, but gain on their short futures positions on, for example, the Chicago Board of Trade. On the other hand, bakers and feed producers who need to buy grain from elevators enter into long grain futures positions. For them, if cash prices for grains go up, they need to pay more to buy from a local elevator, but gain on their long grain futures positions at the exchange. Despite the diversity of the commercial hedgers, in the aggregate they tend to be net short in commodity futures. The long-standing hedging-pressure theory posits that commercial hedgers need to offer premia to attract non-commercial buyers to absorb their net short positions due to a limited commercial buyer interest on the long side.[6] In our analysis, we classify commercial hedgers as traders in the LTRS system with registration, reporting and designation codes that clearly indicate commercial use in all the commodities in which they trade. We use a conservative classification compared to the Commitment of Traders (COT) reports in that we require commercial usage in all commodities in which a trader trades, as well as an explicitly stated purpose for commercial usage (e.g., a "Livestock Feeder").

Hedge funds who trade in commodity derivatives must register with the CFTC as Commodity Pool Operators (CPOs). If they do not trade commodity derivatives, but provide advice to their clients, they must register as Commodity Trading Advisors (CTAs). These funds invest others' money on a discretionary basis in commodities, commodity futures, and options on futures. They make use of leverage as only a fraction of money that must be paid to enter into a position. Moreover, they face far fewer trading restrictions than traditional money managers, such as mutual funds and pension funds. For example, they may enter into both long and short positions, trade spreads, and construct complex trading strategies, which include both commodity derivatives and cash positions. The use of leverage makes funding risk an important part of their business. In several historical episodes, inability to secure funding caused some hedge funds to "bail out" of positions during market stress, such as the crisis of the Long-Term Capital

[6] This theory was initially proposed by Keynes (1930) and Hicks (1939) and further developed by Hirshleifer (1988). Consistent with this theory, Bessembinder (1992), de Roon, Nijman and Veld (2000), and Acharya, Lochstoer, and Ramadorai (2010) find that returns of commodity futures increase with commercial hedgers' hedging needs after controlling for systematic risk.

Management in 1998. In our analysis, we classify hedge funds as traders who are registered with the CFTC as commodity pool operators and commodity trading advisors or designated in the LTRS as managed money.

A new breed of commodity market participants—commodity index traders—emerged during the mid-2000s. After the U.S. equity market collapsed in 2001, attractive historical returns from investing in commodity futures together with their slightly negative correlations with equity returns, as summarized by Erb and Harvey (2006) and Gorton and Rouwenhorst (2006), motivated many prudent buy-side financial institutions, such as university endowments, insurance companies, and pension funds, to incorporate commodities as a new asset class in their portfolios. These institutions tend to focus on strategic asset allocation between commodities and other asset classes, including stocks and bonds, and designate assets among specific commodities to a commodity investment index that tracks performance of a basket of commodity futures contracts.[7] Thus, they are often referred to as commodity index traders.[8] As CITs are exposed to stock market fluctuations through their stock positions, they may need to tighten up their risk exposures in commodities after suffering large losses in stocks. Unlike CPOs and CTAs, CITs are not a registered category with the CFTC. We identify CITs based on the CIT classification of the CFTC's Supplemental COT report and two additional criteria motivated by the trading patterns of broad-based portfolio investors in commodity indices: 1) they should be invested in many commodities (greater than eight in our sample); and 2) they should be mostly net long in those commodities over the previous year (more than 70% net long in our sample).

2.3 The netting problem and conflicting groups

The CFTC's LTRS database is designed for market oversight and enforcement purposes over

[7] A commodity index functions like an equity index, such as the S&P 500, in that its value is derived from the total value of a specified basket of commodity futures contracts with specified weights. These contracts are typically nearby contracts with delivery times longer than one month. When a first-month contract matures and the second-month contract becomes the first-month contract, a commodity index specifies the so-called "roll" (i.e., replacing the current contract in the index with a following contract). In this way, commodity indices provide returns comparable to passive long positions in listed commodity futures contracts. By far the largest two indices by market share are the SP-GSCI and the Dow-Jones UBS Commodity Index (DJ-UBS). These indices differ in terms of index composition, commodity selection criteria, rolling mechanism, rebalancing strategy, and weighting scheme. Instead of entering positions on individual futures contracts, CITs typically purchase financial instruments that give them exposures to returns of a commodity index. There are three types of such instruments: commodity index swaps, exchange-traded funds, and exchange-traded notes.

[8] See Tang and Xiong (2010) for an analysis of the growth of CITs and their potential impact on commodity prices.

markets subject to the jurisdiction of the CFTC. Until the adoption of the Dodd-Frank Wall Street Reform and Consumer Protection Act, the CFTC did not have jurisdiction of commodity swaps. As a result, the LTRS includes only a subset of positions of market participants in commodity derivatives. At a practical level, CITs often establish commodity index positions by acquiring index swap contracts from swap dealers, rather than taking long positions in individual commodity futures. Swap dealers then hedge themselves by taking long positions in individual commodity futures and report their futures positions to the CFTC. For this reason, CITs classified in our analysis are mostly swap dealers. As swap dealers are likely to hold other positions related to their other derivative transactions, their positions reported to the CFTC contain commodity exposures both of the clients and their own. Although this is a limitation of the LTRS data, we have an ex ante expectation of which commodities are more susceptible to this netting problem. In particular, this problem is severe in energies and metals, which have deep derivative markets beyond index swaps, but not in agricultural commodities, where other derivatives are quite rare.[9]

This netting problem of comingling different lines of business activity in the exposures reported to the CFTC goes beyond the CITs. Traders may be engaged in multiple lines of business, including, for example, both CIT business and managed money. As a result, a trader in the LTRS data may have multiple self-reported trader registrations. Therefore, it is possible for a trader to have designations of both a CIT and a commodity trading advisor (hedge fund). Thus, even the disaggregated LTRS data faces the netting problem across each trader's multiple business lines. We classify traders as CITs, hedge funds, and commercial hedgers while separately tracking groups of traders who have multiple designations, and use the LTRS data to resolve the problem of position overlap. It is important to note that our goal is not to measure the levels of positions in each trader group, but rather to capture the trading pattern of certain types of traders. There are eight total trader group categorizations: three conflict-free categories (CIT, Hedge Fund, Hedger); four conflict categories (CIT-HFs, Hedger-HFs, CIT-Hedgers, Triple), and other unclassified traders. The difference of the sum of these positions and zero are positions that are not reported to the CFTC.

[9] This is noted in the CFTC's accompanying note to the Supplemental COT report. The note is available online at http://www.cftc.gov/ucm/groups/public/@commitmentsoftraders/documents/file/noticeonsupplementalcotrept.pdf.

2.4 Other data

Our data on the VIX, S&P 500 Total Return, and GSCI come from Bloomberg. We use the following weekly macroeconomic indicators as control variables: the Baltic Dry Index (from Bloomberg), the Moody's Baa credit spread (from the Federal Reserve Board), and the 10-year inflation compensation (Gürkaynak, Sack, and Wright 2010; data from their paper).[10] Our choice of macroeconomic indicators is constrained by our desire to focus on a weekly frequency. The Baltic Dry Index (BDI) tracks worldwide international shipping rates and is a measure of global demand for commodities; higher values represent higher shipping rates and greater expected demand. Higher Baa credit spreads indicate worsening credit conditions in the economy, and higher inflation compensation generally indicates higher inflation expectations.

3. Market Participation of Different Trader Groups

Commodities futures markets have grown dramatically over the past decade, and the nature of market participation has changed dramatically as well. Table 2 reports summary statistics by trader types through time. Panel A reports the number of traders, Panel B reports the median dollar notional net position across traders within each category, Panel C reports the average number of commodities with any exposure across, while Panel D reports the average percentage of contracts long. The Online Appendix also provides two bubble figures that visually illustrate the evolution of traders in different groups across our sample period.

Table 2 shows several salient features about the different trader groups. First, there are relatively few commodity index traders, yet their net positions are typically very large. In 2010, the median CIT had an average notional position size well in excess of $2 billion net long, and the median CIT-HF had an average position size of $700 million net long, even though there are only 32 traders between the two categories in 2010.[11] In contrast, the median commercial hedger was net short $7 million while the median hedge fund was net long $1.3 million.

Second, hedge funds tend to have slightly net long exposure, with 60% of their contracts

[10] The Bloomberg codes for VIX, S&P 500, and BDI are VIX Index, SPTR Index, and BDIY Index, respectively.

[11] The number of traders is low compared to those reported in the public COT reports. In this sense, our classification scheme is conservative and likely an underestimate of the size of the CIT sector. For our purposes, we are more interested in the time series properties of changes in true CIT behavior.

long, as indicated in Panel D of Table 2. Third, commercial hedgers are mostly invested in one or two commodities (on average, 1.2 commodities, as indicated in Panel C of Table 2), consistent with the nature of their specific hedging needs. While hedgers' positions are typically net short (25% long in 2010 as indicated in Panel D of Table 2), there is a subset of hedgers taking net long positions. These net long hedgers are clustered in the lower right corner of Figure A2 in the Online Appendix.

As indicated in Table 2, Panel A, there are a number of other unclassified traders. Although, as indicated in Panels B-D, most of these traders are small, some of them have a significant net short exposure. These traders might be commercial hedgers who were not registered with, reported to or designated by the CFTC as such. There are also a few CIT-HF traders; for confidentiality reasons, their exact count in not reported. The behavior of these traders, however, appears to be fairly similar to the 18 traders who had the CIT designation, but not a hedge fund designation. There are very few traders who have designations as both a Commercial Hedger and a Hedge Fund. Lastly, there were no traders who were classified as CIT-Hedger or who had all three designations.

Table 2 also shows that from 2000 to 2010 the landscape of commodity investing has fundamentally changed. Prior to 2004, there were fewer traders and fewer traders invested in multiple commodities. Since 2004, however, there has been an explosion in index investing. In particular, Panel A shows that the number of traders has been increasing through time in the CIT, Hedge Fund, and Commercial Hedger categories, and Panel B shows that the average net notional position of the median CIT trader has exploded since 2004.

Figure 3 plots the aggregate net notional position of each trader category, where positions have been aggregated across all 19 commodities.[12] Although our categorizations are meant to conservatively capture the trading pattern of different groups in the market rather than the pure level of positions, the plots are useful in describing the pattern of investing through time. Panel A plots notional positions computed using contemporaneous prices and thus are a measure of actual

[12] Figures 3 and 4 may exhibit jumps in positions on January 1 of each year, as positions are re-shuffled due to the re-categorization of traders on an annual basis. In this sense, the change in the aggregate level here is not the same as the flow on the first trading day of each year (or any week/time unit that spans multiple years), as the categorization changes. In subsequent calculations involving flows, flows are always computed using a constant sample composition. For example, the flow on the first trading day of the year for the CIT grouping is the change in position for the new group.

value (in real December 2006 dollars), while Panel B computes notional positions using a fixed price throughout (December 15, 2006 prices). Evidently, the long side of the commodities futures markets has become increasingly dominated by commodity index traders and hedge funds, with commercial hedgers and other unclassified traders forming the bulk of the short side.

Figure 4 plots the aggregate net notional positions (using fixed prices) for each of the five sectors of commodities, and these observations seem to hold within each sector. However, it is evident that the netting problem is severe in the energy and metal sectors, with CITs "appearing" to take even a net short position in metals. This is consistent with the CFTC's acknowledgement in the Supplemental COT report that CIT positions are difficult to measure in the energy and metals markets due to the heavy use of derivatives in these markets.

To summarize the differences across trader groups, we compare second moments of trader flows rather than the first moments of levels. In contrast to other trader groups, commodity index traders should be relatively passive, and this is borne out in the data. Figure 4 shows that the volatility of position changes in grains, livestock, and softs is strikingly lower for CIT traders. Table 3 formalizes this by providing summary statistics on the flows for each trader category during the post-financial crisis sample period. The volatility of flows for CITs is substantially lower than other groups in nearly every commodity. Hedge funds have extremely high volatility of flows, with commercial hedgers and other unclassified traders in between. The magnitudes are striking: across the 12 agricultural commodities, the volatility of hedge fund flows is 2.6 times the volatility of CIT flow. However, although CITs are passive, their positions are not constant, as demonstrated by Figures 3 and 4, which show sharp decreases in CIT positions during the financial crisis.

4. Empirical Results

4.1 VIX changes and commodity returns

Table 4 reports the results from estimating a linear regression where the left-hand side variable is the weekly commodity return and the right-hand side variables are weekly VIX changes. We allow for VIX changes to affect commodity prices with a delay, and thus use the contemporaneous, as well as one lag of weekly VIX changes on the right-hand side. We also control for one lag of commodity returns to allow for persistence in commodity price movements, as well as our weekly macroeconomic indicators, which are the contemporaneous percentage change in the BDI index, change in inflation compensation, and change in Baa credit spread. We use the Newey and West (1987) construction for the covariance matrix of the estimators with four lags.

The results indicate a strong effect of VIX changes on commodity markets in the post-crisis period (September 15, 2008 to June 1, 2011). The first major column reports the coefficient on the contemporaneous VIX changes during this period. With the exception of lean hogs and gold, all commodities display a negative price relationship with the VIX, with almost all coefficients statistically significant at the 5% level. The second major column shows that this relationship also holds in the second half of the post-crisis period (January 1, 2010 to June 1, 2011) for most of the commodities. For most commodities, the negative correlation persisted over a year after the collapse of Lehman Brothers.

This relationship does not hold during the pre-crisis period. The third major column of Table 4 reports the coefficient on the contemporaneous VIX change for the period January 1, 2006 to September 15, 2008, a pre-crisis period of nearly equal length with our post-crisis period. The coefficients during this period are mostly insignificant with the exception of coffee and copper having significantly negative coefficients at the 5% level. The fourth major column goes back even further and analyzes the period January 1, 2001 to January 1, 2006 and similarly finds little systematic relationship between VIX changes and commodity returns.

4.2 VIX changes and trader positions

We now estimate the effect of changes in the VIX on the changes of aggregate positions of different groups of traders. We focus on the aggregate positions of different trader groups as we are interested in identifying which groups have been driving the price, and do not want small individual traders who may behave in a nonsystematic way to change our analysis. We estimate the same specification in Table 4 but with position changes on the left-hand side. As discussed above, the netting problem in the LTRS position data is particularly severe for commodities in the energy and metal sectors. This problem contaminates our analysis of the relationship between traders' positions and VIX changes for these commodities. Below, we report results only for commodities in the grains, livestock, and softs sectors.

Our running null hypothesis is that the VIX did not systematically affect a given trader group's position changes. One alternative is that increases in the VIX positively affected CIT and hedge fund positions and negatively affected hedger's positions. This would be consistent with an increase in the VIX causing greater incentives for hedgers to hedge. Another alternative predicts the VIX increase may have induced greater distress to financial traders than to hedgers. As a result, it may have negatively affected CIT and hedge fund positions, while positively affected commercial hedger positions. Given the negative correlation between VIX changes and commodity returns in the post-crisis period, the economic content of this prediction is that both CITs and hedge funds were willing to sell at such deep discounts that commercial hedgers were willing to reduce their net short positions as the VIX rose.

Table 5 reports the results where the left-hand side variable is the weekly change in position (flows) and the right-hand side variables are weekly VIX changes. We again allow for VIX changes to affect commodity prices with a delay by including the contemporaneous, as well as one lag of weekly VIX changes on the right-hand side, control for one lag of commodity returns as well as our weekly macroeconomic indicators, and use the Newey and West (1987) covariance matrix with four lags. Panel A reports the estimated coefficients during the post-crisis September 15, 2008 to June 1, 2011 period, while Panel B reports the estimated coefficients during the period immediately before the crisis, January 1, 2006 to September 15, 2008. The results in Panel A strongly indicate asymmetric responses of market participants to VIX changes in the post-crisis period. When the VIX increases, both CITs and hedge funds tend to reduce their net long exposures, while commercial hedgers and other unclassified traders tend to buy, in virtually all commodities. For CITs, the association between position changes and the contemporaneous VIX change is negative and statistically significant at the 10% level or better among 8 of the 12 agricultural commodities (grains, livestock, and softs), with an average economic significance of -0.21-standard deviations. Hedge funds display a positive and statistically significant relationship (at the 10% level or better) between positions and contemporaneous VIX change in 6 of the 12 commodities, with an average economic significance of -0.12-standard deviations; only one commodity has a positive point estimate.

In contrast, Table 5 shows that commercial hedgers tend to display a positive relationship between VIX changes and position changes. The relationship is positive and statistically significant for 8 of the 12 commodities, with only one negative point estimate. The average economic significance among all 12 commodities is +0.16-standard deviations. Interestingly, the other unclassified traders are similar to commercial hedgers: the relationship is negative and statistically significant for 8 of the 12 commodities, with an average economic significance of +0.15 standard deviations. This is perhaps not surprising given the CFTC's designation of commercial hedgers.

Panel B of Table 5 shows weak evidence of VIX changes affecting traders' positions during the pre-crisis period from January 1, 2006 to September 15, 2008, a period nearly equal in length to our post-crisis period of September 15, 2008 to June 1, 2011. In sharp contrast to the post-crisis period, across all of the trader groups and all 12 commodities, the coefficients of the contemporaneous VIX changes in the pre-crisis period are virtually insignificant with the exception of one or two commodities for each group.

The patterns in Table 5 show that changes in the VIX had asymmetric impacts on commodity futures markets participants after September 2008. An increase in the VIX led both CITs and hedge funds to sell commodity futures, which commercial hedgers bought. This pattern indicates that CITs and hedge funds were more sensitive than hedgers to changes in the VIX during the financial crisis due either to changes in risk appetite or funding concerns.

The finding that commercial hedgers were buying, rather than selling, as the VIX increased is inconsistent with the traditional hedging pressure theory with a single focus on the hedging incentives of commercial hedgers. This theory implies that during the financial crisis, an increase in the VIX incentivized commercial hedgers to hedge (i.e., to increase their aggregate short positions in commodity futures). Instead, they reduced, rather than increased, their short positions. This buying behavior on the part of hedgers is remarkable in light of the observation that hedgers who were short stood to make extreme profits from the steep price fall during the financial crisis. That is, they provided liquidity to financial traders, while financial traders consumed liquidity.

4.3 Cross-sectional evidence

We examine the responses of different traders within the same group to further isolate our competing hypotheses.

4.3.1 Evidence on distressed financials. The distressed financials theory implies that the more distressed financial traders are more sensitive to VIX changes during the financial crisis. We provide direct evidence that the trading responses of CITs to the VIX are heterogeneous across firms with different CDS spreads. The theory implies that CIT trading accounts with high CDS spreads have a higher position change-sensitivity to changes in the VIX through two possible channels. First, the CIT institutions (large financial intermediaries) may need to sell their own proprietary positions when volatility rises in order to contain risk exposures. Second, investors who entered into swap contracts with CITs may potentially withdraw their investment when the institution is distressed.

We manually matched large traders identified as CITs to the names of their respective firms and collected their CDS spreads from Bloomberg.[13] For each week, we split the group of CIT accounts into accounts with high CDS spreads (above the median) and low CDS spreads (below the median). We regress the account-level position change as the left-hand side variable on the change in the VIX, an indicator for whether the trader has a high CDS spread, and the interaction of these two terms, and again control for the same set of weekly macroeconomic indicators.[14] Table 6 reports the results from this regression. Consistent with the distressed financials theory, high CDS spread firms sell more, and, furthermore, are more sensitive to changes in the VIX in 5 of the 12 agricultural commodities: Chicago wheat, corn, coffee, cotton, and sugar. This regression exploits the relative ranking of firms with high and low CDS spreads. Alternatively, one may expect that the absolute level of CDS spreads is what matters. A regression that substitutes the raw log CDS spread in place of high/low indicator reveals nearly identical results, which are available from the authors upon request.

4.3.2 Another argument on hedging pressure. For the traditional hedging pressure theory to explain the commercial hedgers' responses to changes in the VIX, their incentives to hedge would have to vary with the fluctuations of VIX. Table 5 suggests that commercial hedgers actually bought when the VIX was rising, contrary to most theories of hedging, which predict

[13] For this portion of the analysis, we aggregate CITs and CIT-HFs due to the small number of CITs.
[14] We cluster standard errors at the weekly level because position changes across traders may be correlated within a week given aggregate shocks. Clustering standard errors at the account-level generates nearly identical results, which are available from the authors.

that commercial hedgers, who are typically short, would actually increase their hedges and short more. However, one might argue that the specific reasons discussed in the previous section may be incomplete and that an unspecified reason might cause commercial hedgers to have reduced incentives to hedge after the VIX increases. Comparing the responses of long hedgers and short hedgers provides a channel to address this concern. While commercial hedgers are mostly on the short side, there are a number of long hedgers in our sample. As the greater hedging incentives motivate long hedgers and short hedgers to trade in opposite directions, we expect them to have opposite responses to VIX shocks if their trading was driven by fluctuations in their hedging incentives.

To explore this consideration, we classify a hedger as a "long hedger" in a commodity if the hedger maintained an average net long position in the previous calendar year. Specifically, for each day, we compute the fraction of long contracts in which a hedger is invested, and compute the time average over the year. If the average fraction is greater than 50%, we classify the hedger as long, while a fraction less than 50% corresponds to short. We then separately regress the aggregate position change of long hedgers on changes in the VIX, including both contemporaneous and lagged changes as usual and including one lag of commodity returns as a control, along with our weekly macroeconomic indicators. Table 7 reports the results and shows that, consistent with Table 5, short hedgers drive the positive relationship between hedgers' position changes and changes in the VIX. However, there is no clear pattern of the opposite reaction for long hedgers. For example, it appears that although long hedgers were selling in sugar, in fact they were buying in Chicago wheat and coffee. This suggests that the long hedgers of coffee and Chicago wheat were trading in the same direction as the short hedgers, invalidating the argument that unspecified reasons might have caused hedgers to have reduced incentives to hedge after the VIX increases.

4.4 Informational advantage hypothesis

Traders might also trade against each other in order to exploit an informational advantage rather than to reallocate risk. Suppose that an increase in VIX contains negative information about commodity market fundamentals and that financial traders such as CITs and hedge funds are faster in absorbing the information than commercial hedgers. Then, we could expect that in response to an increase in VIX, commodity prices would co-move negatively with the VIX increase and financial traders would sell commodity futures to commercial hedgers. The premise of this informational advantage hypothesis is that by absorbing the information contained in VIX movements at a faster pace, financial traders can profit from commercial hedgers. As the more active hedgers tend to be more attentive to VIX movements than passive hedgers, this hypothesis naturally implies that passive hedgers are more likely than active hedgers to be on the other side of financial traders' trades in response to VIX changes.

We explore this informational advantage hypothesis by classifying a group of "active" hedgers who have a record of trading both frequently and in large amounts. Specifically, we compute the median daily absolute position change for every hedger every year, and classify a hedger as active if it was in the top decile of all hedgers in that commodity in the previous year. We use the median rather than the mean as we want to capture hedgers who consistently and frequently trade large amounts as opposed to those who trade extraordinarily large amounts infrequently. By the same reasoning, we use the absolute position changes as opposed to a measure of portfolio turnover.[15] We then aggregate active and passive hedgers and test whether the aggregate positions of active hedgers display a significantly more positive sensitivity to the VIX than passive hedgers in a panel of these two time series.[16]

In Table 8, we regress weekly position changes on changes in the VIX, an indicator for the active group of hedgers, and an interaction between these two terms, along with one lag of commodity returns and our weekly macroeconomic controls and during the post-crisis period. The active hedgers tended to be on the other side of the financial traders' trades in that they typically display a more pronounced positive sensitivity to the VIX, meaning that as the VIX rose, they were buying. This evidence is inconsistent with the informational advantage hypothesis. In the Online Appendix, we provide further evidence against the informational advantage hypothesis by showing that the position responses of financial traders and especially those of CITs are persistent even after a 13-week window, suggesting that they represent permanent position changes as opposed to transitory trading driven by informational advantages.

4.5 Comparability and further analysis

[15] Ranking on portfolio turnover yields qualitatively results that hedgers with higher portfolio turnover in the previous year tend to display a significantly more positive sensitivity to the VIX than passive hedgers.

[16] For our panel regression, we report standard errors clustered by time. FGLS estimates corrected for serial correlation yield nearly identical results.

4.5.1 Comparability with COT reports. Table 9 reports results from our baseline analysis, which regresses position changes on movements in the VIX for the trader categories from the disaggregated COT reports, as well as the Supplemental CIT report. The results are consistent with those in Table 5, which shows that producers' positions react positively to the VIX and that managed money traders react negatively to the VIX. Other financial traders are roughly neutral.

Although CIT traders are not separately classified within the disaggregated COT reports, much of the CIT business is conducted through swaps. Consistent with this, swap dealers react negatively to the VIX in the disaggregated COT reports, although the statistical significance is limited. This is interesting as swap dealer positions are usually aggregated with commercial positions in the historical COT reports, which only break down commercial and non-commercial positions. Table 9 also examines how position changes of CITs respond to changes in the VIX, and confirm our earlier result that CITs react negatively. Notably, these positions are not simply a subset of any single category in the disaggregated COT reports, but instead are a mix of the swap dealer positions and managed money positions due to the netting problem described in Section 1. Therefore, our effects are not driven by our classification scheme.

4.5.2 Changes in expected commodity demand. We also check whether our results may be explained by observable shifts in expected demand. One alternative explanation is that our results are fully explained by movements in demand not captured in our macroeconomic controls. To examine this issue more closely, we collect monthly projections of world usage for the upcoming harvest issued by the U.S. Department of Agriculture (USDA) for wheat, corn, soybeans, soybean oil, and cotton in its *World Agricultural Supply and Demand Estimates* reports. In the middle of each month, the USDA projects the usage of the coming year's harvest for these crops. We repeat our exercise at a monthly frequency and include the year-on-year percentage change in forecasted world usage as a control. Table 10 reports the results, which are very similar to our previous weekly results. We choose the year-on-year percentage change in forecast because each month's forecast is a forecast for that year's harvest, with the forecasted harvest year typically changing to the subsequent harvest year in May.[17]

[17] For example from May 2006 through April 2007, the USDA forecasts the harvest and usage for the 2006-2007 harvest year; in May 2007, it begins forecasting the 2007-2008 harvest. The April 2007 projection is typically very accurate for the actual realized 2006-2007 harvest. The estimated actual 2006-2007 harvest is reported from May

4.5.3 Impact on cash positions. In the Online Appendix, we also provide extensive results on how commercial hedgers adjust their cash positions (physical stocks, and purchase and sales commitments) in response to changes in the VIX. We make use of a CFTC dataset on the cash positions of bona fide commercial hedgers in a subset of agricultural commodities subject to federal position limits. We find that bona fide hedgers reduced their net short positions in commodity futures in response to changes in the VIX as well as their long positions in cash commodities. Large traders who have been granted bona fide hedger designations by the CFTC are typically agribusiness middlemen rather than farmers. Thus, the fact that they reduced their long position in cash agricultural commodities in response to an increase in the VIX suggests that they reduced purchase commitments to farmers, which, in turn, led risk to flow towards the ultimate producers of these commodities.

4.5.4 Alternative proxy of shocks. We note that the link between equity markets and commodity futures markets is not only manifested in the responses of prices and traders' responses in the commodity futures markets to the VIX changes. We focus on the VIX because of its intuitive appeal as a proxy both for the distress of financial traders and its relation to hedging demands of commercial hedgers. We are also motivated to explain the observed link between the two markets. We have re-run our analysis using total returns to the S&P 500 as the source of shocks and obtain qualitatively identical results. This exercise more directly measures shocks to equity markets and how CITs and hedge funds link the two markets.

5. Conclusion

We analyze the joint responses of prices and positions of all trader groups in the commodity futures markets to movements in the VIX. Although the price movements are naturally related to VIX movements as a fundamental, jointly analyzing positions and prices allows us to examine whether amplification effects due to distressed financial traders or hedging pressure are also at work. We find that CITs and hedge fund positions reacted negatively to the VIX during the recent financial crisis, with commercial hedgers taking the other side. Furthermore, consistent with the hypothesis that the VIX increases during the crisis caused greater distress to financial

2007 through April 2007, with the finalized actual 2006-2007 harvest numbers reported starting May 2008, subject to subsequent revision.

traders than to hedgers, we find that CITs with high CDS spreads are more sensitive to movements in the VIX. Contrary to the traditional hedging pressure theory with a single focus on hedgers' hedging needs, we do not find that hedgers increased their hedges as the VIX rose. Finally, the findings show that the reactions of all trader groups were persistent over time.

This evidence suggests that during times of distress, there was a flow of risk away from financial traders back towards commercial hedgers. Much like the convection of a current of air that flows from a high pressured area to low pressured one, this "risk convection" reallocates risk from the more distressed groups to the less distressed groups. The presence of such risk convection confirms the market impact of financial traders conditional on trades initiated by them and motivates an extension of the long-standing hedging pressure theory of commodity futures markets to incorporate time-varying risk capacities of financial traders.

References

Acharya, Viral, Lars Lochstoer and Tarun Ramadorai (2010), Limits to arbitrage and hedging: evidence from commodity markets, Working paper, NYU Stern.

Adrian, Tobias and Hyun Song Shin (2010), Liquidity and leverage, *Journal of Financial Intermediation* 19, 418-437.

Bessembinder, Hendrik (1992), Systematic risk, hedging pressure, and risk premiums in futures markets, *Review of Financial Studies* 4, 637-667.

Brunnermeier, Markus and Lasse Pedersen (2009), Funding liquidity and market liquidity, *Review of Financial Studies* 22, 2201-2238.

Buyuksahin, Bahattin and Michel Robe (2010), Speculators, commodities and cross-market linkages, Working paper, International Energy Agency and American University.

Danielsson, Jon, Jean-Pierre Zigrand, and Hyun Song Shin (2010), Balance sheet capacity and endogenous risk, Working paper, London School of Economics and Princeton University.

de Roon, Frans, Theo Nijman, and Chris Veld (2000), Hedging pressure effects in futures markets, *Journal of Finance* 55, 1437-1456.

Erb, Claude and Campbell Harvey (2006), The strategic and tactical value of commodity futures, *Financial Analysts Journal* 62 (2), 69-97.

Etula, Erkko (2009), Broker-dealer risk appetite and commodity returns, Working paper, Federal Reserve Bank of New York.

Froot, Kenneth, David Scharfstein, and Jeremy Stein (1993), Risk management: Coordinating corporate investment and financing policies, *Journal of Finance* 48, 1629-1658.

Gorton, Gary and Geert Rouwenhorst (2006), Facts and fantasies about commodity futures, *Financial Analysts Journal* 62 (2), 47-68.

Gromb, Denis and Dimitri Vayanos (2002), Equilibrium and welfare in markets with financially constrained arbitrageurs, *Journal of Financial Economics* 66, 361-407.

Hamilton, James and Jing Cynthia Wu (2011), Risk premia in crude oil futures prices, Working paper, University of California, San Diego.

He Zhiguo and Arvind Krishnamurthy (2009), Intermediary asset pricing, Working paper, University of Chicago and Northwestern University.

He Zhiguo, In Gu Khang, and Arvind Krishnamurthy (2010), Balance sheet adjustment in the 2008 Crisis, *IMF Economic Review* 1, 118-156.

Hicks, Charles (1939), *Value and Capital*, Oxford U.P., Cambridge.

Hirshleifer, David (1988), Residual risk, trading costs, and commodity futures risk premia, *Review of Financial Studies* 1, 173-193.

Irwin, Scott and Dwight Sanders (2011), Index funds, financialization, and commodity futures markets, *Applied Economics Perspectives and Policy* 33, 1-31.

Keynes, John Maynard (1930), *A Treatise on Money*, Vol. 2, Macmillan, London.

Kyle, Albert and Wei Xiong (2001), Contagion as a wealth effect, *Journal of Finance* 56, 1401-1440.

Mitchell, Mark, Lasse Heje Pedersen and Todd Pulvino (2007), Slow moving capital, *American Economic Review* 97, 215-220.

Newey, W.K., and K.D. West (1987), A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica*, 55(3), 703-708.

Shleifer, Andrei and Robert Vishny (1997), Limits of arbitrage, *Journal of Finance* 52, 35-55.

Singleton, Kenneth (2011), Investor flows and the 2008 boom/bust in oil prices, Working paper, Stanford University.

Stoll, Hans and Robert Whaley (2010), Commodity index investing and commodity futures prices, *Journal of Applied Finance* 1, 1-40.

Tang, Ke and Wei Xiong (2010), Index investment and financialization of commodities, Working paper, Princeton University.

Figure 1: Open Interest and the VIX

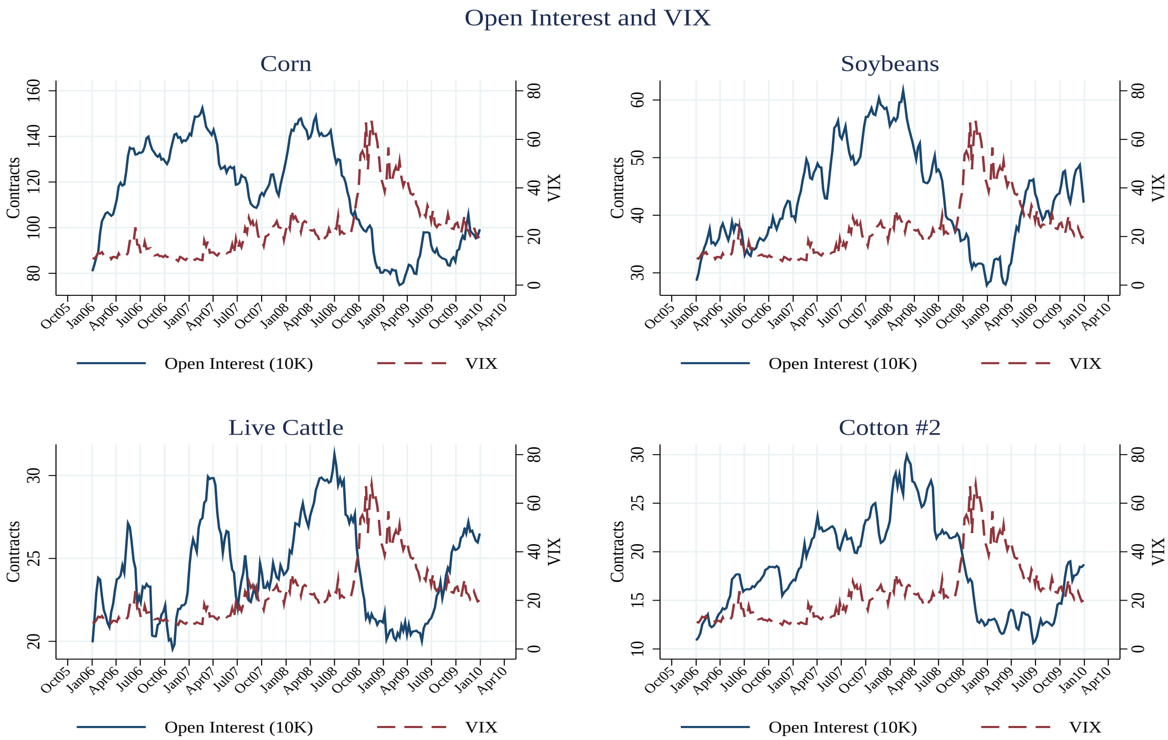


Figure 2: Correlations between Changes in VIX and SP-GSCI Indices

The correlations are estimated from one-year rolling correlations of daily changes to the VIX and returns of SP-GSCI commodity index in different commodity sectors.

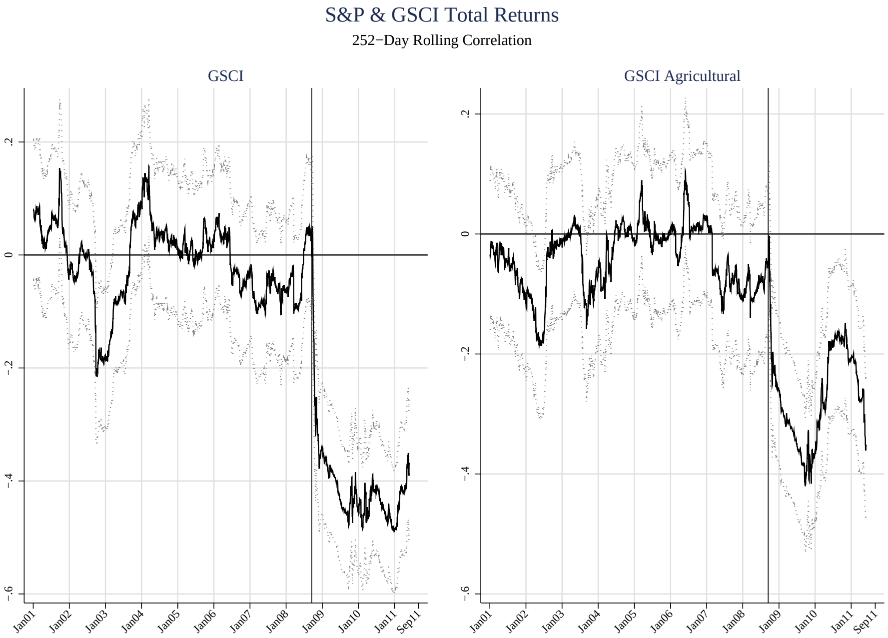
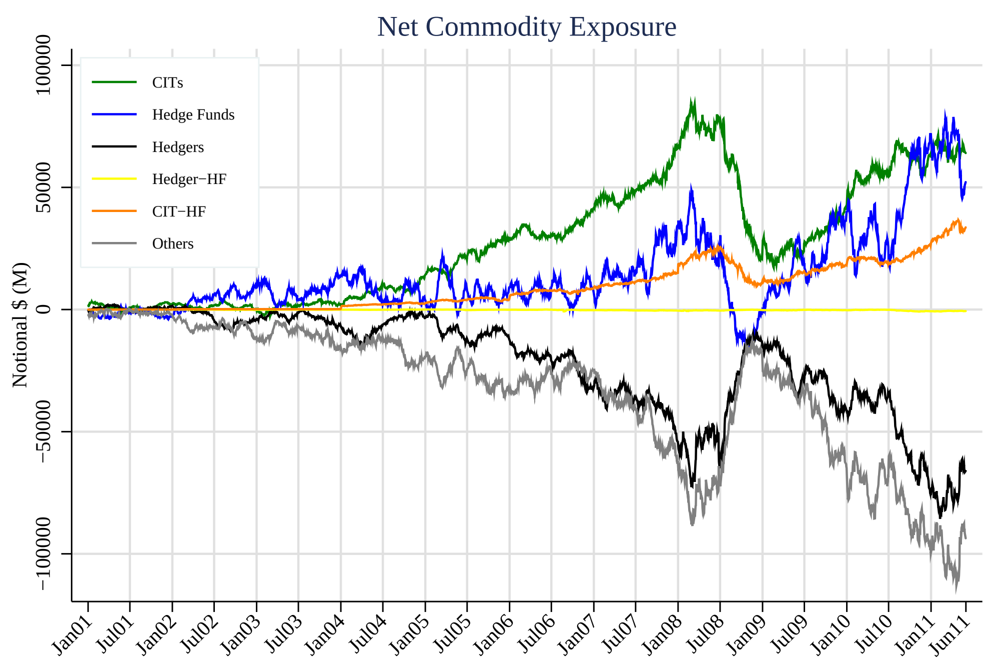


Figure 3: Net Commodity Exposures

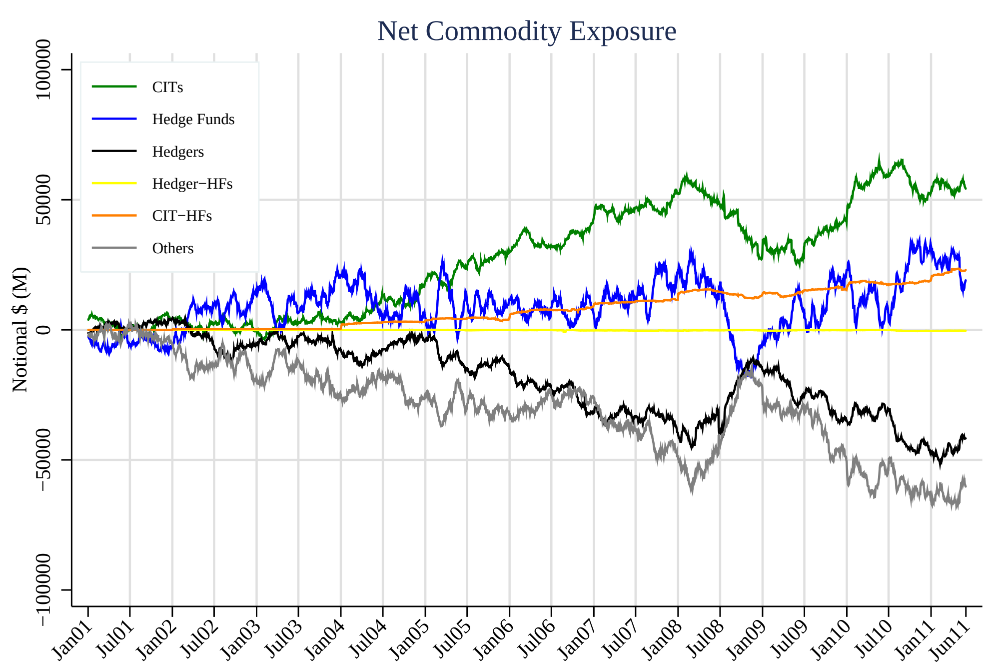
This figure plots the daily net notional value of positions held by the different trader groups. Panel A computes notional values using contemporaneous nearby prices adjusted for inflation to real 2006 prices. Panel B computes notional values using fixed nearby prices as of December 15, 2006.

Panel A



Exposure defined as Net Position(t) x Front Month Price(t), Real Dec2006 $

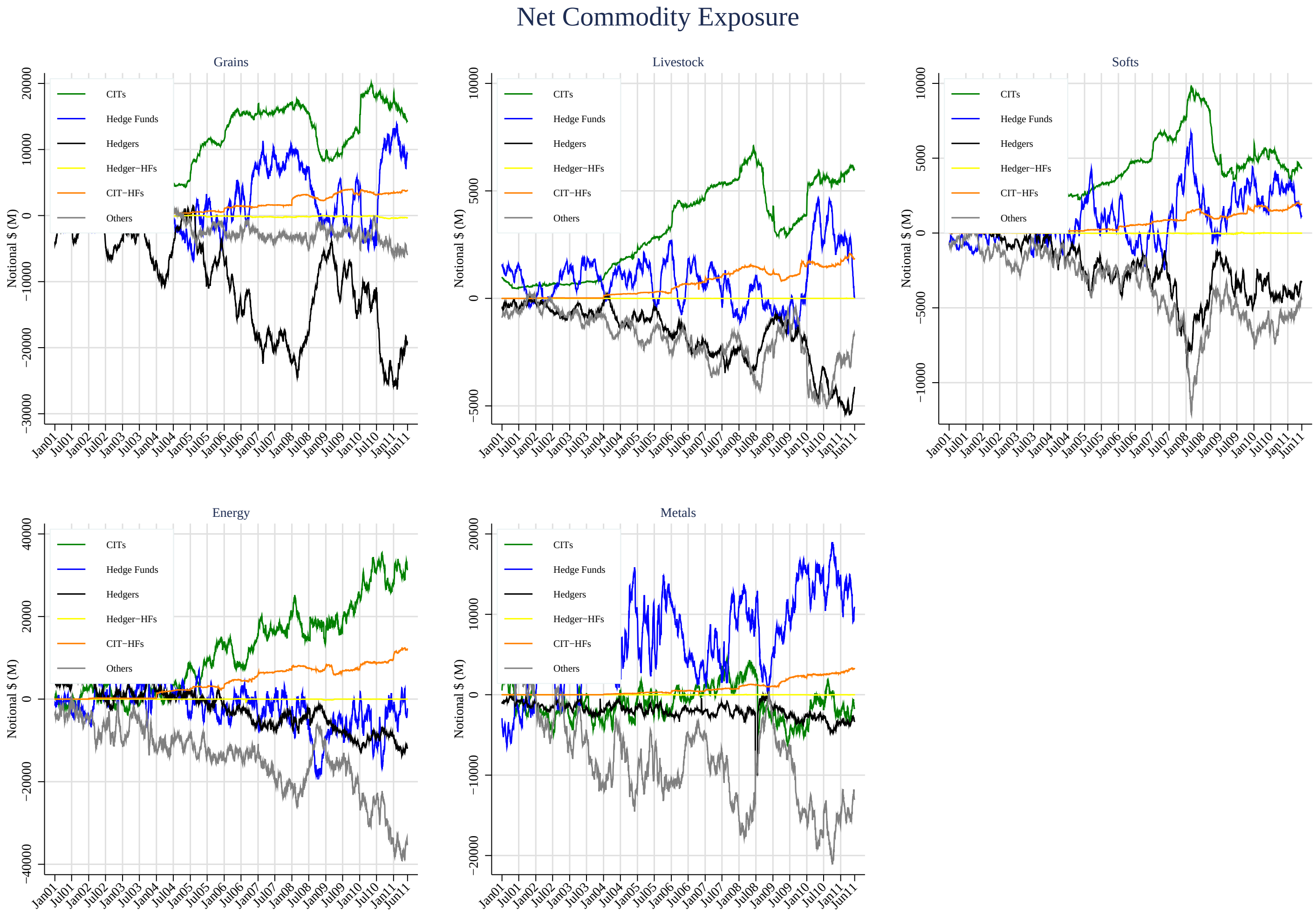
Panel B



Exposure defined as Net Position(t) x Front Month Price(15Dec2006)

Figure 4: Net Commodity Exposure by Sector

This figure plots the daily net notional value of positions held by the different trader groups across each commodity sector. Notional values were computed using fixed nearby prices as of December 15, 2006.



Exposure defined as Net Position(t) x Front Month Price(15Dec2006)

Table 1: Commodities

We list the 19 U.S. indexed commodities compromising the S&P GSCI and Dow Jones-UBS Commodity Indices in 2011. Aluminum, brent crude oil, lead, gasoil, nickel, and zinc are not included as they are not traded on U.S. exchanges. For a given commodity, each index tracks the same contract (e.g., Sugar #11 traded on ICE), except for Copper, noted below.

Sector	Commodity Name	Exchange	GSCI	DJ-UBS
Grains	Chicago Wheat	CME/CBT	X	X
	Corn	CME/CBT	X	X
	Kansas City Wheat	KBCT	X	
	Soybeans	CME/CBT	X	X
	Soybean Oil	CME/CBT		X
Livestock	Feeder Cattle	CME	X	
	Lean Hogs	CME	X	X
	Live Cattle	CME	X	X
Softs	Cocoa	ICE	X	
	Coffee	ICE	X	X
	Cotton #2	ICE	X	X
	Sugar #11	ICE	X	X
Energy	Crude Oil	CME/NYMEX	X	X
	Heating Oil	CME/NYMEX	X	X
	Natural Gas	CME/NYMEX	X	X
	RBOB Gasoline	CME/NYMEX	X	X
Metals	Copper	CME/COMEX	X	X
	Gold	CME/COMEX	X	X
	Silver	CME/COMEX	X	X

Table 2: Trader Characteristics

We report the number of traders and trader characteristics by year and trader category. Panel A gives the counts of traders, while Panel B gives the median notional value of each traders' positions during the year. Panel C reports the average number of commodities with any exposure. Panel D reports the average percentage of contracts long. For security reasons, the number of traders for CIT-HF and Hedger-HFs are concealed as they are very small.

Panel A: Number of Traders

Ranking Year	Population	CIT	C.Hedger	Hedge Fund	CIT-HF	Hedger-HF	Others
2000	4822	4	810	324			3672
2001	4576	4	857	334			3369
2002	4729	6	953	391			3363
2003	4990	6	1075	466			3424
2004	5376	9	1169	567			3610
2005	5197	9	1208	688			3267
2006	5664	12	1453	874			3293
2007	5629	12	1483	974			3123
2008	5667	15	1503	1089			3027
2009	5148	20	1332	1082			2686
2010	5699	18	1465	1116			3072

Panel B: Median Notional Net Position, 15Dec2006 Indexed Contract Prices $M

Ranking Year	Population	CIT	C. Hedger	Hedge Fund	CIT-HF	Hedger-HF	Others
2000	0.026	549.758	-2.434	0.806	.	-3.936	0.070
2001	0.014	527.124	-1.056	-0.039	181.463	-2.463	0.055
2002	0.005	315.939	-2.970	1.712	314.100	-4.127	0.046
2003	0.023	482.972	-2.482	2.394	278.254	-4.814	0.056
2004	-0.008	352.938	-3.265	0.720	388.174	-5.765	0.000
2005	-0.181	1893.471	-3.626	0.110	487.965	-5.048	-0.041
2006	-0.103	1737.572	-4.760	0.192	297.596	-7.797	0.000
2007	-0.191	2678.250	-5.569	0.368	403.775	-6.402	-0.024
2008	-0.291	2335.372	-5.301	0.200	483.518	-6.139	-0.014
2009	-0.261	1746.668	-5.084	0.438	546.638	-4.362	-0.054
2010	-0.242	2332.411	-7.128	1.362	725.793	-6.736	-0.013

Panel C: Average Number of Commodities with Any Exposure

Ranking Year	Population	CIT	C. Hedger	Hedge Fund	CIT-HF	Hedger-HF	Others
2000	1.257	14.925	1.246	2.364	.	1.011	1.147
2001	1.268	15.070	1.215	2.427	9.382	1.166	1.148
2002	1.263	15.629	1.210	2.442	12.516	1.106	1.113
2003	1.289	16.383	1.210	2.387	10.616	1.053	1.131
2004	1.328	16.345	1.204	2.543	13.727	1.160	1.128
2005	1.373	16.795	1.194	2.593	14.099	1.164	1.113
2006	1.415	17.626	1.200	2.571	13.637	1.337	1.101
2007	1.480	18.493	1.243	2.634	13.380	1.233	1.111
2008	1.502	17.627	1.239	2.410	13.894	1.164	1.174
2009	1.549	16.227	1.208	2.506	14.686	1.154	1.161
2010	1.574	16.713	1.242	2.594	14.553	1.221	1.216

Table 2, Continued

Panel D: Average Percentage of Contracts Long

Ranking Year	Population	CIT	C. Hedger	Hedge Fund	CIT-HF	Hedger-HF	Others
2000	0.522	0.860	0.394	0.599	.	0.212	0.545
2001	0.528	0.858	0.449	0.512	1.000	0.413	0.550
2002	0.521	0.842	0.400	0.609	0.999	0.206	0.546
2003	0.520	0.863	0.392	0.646	0.947	0.331	0.542
2004	0.495	0.894	0.367	0.587	0.981	0.207	0.522
2005	0.465	0.873	0.352	0.545	0.986	0.193	0.489
2006	0.469	0.887	0.323	0.563	0.987	0.221	0.506
2007	0.452	0.893	0.295	0.581	0.991	0.190	0.484
2008	0.448	0.873	0.299	0.549	0.984	0.248	0.483
2009	0.452	0.880	0.301	0.575	0.979	0.235	0.473
2010	0.445	0.872	0.250	0.604	0.963	0.229	0.477

Table 3: Time Series Summary Statistics for Flows and Returns

We report summary statistics for 19 indexed commodities at a weekly frequency. Indexed contract returns are expressed in basis points, while flows are expressed as notional dollar values ($M) normalized using indexed contract prices on December 15, 2006. Panel A reports summary statistics for the period September 15, 2008 onwards. Panel B reports the ratio of trader flow volatilities for September 15, 2008 onwards, as well as for the periods January 1, 2006 to September 15, 2008 and January 1, 2001 to January 1, 2006.

Panel A: Summary Statistics, 15Sep2008-01Jun2011

Sector	Commodity	Mean Indexed Contract Return	SD Indexed Contract Return	SD Flow: CIT	SD Flow: HF	SD Flow: C. Hedger	SD Flow: Other Unclass.	T
Grains	Chicago Wheat	-14.5	547.3	103.7	194.6	141.7	132.4	142
	Corn	13.5	566.7	177.6	457.1	391.1	204.3	142
	Kansas City Wheat	4.8	509.3	28.8	78.7	92.8	44.3	142
	Soybeans	23.9	422.3	121.6	429.7	386.7	254.9	142
	Soybean Oil	10.1	441.3	49.2	150.6	139.7	104.9	142
Livestock	Feeder Cattle	-1.3	222.4	16.8	55.5	28.4	35.5	142
	Lean Hogs	-28.2	370.8	50.2	105.7	52.6	113.2	142
	Live Cattle	-14.1	209.9	81.9	194.0	118.3	141.5	142
Softs	Cocoa	12.6	447.2	17.3	53.1	38.8	41.5	142
	Coffee	40.3	454.9	68.8	204.5	171.7	108.5	142
	Cotton #2	68.4	532.2	62.9	125.4	67.3	145.6	142
	Sugar #11	50.6	615.4	98.0	136.5	160.3	158.2	142
Energy	Crude Oil	-27.7	619.5	851.8	1173.7	388.5	755.3	142
	Heating Oil	-6.4	566.1	288.1	567.0	264.2	526.9	142
	Natural Gas	-99.3	655.3	512.5	834.1	244.8	637.2	142
	RBOB Gasoline	16.7	616.7	156.8	519.3	279.4	479.9	142
Metals	Copper	29.0	486.0	121.7	267.8	78.8	253.0	142
	Silver	98.0	573.4	123.7	216.6	63.1	143.4	142
	Gold	49.4	295.9	493.4	741.5	182.9	627.0	142

Panel B: Ratio of Flow Volatilities, Grain/Livestock/Softs Average

Period:	HF/CIT	C. Hedger /CIT	Other/CIT	HF /C. Hedger
15Sep2008-01Jun2011	2.6	2.0	1.8	1.4
01Jan2006-15Sep2008	3.5	2.6	2.4	1.5
01Jan2001-01Jan2006	6.3	4.2	4.2	1.6

Table 4: Commodity Returns and the VIX

We report coefficients from a weekly regression of commodity returns as the left-hand side variable on contemporaneous and one lag of changes in the VIX as right hand side variables, controlling for lagged commodity returns, percentage changes in the BDI, changes in the Baa credit spread, and changes in inflation compensation. Each row reports coefficients for a different commodity and each set of columns reports coefficients for different sample periods. For brevity, only the coefficients on the contemporaneous change in VIX are reported. Coefficients are reported where both returns and the VIX are in basis points. We use the Newey and West (1987) construction for standard errors with four lags. */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively.

Coefficient on Contemporaneous ΔVIX

		Post-Crisis				**Pre-Crisis**			
		15Sep2008-01Jun2011 *T*=142 Weeks		**01Jan2010-01Jun2011** *T*=74 Weeks		**01Jan2006-15Sep2008** *T*=141 Weeks		**01Jan2001-01Jan2006** *T*=262 Weeks	
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic
Grains	Chi W	-0.6174	[-6.8105]***	-0.9345	[-3.8257]***	0.0068	[0.0303]	0.0747	[0.8290]
	Corn	-0.4551	[-3.8024]***	-0.7121	[-4.8204]***	-0.1429	[-0.8316]	-0.0166	[-0.1937]
	KC W	-0.5688	[-6.9442]***	-0.8676	[-3.9568]***	-0.0354	[-0.1510]	0.113	[1.2397]
	Soybeans	-0.3718	[-4.6336]***	-0.4896	[-3.4953]***	-0.0344	[-0.2206]	0.0203	[0.2320]
	Soyb Oil	-0.4115	[-4.9881]***	-0.4951	[-4.1131]***	-0.0384	[-0.2652]	-0.0587	[-0.6628]
Livestock	F Cattle	-0.2252	[-3.9118]***	0.0065	[0.1067]	0.0524	[0.5151]	0.0477	[0.9251]
	L Hogs	-0.0919	[-1.1710]	-0.3613	[-2.3938]**	0.0143	[0.1208]	-0.1337	[-1.3270]
	L Cattle	-0.1963	[-4.9440]***	-0.0775	[-1.1357]	-0.042	[-0.4006]	0.0666	[1.3047]
Softs	Cocoa	-0.2134	[-2.3469]**	-0.1228	[-0.7663]	-0.3467	[-1.7125]*	-0.0691	[-0.5049]
	Coffee	-0.2914	[-4.0742]***	-0.4263	[-2.2689]**	-0.2348	[-1.7615]*	0.0336	[0.2606]
	Cotton	-0.371	[-6.4895]***	-0.3929	[-1.9713]*	-0.0891	[-0.5968]	-0.1032	[-0.8861]
	Sugar	-0.2701	[-2.0996]**	-0.5985	[-2.1881]**	-0.0577	[-0.3413]	0.2296	[1.7985]*
Energy	Oil	-0.4674	[-3.7665]***	-0.4941	[-2.6536]***	0.0206	[0.1382]	-0.076	[-0.6132]
	Heat Oil	-0.4134	[-3.7817]***	-0.3638	[-2.5819]**	0.0719	[0.4626]	-0.1516	[-1.1289]
	Nat Gas	-0.3597	[-2.5277]**	-0.3229	[-1.1624]	-0.0572	[-0.2505]	-0.2669	[-1.5913]
	Gas	-0.3531	[-2.4924]**	-0.4439	[-2.9168]***	0.1	[0.5812]		
Metals	Copper	-0.3648	[-3.9503]***	-0.6387	[-5.1094]***	-0.4338	[-1.8313]*	-0.1942	[-2.8210]***
	Gold	-0.1199	[-1.1664]	-0.0917	[-0.7926]	-0.1203	[-0.6312]	-0.0175	[-0.3034]
	Silver	-0.332	[-2.3913]**	-0.431	[-1.5223]	-0.4193	[-1.5138]	-0.0854	[-0.9789]

Table 5: Position Changes and the VIX

We report coefficients from a weekly regression of position changes as the left-hand side variable on contemporaneous and one lag of changes in the VIX as right hand side variables, controlling for lagged commodity returns, percentage changes in the BDI index, changes in the Baa credit spread, and changes in inflation compensation. Each row reports coefficients for a different commodity, and each column reports coefficients for different trader groups. The sample period is September 15, 2008 through June 1, 2011. Changes in the VIX are measured in basis points and flows are the number of contracts normalized to a dollar value (in millions) by multiplying the quantity of contracts by fixed prices on December 15, 2006. For brevity, only the term on the contemporaneous change in VIX is reported. We use the Newey and West (1987) construction for standard errors with four lags. */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively.

Panel A: Post-Crisis, 15Sep2008-01Jun2011 (*T*=142 Weeks)

		Post-Crisis, 15Sep2008-01Jun2011 (T=142 Weeks)							
		CITs		**Hedge Funds**		**C.Hedgers**		**Other Unclassified**	
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic
Grains	Chi W	-0.0406	[-2.0679]**	-0.0992	[-2.6972]***	0.0983	[3.9693]***	0.0537	[1.6003]
	Corn	-0.0718	[-1.8418]*	-0.1729	[-1.7389]*	0.1217	[1.6063]	0.0901	[2.5066]**
	KC W	-0.0127	[-2.3353]**	-0.0242	[-1.6728]*	0.0477	[2.7001]***	0.0004	[0.0600]
	Soybeans	-0.0613	[-2.2734]**	-0.1772	[-1.8907]*	0.1703	[2.3964]**	0.1277	[2.5582]**
	Soyb Oil	-0.0115	[-1.0703]	-0.0437	[-1.3787]	0.05	[1.5339]	0.0368	[2.3800]**
Livestock	F Cattle	-0.0034	[-1.3905]	-0.0089	[-0.8355]	0.0119	[2.3098]**	-0.003	[-0.5542]
	L Hogs	-0.0208	[-1.0839]	-0.0144	[-1.0220]	-0.0004	[-0.0404]	0.0546	[2.2974]**
	L Cattle	-0.0705	[-2.7050]***	-0.026	[-0.6738]	0.0481	[2.4147]**	0.0519	[2.3585]**
Softs	Cocoa	-0.0045	[-1.0804]	0.0004	[0.0404]	0.0036	[0.7471]	0.006	[0.5533]
	Coffee	-0.0609	[-3.6880]***	-0.0647	[-1.6287]	0.0834	[2.7330]***	0.0506	[2.4617]**
	Cotton	-0.0299	[-2.0970]**	-0.0544	[-2.3864]**	0.0352	[2.7333]***	0.0818	[2.7030]***
	Sugar	-0.0644	[-2.3465]**	-0.0477	[-1.7686]*	0.0533	[2.2771]**	0.089	[2.7478]***
Average R-Squared		9.45%		15.99%		15.76%		9.77%	

Table 5, continued

Panel B: Pre-Crisis, 01Jan2006-15Sep2008 (*T*=141 Weeks)

		Coefficient on Contemporaneous ΔVIX							
		CITs		**Hedge Funds**		**C.Hedgers**		**Other Unclassified**	
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic
Grains	Chi W	0.0489	[1.4619]	0.1694	[2.3234]**	-0.0813	[-1.4291]	-0.128	[-2.7704]***
	Corn	0.0242	[0.3914]	-0.0223	[-0.1528]	0.104	[0.7782]	-0.0722	[-1.0279]
	KC W	0.0114	[1.6206]	0.0254	[0.6491]	-0.0397	[-0.8581]	0.0015	[0.0640]
	Soybeans	0.0481	[1.0047]	0.0375	[0.2697]	-0.0594	[-0.5393]	-0.1231	[-1.2378]
	Soyb Oil	0.0143	[1.1623]	-0.0233	[-0.4291]	0.0316	[0.7071]	-0.0158	[-0.4083]
Livestock	F Cattle	0.0102	[1.1226]	-0.0245	[-1.6905]*	0.001	[0.1283]	0.0106	[0.7442]
	L Hogs	-0.0429	[-1.7085]*	-0.0459	[-1.4848]	-0.0206	[-1.0118]	0.1103	[2.2984]**
	L Cattle	-0.0031	[-0.1626]	-0.0044	[-0.0608]	0.0444	[1.2345]	-0.021	[-0.4048]
Softs	Cocoa	0.0045	[0.7035]	-0.0737	[-2.0659]**	0.0362	[1.3269]	0.0273	[1.3053]
	Coffee	-0.0116	[-0.6407]	0.0006	[0.0076]	0.0177	[0.3468]	0.0064	[0.1122]
	Cotton	-0.0014	[-0.0431]	0.026	[0.3804]	-0.0216	[-0.7584]	0.0185	[0.2223]
	Sugar	-0.0647	[-1.7767]*	-0.0454	[-0.6309]	0.0735	[0.5311]	0.0798	[0.7674]

Panel C: 01Jan2001-01Jan2006 (T=262 Weeks)

		CITs		**Hedge Funds**		**C.Hedgers**		**Other Unclassified**	
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic
Grains	Chi W	0.0002	[0.0182]	-0.0005	[-0.0151]	-0.0113	[-0.4594]	0.0189	[0.7776]
	Corn	0.0265	[1.7070]*	-0.015	[-0.2191]	0.0014	[0.0199]	0.0025	[0.0879]
	KC W	-0.0059	[-1.5424]	0.0314	[1.7672]*	-0.0288	[-1.7969]*	-0.0054	[-0.3117]
	Soybeans	0.0383	[2.8007]***	-0.012	[-0.2053]	-0.0168	[-0.2548]	-0.0023	[-0.0629]
	Soyb Oil	0.0009	[0.3881]	-0.0119	[-0.5025]	0.0165	[0.5717]	0.0104	[0.7378]
Livestock	F Cattle	0.0005	[0.7531]	0.0129	[1.1078]	-0.0012	[-0.2722]	-0.0073	[-0.9909]
	L Hogs	0.0012	[0.5510]	-0.0023	[-0.1698]	-0.0054	[-0.8415]	0.0055	[0.4722]
	L Cattle	-0.0027	[-0.6116]	0.0351	[1.1263]	-0.0372	[-2.4287]**	0.0258	[1.3559]
Softs	Cocoa	0.0008	[0.6870]	-0.0313	[-1.8719]*	0.0109	[1.0440]	0.021	[1.5734]
	Coffee	-0.002	[-0.2604]	0.0018	[0.0373]	-0.0116	[-0.4158]	0.0119	[0.3739]
	Cotton	0.0032	[1.3217]	0.0282	[0.8339]	-0.0055	[-0.3269]	-0.0242	[-0.9760]
	Sugar	-0.0025	[-0.6526]	0.0848	[1.8658]*	-0.0719	[-2.1661]**	-0.0343	[-1.2563]

Table 6: Financial Distress and CIT Position Changes

We report coefficients from a weekly account-level panel regression of CIT position changes as the left-hand side variable on changes in the VIX, an indicator for whether the trader has a CDS spread above the median, and an interaction between the two, controlling for lagged commodity returns, percentage changes in the BDI index, changes in the Baa credit spread, and changes in inflation compensation. Each row reports coefficients for a different commodity. The sample period is September 15, 2008 through June 1, 2011. Changes in the VIX are measured in basis points and flows are the number of contracts normalized to a dollar value (in millions) by multiplying the quantity of contracts by fixed prices on December 15, 2006. Standard are clustered at the week level (*T*=142). */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively.

		CDS Hi/Lo		**Change in VIX**		**Interaction**		***N***	**R-Squared**
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic		
Grains	Chi W	-2.4707	[-1.4571]	0.0006	[0.3021]	-0.0063	[-2.3222]**	1480	0.0083
	Corn	1.2416	[0.4841]	0.0015	[0.4648]	-0.0124	[-2.3353]**	1480	0.0124
	KC W	0.7686	[1.5370]	-0.0007	[-0.9089]	-0.0012	[-1.3178]	1333	0.0126
	Soybeans	0.1508	[0.0711]	-0.0033	[-1.1243]	0.0003	[0.0611]	1480	0.0099
	Soyb Oil	-0.4106	[-0.4452]	-0.0006	[-0.5533]	0.0001	[0.0752]	1421	0.0074
Livestock	F Cattle	-0.2099	[-0.5660]	0	[-0.0119]	-0.0006	[-0.7565]	1227	0.0069
	L Hogs	-1.1912	[-1.3219]	-0.0007	[-0.7136]	-0.0008	[-0.3948]	1422	0.0189
	L Cattle	-1.4333	[-1.0355]	-0.0049	[-2.4045]**	-0.002	[-0.5185]	1422	0.0202
Softs	Cocoa	-0.3576	[-0.7369]	0.0001	[0.1206]	-0.0009	[-0.4630]	1244	0.0034
	Coffee	-1.5446	[-1.6353]	-0.0007	[-0.4404]	-0.0066	[-3.0605]***	1422	0.0316
	Cotton	-0.7968	[-0.8265]	0.001	[0.7768]	-0.0053	[-1.9560]*	1420	0.0234
	Sugar	-1.6204	[-1.1252]	0.0006	[0.2197]	-0.0079	[-2.0602]**	1480	0.0155

Table 7: Commercial Hedgers and Hedge Fund Sub-Groups

We report coefficients from a weekly regression of position changes as the left-hand side variable on contemporaneous and one lag of changes in the VIX as right hand side variables, controlling for lagged commodity returns, percentage changes in the BDI index, changes in the Baa credit spread, and changes in inflation compensation. Each row reports coefficients for a different commodity, and each column reports coefficients for different trader groups. The sample period is September 15, 2008 through June 1, 2011 (T=142 weeks). Changes in the VIX are measured in basis points and flows are the number of contracts normalized to a dollar value (in millions) by multiplying the quantity of contracts by fixed prices on December 15, 2006. For brevity, only the term on the contemporaneous change in VIX is reported. We use the Newey and West (1987) construction for standard errors with four lags. */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively.

		C.Hedgers, Long		**C.Hedgers, Short**	
CIT Position Changes		Coef.	t-statistic	Coef.	t-statistic
Grains	Chi W	0.0065	[1.9214]*	0.0918	[3.9348]***
	Corn	-0.0011	[-0.0612]	0.1168	[1.7359]*
	KC W	0.0008	[0.1143]	0.0445	[3.2131]***
	Soybeans	0.0007	[0.0456]	0.1507	[2.2548]**
	Soyb Oil	0.0193	[1.3809]	0.0338	[1.4093]
Livestock	F Cattle	0.0019	[1.0432]	0.0068	[2.0401]**
	L Hogs	0.0031	[1.3733]	0.0011	[0.1688]
	L Cattle	-0.0051	[-1.4066]	0.0578	[3.0390]***
Softs	Cocoa	0.0006	[0.2442]	0.0032	[0.7040]
	Coffee	0.0121	[1.7131]*	0.0787	[2.7089]***
	Cotton	-0.003	[-1.8002]*	0.0346	[2.7801]***
	Sugar	-0.0088	[-2.2474]**	0.0551	[2.4479]**
Average R-Squared		7.85%		13.51%	

Table 8: Active and Passive Commercial Hedgers

We test whether active commercial hedgers behave differently than passive commercial hedgers in aggregate by constructing a weekly panel of aggregate position changes for these two groups. This table reports the coefficients from regressing these weekly changes as the left-hand side variable on changes in the VIX, an indicator for the active group, and an interaction between the two, controlling for lagged commodity returns, percentage changes in the BDI, changes to the Baa credit spread, and changes to break-even inflation compensation. The sample period is September 15, 2008 through June 1, 2011. Changes in the VIX are measured in basis points and flows are the number of contracts normalized to a dollar value (in millions) by multiplying the quantity of contracts by fixed prices on December 15, 2006. For brevity, the term on the lagged commodity return is omitted. Standard are clustered at the week level (*T*=142). */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively.

		Active Trader Flag		**Change in VIX**		**Interaction**		**R-Squared**
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	
Grains	Chi W	-2.2906	[-0.2827]	0.0157	[1.7490]*	0.0681	[4.3833]***	0.1281
	Corn	4.1253	[0.2057]	0.0491	[1.6723]*	0.0026	[0.0777]	0.0757
	KC W	-2.7796	[-0.4950]	0.013	[1.4698]	0.014	[1.1340]	0.0867
	Soybeans	-7.0281	[-0.2957]	0.0036	[0.2496]	0.13	[2.5159]**	0.0728
	Soyb Oil	-4.0109	[-0.4364]	0.0121	[1.2002]	0.0286	[1.7098]*	0.0694
Livestock	F Cattle	0.3638	[0.2653]	0.0031	[1.2106]	0.0023	[0.9191]	0.1408
	L Hogs	-0.0625	[-0.0156]	0.0032	[0.8702]	-0.0075	[-1.0000]	0.0209
	L Cattle	1.5305	[0.2612]	0.0099	[1.2379]	0.0172	[1.0942]	0.0853
Softs	Cocoa	-3.9815	[-1.6633]*	0.0074	[1.6289]	-0.0101	[-1.9346]*	0.165
	Coffee	1.8139	[0.2954]	0.0477	[2.6561]***	-0.0118	[-0.8943]	0.269
	Cotton	0.3193	[0.0850]	-0.0003	[-0.0483]	0.0246	[2.7797]***	0.0719
	Sugar	4.5892	[0.3875]	-0.0019	[-0.1909]	0.049	[1.9074]*	0.0329

Table 9: Analysis of Commitment of Traders Data

We report coefficients from a weekly regression of position changes as the left-hand side variable on contemporaneous and one lag of changes in the VIX as right hand side variables, controlling for lagged commodity returns, percentage changes in the BDI index, changes in the Baa credit spread, and changes in inflation compensation. Each row reports coefficients for a different commodity, and each column reports coefficients for different trader groups from the Commitment of Traders reports. The sample period is September 15, 2008 through June 1, 2011 (T=142 weeks). Changes in the VIX are measured in basis points and flows are the number of contracts normalized to a dollar value (in millions) by multiplying the quantity of contracts by fixed prices on December 15, 2006. For brevity, only the term on the contemporaneous change in VIX is reported. We use the Newey and West (1987) construction for standard errors with four lags. */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively.

		Disaggregated COT Report								**CIT Supplemental**	
		Producers		**Swap Dealers**		**Managed Money**		**Other Non-Comm.**		**CITs**	
		Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic	Coef.	t-statistic
Grains	Chi W	0.1459	[3.5170]***	-0.02	[-1.1457]	-0.0864	[-2.0865]**	-0.0005	[-0.0200]	-0.0228	[-1.6602]*
	Corn	0.2167	[2.1785]**	-0.0378	[-1.3665]	-0.1776	[-1.8407]*	0.0267	[1.0308]	-0.0993	[-3.5983]***
	KC W	0.0532	[3.0400]***	-0.0085	[-1.4402]	-0.0225	[-1.4432]	-0.0123	[-1.7798]*	-0.015	[-2.4855]**
	Soybeans	0.2734	[2.6283]***	-0.0361	[-1.4866]	-0.1856	[-2.0988]**	0.0712	[2.7371]***	-0.074	[-2.7992]***
	Soyb Oil	0.0697	[1.7575]*	-0.0076	[-0.8161]	-0.0475	[-1.4857]	0.0412	[3.2438]***	-0.0164	[-1.9086]*
Livestock	F Cattle	0.0166	[2.3488]**	-0.003	[-1.0045]	-0.0125	[-1.2046]	0.0058	[1.0483]	-0.0028	[-0.7466]
	L Hogs	0.0172	[0.8837]	-0.0066	[-0.4727]	-0.0217	[-1.5049]	0.0088	[0.8128]	-0.0085	[-0.5590]
	L Cattle	0.079	[2.4195]**	-0.0375	[-2.4722]**	-0.0463	[-1.1485]	-0.0027	[-0.1026]	-0.0575	[-3.0275]***
Softs	Cocoa	0.0099	[0.9047]	-0.002	[-0.5053]	0.0049	[0.4912]	-0.0048	[-2.0938]**	-0.0004	[-0.0712]
	Coffee	0.1112	[2.6026]**	-0.0336	[-2.5334]**	-0.0726	[-1.8089]*	0.0194	[1.4530]	-0.0388	[-2.8539]***
	Cotton	0.1093	[3.4673]***	-0.0231	[-1.4759]	-0.0463	[-1.8947]*	0.0240	[1.4492]	-0.0091	[-0.7493]
	Sugar	0.1128	[3.3121]***	-0.0547	[-1.7460]*	-0.0452	[-1.6949]*	-0.0112	[-1.3279]	-0.0454	[-1.9083]*
Average R-Squared		16.10%		8.54%		15.70%		6.99%		12.39%	

Table 10: Projected World Usage

We report coefficients from a monthly regression of position changes as the left-hand side variable on contemporaneous and one lag of changes in the VIX as right hand side variables, controlling for lagged commodity returns and the 12-month change in projected world usage for the upcoming harvest. The sample period is September 2008 through May 2011. Changes in the VIX are measured in basis points and flows are the number of contracts normalized to a dollar value (in millions) by multiplying the quantity of contracts by fixed prices on December 15, 2006. We use the Newey and West (1987) construction for standard errors with 1 lag. */**/*** denotes significant at the 10%, 5%, and 1% levels, respectively. For brevity, we do not report the constant term.

	CITs					Hedge Funds				
	Chi W	**Corn**	**Soybeans**	**Soyb Oil**	**Cotton**	**Chi W**	**Corn**	**Soybeans**	**Soyb Oil**	**Cotton**
ΔVIX (*t*)	-0.1065	-0.267	-0.1712	-0.0545	-0.0878	-0.1996	-0.4828	-0.6099	-0.1266	-0.0567
	[-2.3885]**	[-3.1240]***	[-3.1591]***	[-1.9653]*	[-1.9372]*	[-1.2962]	[-1.9413]*	[-1.8810]*	[-1.3703]	[-0.9586]
ΔVIX (*t*-1)	-0.0546	-0.0659	-0.0697	-0.0367	0.0157	0.061	-0.2776	-0.0717	-0.0523	-0.1715
	[-1.0689]	[-0.6371]	[-1.2017]	[-0.7851]	[0.3918]	[0.4167]	[-0.8140]	[-0.2269]	[-0.6000]	[-1.6444]
Futures Return (*t*-1)	-0.0673	-0.1209	-0.0387	-0.0235	0.0206	-0.0549	-0.1138	-0.1127	-0.1039	-0.0954
	[-1.3714]	[-1.7775]*	[-0.6946]	[-0.3939]	[0.7485]	[-0.4889]	[-0.5301]	[-0.3808]	[-1.1891]	[-1.9323]*
%ΔForecasted Usage (*t*)	-0.3392	-0.1847	-0.122	0.0011	-0.0227	0.0702	0.6058	0.1406	0.0494	-0.0136
	[-3.2590]***	[-0.7302]	[-1.9034]*	[0.0321]	[-0.7324]	[0.2693]	[0.5763]	[0.4487]	[0.4614]	[-0.2221]
Observations	33	33	33	33	33	33	33	33	33	33
R-Squared	0.347	0.272	0.282	0.0958	0.164	0.0861	0.0953	0.161	0.0826	0.158

	Commercial Hedgers					Other Unclassified				
	Chi W	**Corn**	**Soybeans**	**Soyb Oil**	**Cotton**	**Chi W**	**Corn**	**Soybeans**	**Soyb Oil**	**Cotton**
ΔVIX (*t*)	0.2473	0.4899	0.4512	0.2273	0.1329	0.1025	0.2325	0.377	0.0219	0.0616
	[3.1369]***	[2.3916]**	[1.8594]*	[2.7114]**	[2.7709]***	[1.5247]	[3.5796]***	[2.4591]**	[0.3608]	[1.0949]
ΔVIX (*t*-1)	-0.0394	0.5544	-0.0791	0.0626	0.0154	0.0366	-0.129	0.1825	0.0273	0.1731
	[-0.5098]	[1.8747]*	[-0.2905]	[0.6138]	[0.3638]	[0.4074]	[-1.4759]	[1.1532]	[0.6476]	[2.0459]*
Futures Return (*t*-1)	0.0611	0.2952	-0.069	0.0749	0.0108	0.058	0.0345	0.3192	0.0779	0.094
	[0.8750]	[1.6183]	[-0.3020]	[0.6938]	[0.3911]	[1.0097]	[0.4525]	[1.8761]*	[1.3700]	[1.8348]*
%ΔForecasted Usage (*t*)	0.0754	-0.6233	-0.0181	-0.008	0.0233	0.0983	-0.0997	-0.077	-0.0465	0.0102
	[0.5243]	[-0.7579]	[-0.0491]	[-0.1005]	[0.7299]	[1.3365]	[-0.4370]	[-0.6206]	[-0.5948]	[0.1571]
Observations	33	33	33	33	33	33	33	33	33	33
R-Squared	0.277	0.194	0.101	0.222	0.274	0.168	0.197	0.288	0.055	0.155