Futures market hedging pressure, speculative pressure and spot market volatility

by

Latha Shanker[a]

Abstract

Traditionally, hedging pressure is measured by the amount by which short hedging exceeds long hedging, while speculative pressure is measured by the amount by which long speculation exceeds hedging pressure. I offer new measures of hedging and speculative pressure which explicitly recognize that not all of long hedging equals balancing hedging contracts. When open short hedging is greater (less) than or equal to open long hedging, I define hedging pressure as the difference between short (long) hedging and balancing hedging contracts and speculative pressure as the difference between long (short) speculation and hedging pressure. I estimate hedging pressure and speculative pressure for 21 different futures contracts in 7 different groups. I show that, when balancing hedging contracts are explicitly accounted for, hedging pressure is higher and speculative pressure is lower in magnitude, than when estimated by the traditional measures of hedging and speculative pressure, respectively. I investigate the effects of the financialization of futures markets and the financial crisis upon the measures of hedging and speculative pressure, and the effect of the measures upon spot price volatility. The results indicate that hedging pressure has a destabilizing influence, while speculative pressure has a destabilizing or stabilizing influence, upon volatility in the spot market.

JEL codes: G13, G14, G18, G28
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[a] *Department of Finance, John Molson School of Business, Concordia University, 1455 de Maisonneuve Boulevard, West Montreal, QC, Canada H3G 1M8. Telephone number (514)848-2424 extension 2791. E-mail address latha.shanker@concordia.ca*

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1. Introduction

The effect of futures markets on the underlying spot markets has long been an area of interest to researchers. Some researchers have addressed the effect of the introduction of a futures market on the underlying cash market (Edwards, 1988, Figlewski, 1981, Powers, 1976). The introduction of futures trading could allow hedgers who have positions in the underlying cash market to transfer risk to speculators who are more willing or able to bear this risk and thus reduce the risk premium in the cash market. On the other hand, traders in the futures market who are not as well-informed as traders in the cash market could act so as to move the cash price away from its appropriate value and thereby increase the volatility of the underlying cash market.

Some researchers have addressed the effect of different groups of traders in an existing futures market upon the futures market itself or upon the underlying cash market. Traders who have been termed as commercials by the Commodity Futures Trading Commission (CFTC) in the sense that they have a position in the underlying cash market have traditionally been classified as hedgers, while noncommercial traders have been treated as speculators.

Gorton et al (2012), Sanders et al (2004), Wang (2002), De Roon et al (2000), Bessembinder (1992), and Chang (1985) have focused on the effect of hedging pressure on risk premiums in futures markets. Hedgers have positions in the cash market and wish to hedge by taking opposite positions in the futures market. Short hedgers own the underlying asset and hedge price risk by taking short positions in the futures market. Long hedgers plan to buy the underlying asset and hedge price risk by taking long positions in the futures markets. If long hedgers cannot meet the demand for futures contracts by short hedgers, speculators are needed to take positions in the futures contracts to meet the excess demand of short hedgers. Previous researchers on hedging pressure have generally used the net position of hedgers (short hedging minus long hedging) to estimate hedging pressure.

Other researchers have addressed the effect of speculative pressure upon the futures markets or the underlying cash markets. The measures of speculative pressure included Working's (1960) speculative *T* index (Robe and Wallen, 2016, Bozic et al, 2015, Buyyuksahin and Robe, 2014, Manera et al, 2013), the net positions of noncommercial traders (Algieri, 2016, Kim, 2015, Ding et al, 2014, Robles et al, 2009), and trading by specific types of traders such as index funds (Aulerich et al, 2014, Buyyuksahin et al, 2013), hedge funds (Brunetti et al, 2016) or managed money traders (Fishe et al, 2014).

The definition of hedging pressure by the net position of hedgers implicitly assumes that all of long hedging offsets short hedging. This assumption may not hold, since, as made clear by previous research, short and long hedgers may differ on the size and timing of their hedge positions as well as the length of the hedging horizon (Hirshleifer, 1990, Peck, 1979-1980, Keynes, 1923). Working (1960) provides a conceptual definition of excess speculation as the amount of speculation in excess of that required to meet unbalanced short hedging, which is short hedging in excess of balancing long hedging contracts. Shanker (2017) comes up with new measures of adequate and excess speculation in futures markets, which explicitly account for balancing hedging and balancing speculative contracts.

I extend Shanker's (2017) approach to come up with new measures of hedging pressure and speculative pressure, which explicitly take into account balancing hedging and balancing speculative contracts. Suppose that open short hedging exceeds long hedging contracts. Then the excess of short hedging contracts over balancing hedging contracts represents the amount of long speculation which is needed to meet unbalanced short hedging needs. The index of hedging pressure is the ratio of unbalanced short hedging to total short contracts (sum of short hedging and short speculation). Excess speculation is the amount by which long speculation exceeds unbalanced short hedging. This equals balancing speculative contracts. The index of speculative pressure is the ratio of balancing speculative contracts to total short contracts. In this case, both the indices of hedging pressure and speculative pressure are positive. Similarly, when open long hedging exceeds short hedging, then the index of hedging pressure is the ratio of unbalanced long hedging to total long contracts (sum of long hedging and long speculation) and the index of speculative pressure is the ratio of balancing speculative contracts to total long contracts. The first measure represents the amount of short speculation which is needed to meet unbalanced long hedging, while the second measure represents the excess of short speculation over that needed to meet unbalanced long hedging. Both measures are negative. Note that at any point in time, the total number of short contracts should equal the total number of long contracts, and therefore the denominator should be the same for each measure at any point in time. This allows for a comparison of the magnitude of the measures to each other and over time.

The index of hedging pressure is an estimate of the proportion of speculation which meets net hedging demand and therefore represents the proportion of speculation which earns a return based on bearing risk transferred from hedgers. The index of speculative pressure is an estimate of the proportion of speculation in excess of that required to meet net hedging demand and hence represents the proportion of speculation which earns a return based on forecasts of future prices. These indices of hedging pressure and speculative pressure can be used to determine the composition of traders in the market over time, and determine how this composition changes as institutional features of these markets such as margin requirements and price limits, are changed. Further, the index of hedging pressure can indicate whether hedging pressure at any point in time is due to short hedgers or long hedgers, as well as its magnitude. The index of speculative pressure can indicate whether speculative pressure at any point in time is due to long speculation or short speculation, as well as its magnitude.

I show that when balancing hedging contracts are taken into account, hedging pressure is higher in magnitude and speculative pressure is lower in magnitude than estimated by the traditional measures of hedging pressure and speculative pressure, respectively.

In Section 2, I provide the methodology and results of the empirical tests on the estimation of the indices of hedging and speculative pressure for 21 different futures contracts in 7 different groups, which includes Grains & Oilseeds, Livestock, Energy, Equity, Interest rate, Metal, and Foreign Exchange, and comparison to the traditional measures of hedging and speculative pressure. The results confirm the expectation, based on the definitions, that hedging pressure is higher in magnitude and speculative pressure is lower in magnitude than when estimated by the traditional measures.

Cheng and Xiong (2014) note that the effect of the financialization of futures markets (which refers to the flow of investment capital into futures markets, similar to the flow into stocks and bonds) upon commodity markets, should be addressed through a review of the mechanisms of risk-sharing and information discovery. Chan et al (2015) investigate the relationship between the ratio of trading volume to open interest, which they term the speculative ratio, and the crude oil futures basis, before and after financialization. Cheng et al (2014) address the effect of the financial crisis upon the commodity futures positions of financial traders and hedgers. In their model, hedgers are short, while financial traders are primarily long, the futures contract. Their model predicts that as a consequence of the reduced ability to bear risk which accompanied the crisis, financial traders would reduce, while hedgers would increase their long positions in the commodity futures markets. This conclusion is confirmed by their empirical research. In Section 3, I add to the research on the impact of financialization and the impact of the financial crisis on risk sharing and information discovery in futures markets by investigating the differences in hedging pressure and speculative pressure, in three different periods: pre-financialization, post-financialization/pre-financial crisis, and post-financial crisis.

Previous research has focused on the question of whether volatility in the spot markets is due to the effect of market fundamentals or due to futures market activity. I extend this analysis by addressing the effect of hedging pressure and of speculative pressure.

Figlewski (1981) notes that the ability of hedgers to hedge in the futures market rather than the spot market would decrease risk premiums in the spot market and, correspondingly, decrease spot market volatility. However, if hedging pressure builds in the futures market without adequate speculation to meet it, then the hedging pressure could spill into the spot market and cause increased spot market volatility. Baker (2012) also offers an explanation as to why hedging pressure from consumers of commodities in futures markets could cause increased volatility in the underlying spot markets. Suppose these consumers want to take long positions in futures contracts. Dealers could assume the opposite position and sell futures contracts to the long hedgers, and arbitrage between the futures and spot markets by buying the underlying commodity, thereby raising the spot price of the commodity and increasing volatility in the spot markets. Extending this argument to the case when hedgers want to sell futures contracts, we note that dealers would then assume long positions in the futures contract and arbitrage by selling the underlying commodity, thereby depressing the commodity price and increasing volatility in the spot market.

Friedman (1953) notes that speculators in currency markets could stabilize these markets, by buying (selling) the currency when the price is too low (high) when compared to its fundamental value. However, De Long et al (1990a, 1990b) explain that both noise traders and rational speculators could move prices away from fundamental values. Vercammen and Doroudian (2014) offer an explanation as to the impact of speculative pressure in futures markets upon volatility in the underlying spot market. When a portfolio investor diversifies by buying futures contracts, the futures price is bid up and being indicative of higher expected future spot prices, storage of the commodity increases. There are two effects associated with this increased storage—a stock effect and a flow effect. Under the stock effect, when net demand is low and prices are below average, the demand for storage will raise spot prices, while when net demand is high and prices are above average, the demand for storage will raise spot prices. Under the flow effect, when net demand is low, there will be an incentive to store less which will reduce spot prices, while when net demand is high, there will be an incentive to withdraw the commodity from storage, which will reduce spot prices. Their simulation shows that the stock effect dominates the flow effect when net demand is low and cash prices are below average, thus speculation reduces the drop in the spot price. However, the flow effect dominates the stock effect when net demand is high and spot prices are above average, thus speculation reduces the rise in the cash price. The net effect is that speculative pressure would have a stabilizing influence on the spot price.

In Section 3, I add to the research on the effect of market fundamentals and speculation in the futures market upon the volatility in the spot market, by empirically investigating the relationship between the volatility in the spot market, fundamental volatility and the indices of hedging pressure, and speculative pressure. The results indicate that for the contracts for which a significant effect is detected, volatility in the spot market increases with increases in fundamental volatility and hedging pressure, and increases or decreases with increases in speculative pressure. Section 4 provides conclusions.

2. Methodology and results of the estimation of the indices of hedging and speculative pressure

2.1 Data on the futures markets used in the analysis

The CFTC provides a breakdown of the open interest for reporting commercial and noncommercial traders and for non-reporting traders in its Commitment of Traders (COT) reports, for different futures contracts, on a bi-weekly basis prior to September 1992, and weekly thereafter. I obtain these data for 21 futures contracts in seven groups, grains and oilseeds (corn, soybeans, wheat), livestock (feeder cattle, lean hogs, live cattle), energy (crude oil, natural gas, heating oil), equity indexes

(DJIA, S&P 500, NASDAQ 100), interest rates (Eurodollar, 10-Year Tnote, U.S. Tbond), metals (copper, gold, silver), and foreign exchange (British pounds, Euro FX, Japanese yen), for the period 15 January 1986 or the date of contract initiation to 29 December 2015.

Historically, commercial open interest represented hedging positions, while noncommercial open interest represented speculative positions (CFTC, 2006). I allocate non-reporting traders' open interest into commercial and noncommercial categories by assuming that the ratio of commercial to noncommercial positions for non-reporting traders is the same as that for the reporting traders, as in Shanker (2017). I estimate the open interest of short (long) hedgers *HS* (*HL*) as the sum of the short open interest of reporting commercials and allocated non-reporting commercials, and the open interest of short (long) speculators *SS* (*SL*) as the sum of the short (long) open interest of reporting and allocated non-reporting noncommercials and the spread positions of noncommercials.

2.2 Definitions of the indices of hedging and speculative pressure

2.2.1 Hedging and speculative pressure when short hedging exceeds or equals long hedging

Suppose that open short hedging *HS* exceeds or equals open long hedging *HL*, so that $HS \geq HL$. Let *HB* represent balancing hedging contracts, which Working (1960, page 197, footnote 15) describes as "the amount of "balancing" long hedging, that serves to carry, or "balance", an equal amount of short hedging". In this case, unbalanced short hedging equals $HS\text{-}HB$. There is a need for long speculative contracts equal to $HS\text{-}HB$ to meet the needs of unbalanced short hedging. In this case, hedging pressure is long, and the index of hedging pressure *INDHEDGP* may be represented by:

$$INDHEDGP = \left(HS - HB\right) / TOI \qquad (1)$$

In equation (1), *TOI* represents the total open interest. This should equal open short contracts $HS+SS$ or open long contracts $HL+SL$.

Excess long speculation is the amount by which total long speculation *SL* exceeds unbalanced short hedging *HS-HB*. Since total long speculation equals that part which equals unbalanced short hedging, plus that part, *SB*, which serves to carry, or balance, an equal amount of short speculation, speculative pressure equals *SL – (HS-HB)* or *SB*. In this case, speculative pressure is long and the index of speculative pressure *INDSPECP* may be represented by:

$$INDSPECP = \left(SL - \left(HS - HB\right)\right) / TOI = SB / TOI \tag{2}$$

2.2.2 Hedging and speculative pressure when long hedging exceeds or equals short hedging

Suppose that long hedging exceeds or equals short hedging, so that $HS \geq HL$. In this case, unbalanced long hedging equals *HL-HB*. There is a need for short speculative contracts equal to *HL-HB* to meet the needs of unbalanced long hedging. In this case, hedging pressure is short, and the index of hedging pressure *INDHEDGP* may be represented by:

$$INDHEDGP = -\left(HL - HB\right) / TOI \tag{3}$$

Excess short speculation is the amount by which total short speculation *SS* exceeds unbalanced long hedging *HL-HB*. Since total short speculation equals that part which equals unbalanced long hedging, plus that part, *SB*, which serves to carry, or balance, an equal amount of long speculation, speculative pressure equals *SS – (HL-HB)* or *SB*. In this case, speculative pressure is short and the index of speculative pressure *INDSPECP* may be represented by:

$$INDSPECP = -\left(SS - \left(HS - HB\right)\right) / TOI = SB / TOI \tag{4}$$

2.3 Traditional measures of hedging and speculative pressure

The traditionally used measures of hedging pressure implicitly assume that when short hedging exceeds or equals long hedging, all of long hedging balances short hedging. Hence, when $HS \geq HL$, traditional measures of long hedging pressure *TRHEDGP* and long speculative pressure *TRSPECP* may be defined as:

$$TRHEDGP = \left(HS - HL\right) / TOI \tag{5}$$

$$TRSPECP = \left(SL - \left(HS - HL\right)\right) / TOI = SS / TOI \quad (6)$$

Comparing equations (1) and (5), since *HB* should be less than or equal to *HL*, we note that *INDHEDGP* should be greater than or equal to *TRHEDGP*. Comparing equations (2) and (6), since *SB* should be less than or equal to *SS*, we note that *INDSPECP* should be less than or equal to *TRSPECP.*

When long hedging exceeds or equals short hedging, the traditionally used measures of hedging pressure implicitly assume that all of short hedging balances long hedging. Hence, when $HL \geq HS$, traditional measures of short hedging pressure *TRHEDGP* and short speculative pressure *TRSPECP* may be defined as:

$$TRHEDGP = -\left(HL - HS\right) / TOI \quad (7)$$

$$TRSPECP = -\left(SS - \left(HL - HS\right)\right) / TOI = -SL / TOI \quad (8)$$

Comparing equations (3) and (7), since *HB* should be less than or equal to *HS*, we note that $|INDHEDGP|$ should be greater than or equal to $|TRHEDGP|$. Comparing equations (4) and (8), since *SB* should be less than or equal to *SL*, we note that $|INDSPECP|$ should be less than or equal to $|TRSPECP|$.

2.4 Estimations of the indices of hedging and speculative pressure and the traditional measures of hedging and speculative pressure

Estimation of the indices of hedging and speculative pressure and the traditional measures of hedging and speculative pressure need estimates of *HS, HL, SS* and *SL*. In addition, estimation of the indices of hedging and speculative pressure need estimates of balancing hedging *HB* and balancing speculation *SB*. I follow Shanker (2017) in order to estimate these variables. Note that long speculation *SL* equals the sum of that portion of long speculation which equals unbalanced short hedging *HS-HB* and that portion of long speculation which equals balancing speculation *SB*.

$$SL = (HS - HB) + SB \quad (9)$$

Dividing equation (9) throughout by *HS*, substituting $\frac{HB}{HL}.\left(-\frac{HL}{HS}\right)$ for $-\frac{HB}{HS}$ and simplifying, provides us with a linear relationship between the speculative ratio *SL/HS* and the hedging ratio *HL/HS*, as follows:

$$\frac{SL}{HS}-1=\frac{SB}{HS}+\frac{HB}{HL}.\left(-\frac{HL}{HS}\right) \tag{10}$$

The slope of equation (10) equals *HB/HL*, and the intercept equals *SB/HS*. Both should be greater than or equal to zero. Since balancing hedging and balancing speculative contracts should vary over time, the slope and intercept of equation (10) should also vary over time. While equation (10) represents the theoretical model, the empirical model that is to be estimated using the data may be written as:

$$\frac{SL_t}{HS_t}-1=\frac{SB_t}{HS_t}+\frac{HB_t}{HL_t}.\left(-\frac{HL_t}{HS_t}\right) \tag{11}$$

$$\frac{SL_t}{HS_t}-1=a_{0,t}+a_{1,t}\left(-\frac{HL_t}{HS_t}\right) \tag{12}$$

where $a_{0,t}=\frac{SB_t}{HS_t}$, $a_{1,t}=\frac{HB_t}{HL_t}$, $HS_t, HL_t, SL_t, HB_t,$ and SB_t represent open short hedging, long hedging, long speculation, balancing hedging and balancing speculative contracts at time *t*, respectively. Both the intercept $a_{0,t}$ and the slope $a_{1,t}$ of the above model are constrained to be greater than or equal to zero. Following Shanker (2017), I estimate the above model using a state space approach with constraints on the state estimates $a_{0,t}$ and $a_{1,t}$, where equation (12) represents the observation equation of the state space model. This is done by using constrained state-space estimation using Kalman smoothing. Once $a_{0,t}$ and $a_{1,t}$ are estimated, SB_t and HB_t may be estimated as $a_{0,t}.HS_t$ and $a_{1,t}.HL_t$, respectively.

Using the above approach, the indices of hedging and speculative pressure and the traditional measures of hedging and speculative pressure are estimated for the 21 different futures contracts, over a period extending from 31 January 1986 or the date of contract initiation to 29 December 2015. Estimates are biweekly prior to 1992 and weekly thereafter.

2.5 Comparison of the indices of hedging and speculative pressure with traditional measures of hedging and speculative pressure

Table 1 provides the mean and standard deviation of the indices of hedging and speculative pressure and the traditional measures of hedging and speculative pressure for the 21 different futures contracts. T-tests are used to compare the mean values of the index of hedging pressure with the traditional measure of hedging pressure and the index of speculative pressure with the traditional measure of speculative pressure. For 15/21 contracts, the magnitude of the index of hedging pressure is significantly higher than the traditional measure of hedging pressure. For 18/21 contracts, the magnitude of the index of speculative pressure is significantly lower than the traditional measure of speculative pressure. The results indicate that when balancing hedging and balancing speculation are taken into account, that hedging pressure is higher and speculative pressure is lower than estimated by the traditional measures of hedging and speculative pressure. The results are consistent with the expected relationship between the indices and the traditional measures of hedging and speculative pressure, based on their definitions.

2.6 Effect of financialization and the financial crisis

The index of hedging pressure estimates the need for speculation to bear the risk transferred by hedgers, while the index of speculative pressure captures speculation which is based on an expectation of future prices. Accordingly, these indices may be used to determine if there is a change in the mix of market participants as a consequence of financialization and of the financial crisis.

Cheng and Xiong (2014) note that financialization of commodity futures markets may be understood by examining the impacts upon risk sharing and information discovery. A consequence of financialization was that financial traders increased their long positions in the futures markets. If the financial traders' long positions were classified as hedging positions, long hedging pressure in these markets should have decreased. If their positions were classified as speculative, then long speculative pressure should have increased as a consequence of financialization.

Cheng et al (2014) state that as a result of the financial crisis, financial traders were less able to bear risk, and reduced their long positions in the commodity futures markets, while hedgers, who would have previously been short, increased their long positions in the futures market. Long hedging pressure could have increased or stayed the same, depending on whether the financial traders' positions were classified as hedging or speculative. It is not clear what the effect should be on speculative pressure.

I classify the grain and oilseed, livestock, and energy groups plus the copper futures contract as commodity futures, and the equity index, interest rate and foreign exchange groups plus the precious metals (gold and silver) as financial futures contracts. I break down the overall period of the data into three periods: 1) Period I is the pre-financialization period and extends from 31 January 1986 or the date of the futures contract initiation till 26 December 2000; 2) Period II is the post-financialization and pre-financial crisis period and extends from 2 January 2001 through 9 September 2008; and 3) Period III includes the financial crisis and post-financial crisis period and extends from 16 September 2008 through 29 December 2015. These classifications are used to determine if the index of hedging pressure *INDHEDGP*, and the index of speculative pressure *INDSPECP*, change over the three periods and are different for commodity and financial futures.

The following regression is conducted using the 26,868 observations for all of the futures contracts for the overall period:

$$y_{it} = a_1 f_{1,it} p_{1,it} + a_2 f_{1,it} p_{2,it} + a_3 f_{1,it} p_{3,it} + a_4 f_{2,it} p_{1,it} + a_5 f_{2,it} p_{2,it} + a_6 f_{2,it} p_{3,it} + \varepsilon_t \tag{13}$$

For an observation on a futures contract *i* at time *t*: y_{it} is the dependent variable, which is in turn *INDHEDGP,* and *INDSPECP,* $f_{1,it}$ =1 for a commodity futures contract and 0 otherwise, $f_{2,it}$ =1 for a financial futures contract and 0 otherwise, $p_{1,it}$ = 1 for Period I and 0 otherwise, $p_{2,it}$ = 1 for Period II and is 0 otherwise, and $p_{3,it}$ = 1 for Period III and is 0 otherwise. a_1 through a_6 are the regression coefficients and ε_t is the error term. Table 2 shows the results of the two regressions.

2.6.1 Effect on the index of hedging pressure *INDHEDGP*

The first row corresponding to the dependent variable *INDHEDGP* shows the results of the regression analysis for the index of hedging pressure. All of the coefficients a_1 through a_6 are positive and statistically significant at the 0.01 level. Focusing on the coefficients a_1, a_2 and a_3, for commodity futures contracts, on average, the index of hedging pressure is 13% in Period I, reduces to 9% in Period II and increases slightly to 10% in Period III. These results are consistent with the explanation that financialization reduces hedging pressure due to increase in the long positions (classified as hedging) of financial traders, while the financial crisis increases hedging pressure due to the a reduction in the long positions (classified as hedging) of financial traders, in commodity futures markets. The results on the change in hedging pressure over the three periods for commodity futures are in contrast to the results for the financial futures contracts. Focusing on the coefficients a_4, a_5 and a_6, for financial futures contracts, we see that, on average, the index of hedging pressure is 1% in Period I, increases to 15% in Period II and decreases to 7% in Period III. The results suggest that financial traders moved from financial futures contracts to commodity futures contracts in Period II, and from commodity futures contracts to financial futures contracts in Period III.

2.6.2 Effect on the index of speculative pressure *INDSPECP*

The second row corresponding to the dependent variable *INDSPECP* shows the results of the regression analysis for the index of speculative pressure. Coefficients a_1, a_5 and a_6 are positive, while coefficient a_3 is negative, and the four coefficients are statistically significant at the 0.01 level. Both a_2 and a_4 are not statistically significantly different from 0. Focusing on the coefficients a_1, a_2 and a_3, for commodity futures contracts, on average, the index of speculative pressure is 2% in Period I, reduces to 0% in Period II and is -3% in Period III. Long speculative pressure drops in Period II and short speculative pressure increases in Period III. The results on the drop in long speculative pressure from Period I to Period II are not consistent with the expected increase in the long positions of financial traders classified as speculators, as a consequence of financialization. However, the change from Period II to Period III is consistent with long financial traders closing out their speculative positions as a consequence of the financial crisis. The results for commodity futures contracts may be compared to the results for financial futures contracts. Focusing on the coefficients a_4, a_5 and a_6, for financial futures contracts, we see that, on average, the index of speculative pressure is 0% in Period I, increases to 1% in Period II and decreases to 0% in Period III. Long speculative pressure increases in Period II and decreases in Period III. The last result is consistent with long financial traders reducing their speculative long positions in futures contracts, as a consequence of the financial crisis.

3. Relationship between spot market volatility, volatility due to market fundamentals and the indices of hedging and speculative pressure

3.1 Estimation of spot market volatility and volatility due to market fundamentals

I obtain daily spot prices for the markets underlying each of the 21 different futures contracts from Datastream. I obtain daily data on the most recent vintage of the ADS index, described in Aruoba, Scotti and Diebold (2009), from the website of the Philadelphia Federal Reserve. The ADS index has been used by previous researchers such as Brunetti et al (2016), and Büyükşahin and Robe (2014) as a measure of macroeconomic conditions in the U.S. that should influence the volatility of commodity and equity markets. I calculate daily log returns for the spot market and the ADS index and merge these data by date with the time series of hedging and speculative pressure for the corresponding futures contract.

I estimate the spot market volatility and the volatility due to market fundamentals by the stochastic variance of the log return on the spot price and the ADS index, respectively. I apply a stochastic volatility model authored by Harvey et al (1994) to estimate these volatilities. The model is represented by:

$$y_t = \varepsilon_t \sqrt{h_t}, \qquad \varepsilon_t \sim N(0,1) \tag{14}$$

$$\log h_t = \gamma + \varphi \log h_{t-1} + \omega_t, \qquad \omega_t \sim N(0,\sigma^2) \tag{15}$$

y_t is the log return at time *t,* for the spot market and for the ADS index, when estimating the spot market volatility, and the volatility due to market fundamentals, respectively. h_t is the stochastic variance of y_t, which estimates the stochastic variance of the spot market $SVSM_t$ and market fundamentals $SVMF_t$, respectively, at time *t*. ε_t and ω_t are the error terms. γ, φ, and σ are parameters which are to be estimated. Following Harvey et al (1994), I estimate the model parameters using a quasi-maximum likelihood approach and use Kalman smoothing to obtain estimates of volatility for the sample.

3.2 Empirical analysis of the relationship between spot market volatility, volatility due to market fundamentals and the indices of hedging and speculative pressure and results

I examine if volatility in the spot market is caused by market fundamentals, hedging pressure or speculative pressure, by conducting the following multiple regression analysis for each of the 21 different futures contracts.

$$SVSM_t = b_0 + b_1 * SVMF_{t-1} + b_2 * \left| IND_{t-1} \right| + \varepsilon_t \tag{16}$$

$SVSM_t$ is the stochastic variance of the spot market at time *t*, $SVMF_{t-1}$ is the stochastic variance due to market fundamentals at *t-1*, and $|IND_{t-1}|$ is, in turn, the absolute value of the index of hedging pressure and of speculative pressure, respectively, at *t-1*. The coefficient b_1 estimates if volatility in the spot market at time *t* is caused by volatility due to market fundamentals at *t-1*. The coefficient b_2 estimates if volatility in the spot market at time *t* is due to hedging pressure or speculative pressure, respectively, at time *t-1*. ε_t is the error term.

3.2.1 Effect of hedging pressure upon spot market volatility

Table 3 shows the results of the analysis of equation (16) when *IND* represents the index of hedging pressure *INDHEDGP*. b_1 is positive and statistically significant for 11 of the 21 futures contracts, specifically, the wheat, lean hogs, live cattle, natural gas, heating oil, copper, gold, silver, U.S. Tbonds, British pounds and Euro FX futures contracts. For these contracts, spot market volatility increases follow increases in the volatility due to market fundamentals. b_2 is positive and statistically significant for 5 of the 21 futures contracts, specifically, the natural gas, heating oil, copper, U.S. Tbonds, and British pounds futures contracts. For these contracts, spot market volatility increases follow increases in hedging pressure.

3.2.2 Effect of speculative pressure upon spot market volatility

Table 4 shows the results of the analysis of equation (16) when *IND* represents the index of speculative pressure *INDSPECP*. b_1 is positive and statistically significant for 11 of the 21 futures contracts, specifically, the wheat, lean hogs, live cattle, natural gas, heating oil, copper, gold, silver, U.S. Tbonds, British pounds and Euro FX futures contracts. For these contracts, spot market volatility increases follow increases in the volatility due to market fundamentals. b_2 is positive and statistically significant for 4 of the 21 futures contracts, specifically, the feeder cattle, natural gas, silver, and S&P 500 index futures contracts. For these contracts, spot market volatility increases follow increases in speculative pressure. b_2 is negative and statistically significant for 4 of the 21 futures contracts, specifically, the heating oil, gold, U. S. Tbond and Euro FX futures contracts. For these contracts, spot market volatility decreases follow increases in speculative pressure.

4. Conclusion

I develop new measures of hedging pressure and speculative pressure in futures markets that account for the effect of balancing hedging contracts. The measures are based on the recognition that since short and long hedgers differ on the size, timing and length of their hedges, that not all long hedging balances short hedging. I compare these measures with traditional measures of hedging pressure and speculative pressure, which are based on the assumption that all of long hedging balances short hedging. I demonstrate using data for 21 different futures contracts in 7 different groups, that when balancing hedging contracts are taken into account, hedging pressure is higher in magnitude and speculative pressure is lower in magnitude than estimated by the traditional measures of hedging pressure and speculative pressure, respectively. I address the effect of the financialization of commodity futures markets and the effect of the financial crisis upon the measures of hedging and speculative pressure, and the relationship between these measures and volatility in the spot markets. These measures throw new light on the composition of traders in the futures market, and can be used to determine how this composition changes when institutional features of these markets, such as margin requirements for hedgers and speculators are adjusted.

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Table 1.
Comparison of indices of hedging pressure *INDHEDGP* and speculative pressure *INDSPECP* based on accounting for balancing hedging and balancing speculation with traditional measures of hedging pressure *TRHEDGP* and speculative pressure *TRSPECP*

Commodity-Exchange		Hedging pressure %					Speculative pressure %				
		INDHEDGP		***TRHEDGP***			***INDSPECP***		***TRSPECP***		
	No. of obs.	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**t-stat.**	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**	**t-stat.**
Corn-CBT	1376	17.35	34.86	6.65	12.00	10.76***	0.20	1.93	9.16	27.06	-12.24***
Soybeans-CBT	1376	22.86	38.34	10.36	14.18	11.35***	0.60	2.42	12.16	28.55	-14.97***
Wheat-CBT	1375	2.13	44.29	2.30	13.02	-0.13	-1.09	6.30	-3.21	37.31	2.08**
Feeder cattle-CME	1376	3.09	38.63	0.36	9.90	2.54**	2.81	22.38	5.15	50.36	-1.57
Lean hogs-CME	1376	12.26	43.09	3.96	12.53	6.85***	4.28	23.81	10.70	47.54	-4.48***
Live cattle-CME	1376	26.96	36.09	8.42	10.10	18.35***	1.93	3.74	19.65	31.37	-20.8***
Crude oil-NYME	1374	17.47	27.32	4.30	8.18	17.12***	2.10	4.24	14.78	24.71	-18.74***
Natural gas-NYME	1272	-9.98	24.39	-3.51	9.82	-8.78***	-12.07	19.15	-19.03	34.12	6.34***
Heating oil-NYME	1374	10.27	23.63	3.87	6.90	9.63***	0.47	2.63	6.10	20.59	-10.04***
Copper-CMX	1290	5.09	40.74	3.74	17.62	1.09	-0.27	5.00	-0.41	29.79	0.17
Gold-CMX	1375	27.20	43.60	15.62	25.28	8.52***	1.99	3.73	12.48	23.39	-16.42***
Silver-CMX	1375	53.24	12.91	28.59	14.47	47.12***	3.02	3.19	26.80	10.97	-77.11***
DJIA-CBT	750	-1.41	38.66	-0.41	16.54	-0.65	-0.26	3.88	-2.95	27.00	2.7***
NASDAQ 100-CME	912	1.55	26.91	0.03	13.54	1.52	-0.49	3.28	-0.21	18.74	-0.45
S&P 500-CME	1376	-4.68	12.40	-2.55	5.96	-5.76***	-0.93	1.74	-3.49	8.97	10.36***
Eurodollar-CME	1376	5.46	23.11	2.55	8.00	4.41***	-0.25	2.69	2.27	19.57	-4.73***
10-Year Tnote-CBT	1376	-1.73	21.21	-0.73	7.54	-1.64	-0.40	1.57	-1.94	16.47	3.46***
U.S.Tbond-CBT	1376	-3.07	21.23	-1.61	6.56	-2.44**	-0.36	1.76	-2.21	17.45	3.93***
British pounds-CME	1373	2.47	46.51	0.70	28.30	1.21	0.01	1.87	-0.33	21.65	0.58
Euro FX-CME	897	6.96	48.09	3.10	27.85	2.08**	0.69	7.28	3.25	26.43	-2.79***
Japanese yen	1376	-11.01	47.38	-10.30	28.57	-0.48	-0.20	0.79	-2.64	20.36	4.45***

Note. The beginning date is 31 January 1986 or the date of contract initiation and the ending date is 29 December 2015.
***Statistically significant at the 0.01 level, **statistically significant at the 0.05 level

Table 2. Comparison of the index of hedging pressure *INDHEDGP*, and the index of speculative pressure *INDSPECP* for commodity futures and financial futures, in the three periods of I) pre-financialization, II) post-financialization and pre-financial crisis, and III) financial crisis and post-financial crisis

Dependent variable	No. of obs.	Coefficients of independent variables												Adj.Rsq.
		Commodity futures						Financial futures						
		Period I		Period II		Period III		Period I		Period II		Period III		
		a_1		a_2		a_3		a_4		a_5		a_6		
		Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	
INDHEDGP	26868	0.13	26.15***	0.09	15.55***	0.10	16.97***	0.01	2.88***	0.15	26.91***	0.07	10.86***	0.02
INDSPECP	26868	0.02	15.12***	0.00	1.06	-0.03	-19.75***	0.00	-1.88	0.01	5.47***	0.00	2.92***	0.02

Note:

The table shows the results of the following regression.

$$y_{it} = a_1 f_{1,it} p_{1,it} + a_2 f_{1,it} p_{2,it} + a_3 f_{1,it} p_{3,it} + a_4 f_{2,it} p_{1,it} + a_5 f_{2,it} p_{2,it} + a_6 f_{2,it} p_{3,it} + \varepsilon_t \quad (13)$$

y_{it} is the dependent variable, which is in turn *INDHEDGP,* and *INDSPECP,* $f_{1,it}$ =1 for a commodity futures contract and 0 otherwise, $f_{2,it}$ =1 for a financial futures contract and 0 otherwise, $p_{1,it}$ = 1 for Period I and 0 otherwise, $p_{2,it}$ = 1 for Period II and is 0 otherwise, and $p_{3,it}$ = 1 for Period III and is 0 otherwise. a_1 through a_6 are the regression coefficients and ε_t is the error term.

The pre-financialization period Period I extends from 31 January 1986 or the date of contract initiation to 26 December 2000, the post-financialization and pre-financial crisis period Period II extends from 2 January 2001 to 9 September 2008, the financial crisis and post-financial crisis period Period III extends from 16 September 2008 to 29 December 2015.

***Statistically significant at the 0.01 level

Table 3. Results of the regression of spot market volatility on the lagged volatility due to market fundamentals and the lagged absolute value of the index of hedging pressure						
	Nobs.	Lagged volatility due to market fundamentals		Lagged absolute value of the index of hedging pressure		
Commodity/Exchange		**Coeff. b_1**	**t-stat.**	**Coeff. b_2**	**t-stat.**	**Adj.Rsq.**
Corn-CBT	1373	-2.09	-0.73	388.76	1.32	0.0002
Soybeans-CBT	1374	2.77	0.53	368.20	0.93	-0.0006
Wheat-CBT	1373	0.06	9.02***	0.51	0.45	0.0552
Feeder cattle-CME	1199	-0.04	-1.14	1.08	0.69	-0.0004
Lean hogs-CME	1374	9.76	2.28**	64.02	0.22	0.0024
Live cattle-CME	1374	31.10	2.38**	201.43	0.53	0.0027
Crude oil-NYME	1372	-0.25	-0.62	-71.62	-1.31	0.0000
Natural gas-NYME	1270	0.01	3.30***	3.57	5.25***	0.0272
Heating oil-NYME	1362	0.10	14.44***	1.99	2.56***	0.1345
Copper-CMX	1288	0.15	16.55***	4.08	5.69***	0.1848
Gold-CMX	1373	0.42	18.74***	-0.06	-0.12	0.2141
Silver-CMX	1373	0.15	18.78***	0.43	0.84	0.2035
DJIA-CBT	748	-1.52	-1.28	-0.84	-0.02	-0.0005
NASDAQ 100-CME	910	-0.10	-0.16	154.96	1.56	0.0005
S&P 500-CME	1374	-6.01	-0.66	344.74	0.41	-0.0010
Eurodollar-CME	1374	-1.55	-0.58	229.74	0.79	-0.0008
10-Year Tnote-CBT	1374	3.10	0.80	220.16	0.51	-0.0007
U.S.Tbond-CBT	1342	0.17	3.91***	8.46	4.80***	0.0247
British pounds-CME	1371	0.57	10.92***	4.07	7.29***	0.1170
Euro FX-CME	895	1.79	17.28***	0.67	0.98	0.2537
Japanese yen	1374	-12.08	-0.38	164.29	0.64	-0.0010

Note: The table shows the results of the following regression analysis:

$$SVSM_t = b_0 + b_1 * SVMF_{t-1} + b_2 * \left| IND_{t-1} \right| + \varepsilon_t \qquad (16)$$

$SVSM_t$ is the stochastic variance of the spot market at time t, $SVMF_{t-1}$ is the stochastic variance due to market fundamentals at $t-1$, and $\left| IND_{t-1} \right|$ is the absolute value of the index of hedging pressure, at $t-1$. The coefficient b_1 estimates if volatility in the spot market at time t is caused by volatility due to market fundamentals at $t-1$. The coefficient b_2 estimates if volatility in the spot market at time t is due to hedging pressure, at time $t-1$. ε_t represents the error term.

***Statistically significant at the 0.01 level, **statistically significant at the 0.05 level

Table 4. Results of the regression of spot market volatility on the lagged volatility due to market fundamentals and the lagged absolute value of the index of speculative pressure						
	Nobs.	**Lagged volatility due to market fundamentals**		**Lagged absolute value of the index of speculative pressure**		
Commodity/Exchange		**Coeff. b_1**	**t-stat.**	**Coeff. b_2**	**t-stat.**	**Adj.Rsq.**
Corn-CBT	1373	-2.39	-0.83	-2241.23	-1.04	-0.0002
Soybeans-CBT	1374	2.00	0.38	-1753.92	-1.02	-0.0005
Wheat-CBT	1373	0.06	8.96***	-1.76	-1.31	0.0563
Feeder cattle-CME	1199	-0.01	-0.13	1.83	1.99**	0.0025
Lean hogs-CME	1374	9.75	2.28**	-120.82	-0.80	0.0028
Live cattle-CME	1374	27.07	2.05**	1373.15	1.39	0.0039
Crude oil-NYME	1372	-0.24	-0.58	-203.27	-0.95	-0.0006
Natural gas-NYME	1270	0.01	3.12***	1.09	2.28**	0.0101
Heating oil-NYME	1362	0.10	15.28***	-14.81	-5.09***	0.1466
Copper-CMX	1288	0.14	15.96***	0.15	0.09	0.1642
Gold-CMX	1373	0.47	20.93***	-13.18	-7.07***	0.2418
Silver-CMX	1373	0.15	18.77***	4.18	2.12**	0.2057
DJIA-CBT	748	-1.59	-1.34	-137.29	-0.94	0.0007
NASDAQ 100-CME	910	-0.09	-0.14	401.49	1.24	-0.0005
S&P 500-CME	1374	-10.77	-1.17	5281.23	2.40**	0.0031
Eurodollar-CME	1374	-1.18	-0.44	2429.20	1.30	0.0000
10-Year Tnote-CBT	1374	3.42	0.87	149.43	0.06	-0.0009
U.S.Tbond-CBT	1342	0.14	3.18***	-52.84	-7.76***	0.0506
British pounds-CME	1371	0.57	10.70***	-8.70	-1.92*	0.0852
Euro FX-CME	895	1.80	17.68***	-3.45	-2.46**	0.2579
Japanese yen	1374	-14.72	-0.47	-823.00	-0.19	-0.0013

Note: The table shows the results of the following regression analysis:

$$SVSM_t = b_0 + b_1 * SVMF_{t-1} + b_2 * \left|IND_{t-1}\right| + \varepsilon_t \qquad (16)$$

$SVSM_t$ is the stochastic variance of the spot market at time *t*, $SVMF_{t-1}$ is the stochastic variance due to market fundamentals at *t-1*, and $\left|IND_{t-1}\right|$ is the absolute value of the index of speculative pressure, at *t-1*. The coefficient b_1 estimates if volatility in the spot market at time *t* is caused by volatility due to market fundamentals at *t-1*. The coefficient b_2 estimates if volatility in the spot market at time *t* is due to speculative pressure, at time *t-1*. ε_t represents the error term.

***Statistically significant at the 0.01 level, **statistically significant at the 0.05 level, *statistically significant at the 0.10 level.