The Risk and Return of Active vs Passive Trading Strategies with Commodity Futures

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A Thesis

In

The John Molson School of Business

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Administration at
Concordia University
Montreal, Quebec, Canada

December 2008

Your file Votre référence
ISBN: 978-0-494-45465-7
Our file Notre référence
ISBN: 978-0-494-45465-7

ABSTRACT

The Risks and Returns of Active vs Passive Trading Strategies with Commodity Futures

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This paper investigates relationships between profits from dynamic trading strategies, risk premium, convenience yields, and net hedging pressures for commodity futures. The term structure of oil, gold, copper and soybeans futures markets contains predictive power for the corresponding term premium. However, only oil futures and soybean futures lead their spot premium. Significant momentum profits are identified in both outright futures and spread trading strategies when the spot premium and the term premium are used to form winner and loser portfolios. Profits from active strategies based on winner and loser portfolios are conditioned on market structure and net hedging pressure effects. Dynamic trading strategies based on contracts with extreme backwardation, extreme contango, and extreme hedging pressures are also tested. On average, spread trading outperforms outright futures trading in capturing the term structure risk and hedging pressure risk. For such strategies, long-short the long-term spread offers the greatest and most significant return and it offers the only exploitable trading profits built on the past hedging pressure.

ACKNOWLEDGEMENTS

If I need to mention three difficulties in my life, I am sure that thesis must be one of them. I feel that I have owed to many people that without their help, this thesis can never be finished smoothly as planned. My gratefulness should first be given to my supervisor—Dr. Lorne Switzer for the support, encouragement and hard work you put on me. Thank you for not turning my idea down at the very beginning when I actually knew nothing about commodity, thank you for continually referring me the latest papers of commodity trading which have served the backbone of my thesis, most importantly, thank you for not letting me pass so easily and pushing me to the utmost to dig deep in the field. I also want to thank Dr. Betton and Dr. Hochstein for being present in my committee to get through this with me. Also, special thanks to James Burron for giving me the ambitious idea of studying commodity trading which turns out to be a long and frustrating process but worth every minute of my efforts. Last but not least, I would like to thank my beloved husband and my parents for standing behind me and letting me be myself all the time.

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1. Introduction:

In recent years, the commodity market boom has inspired significant interest in this asset class amongst academics and practitioners. As an individual asset class, commodities show several features that distinguish themselves from financial assets, including:

(1) Commodities are real assets that can be used for consumption. They can be packaged as derivative securities for generating returns for investors and for transferring real consumption risk. Therefore, their performance is subject to more factors than financial assets, including but not limited to business cycles, local and global supply-and-demand, technology development, substitute and complementary products.

(2) Based on economic theory, commodity returns in the absence of shocks should mean-revert to the equilibrium marginal rate of production.

(3) Unlike financial assets that are cash-settled at expiration, commodity futures need to be settled by physical delivery; this entails unique storage and shipping costs. For those who want to avoid physical exposure at expiry, contract roll-over is essential. According to Feldman and Till (2006), this roll yield drives the overall yield over the long-term horizon.

(4) Each commodity should be treated as an individual asset class instead of one asset class for all. Erb and Harvey (2006) associate commodity index performance with the performance of its components.

(5) The equilibrium CAPM model does not work well for the commodity markets because some of its critical assumptions are violated: such as an insufficiently diversifiable base of participants in the commodity markets pointed out by Hirshleifer (1988) and the exclusion from capital assets by Erb and Harvey (2006).

Given this background, much of the extant theoretical and empirical research has looked at commodities apart from financial assets. One strand of literature relates commodity returns to inventory level storage costs, which affect the state-time opportunity set for consumption. Another strand focuses on hedging pressures, which constrain the risk transference function. The purpose of this thesis is to synthesize both of these literatures, and to provide empirical tests that differentiate between them. In particular, we provide various tests of the models by looking at the determinants of risk premiums for NYMEX crude oil, COMEX gold, COMEX copper and CBOT soybean contracts. We also conduct tests based on trading strategies for these contracts.

These four commodity futures contracts are chosen for the following reasons: (i) their liquidity; (ii) their diverse historical term structure and hedging experience; and (iii) their different sensitivities to the business cycle.

The thesis finds that both the term structure and hedging pressure variables are significant determinants of commodity returns. In addition they are found to contain information that can be used to construct profitable trading strategies.

The remainder of the paper is organized as follows. Section 2 provides a review of the literature. Section 3 provides a description of the data. The methodology for the tests is provided in section 4. The empirical results follow in Section 5. Section 6 performs three active trading strategies and specifies results. The thesis concludes with a summary in section 7. Besides, a list of some terminology for readers unfamiliar with commodities is attached in Appendix 1.

2. Literature review:

2.1 Theory of storage and theory of inverse carrying charge:

The most well-known benchmark model in commodity futures is the arbitrage-free cost-of-carry model, the core of theory of storage:

$$F^T(t) = S_t e^{(r+s-c)(T-t)} \qquad (1)$$

where r is interest foregone, s storage cost and c convenience yield. A basic drawback of this model is the difficulty in obtaining reliable estimates of s and c.

Kaldor (1939) proposes the convenience yield as a measure that captures the abstract benefit of holding inventory to avoid out-of-stock risk in production process. It is an indirect measure of inventory scarcity and widely used as a variable of inventory in a large body of literature. Brennan (1958) and Dincerler, Khokher and Simin (2005) empirically validate an inverse relationship between inventory and convenience yield in agriculture, energy, and metal markets. Dincerler et. al. (2005) finds that up to 42% of the variation in convenience yield can be explained by inventory levels.

Fama and French (1988) develop an indirect test of the theory of storage for metal markets. Their results are consistent with the theory: when inventory is low (high) futures prices have less (approximately the same) volatility than (as) spot prices.

Working (1948) extends Kaldor's theory (1939) into a theory of inverse carrying charges. In this approach, the carrying charge in the futures market is determined by the shape of the convenience yield. Simply put, nearby futures price P_1 and delayed futures price P_2 are linked by carrying charge P_s as follows:

$$P_1 + P_s - P_2 = 0 \qquad (2)$$

so that the change of nearby futures can be explained in terms of the change of carrying charge and that of distant futures:

$$P_1 = P_2 - P_s \qquad (3)$$

The significance of this theory is two-fold: it clarifies the important role of futures market in adjusting the carry of stock from one date to another[1] and addresses the correlation between the nearby and distant futures in a clear and concise way. Equation (3) suggests that (i) common determinants affecting distant futures price P_2 tend to affect nearby futures price P_1 to a similar extent and (ii) factors affecting carrying charge P_s have an equal but opposite influence on the nearby futures price P_1.

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[1] "Futures markets, through their use for hedging, make the holder of stocks sharply aware of any losses that must be expected from carrying unnecessary stocks in times of relative shortage of supplies, and provide assured returns for storage over periods when there is a surplus to be carried." (Working,1953).

2.2 Net hedging pressure hypothesis:

The net hedging pressure hypothesis is another equally important theory in the commodities literature. Working (1953) recognizes the significant role of hedgers in the development of the U.S. grain futures market. Cootner (1960) establishes the theory, reconciles it to the theory of storage and proposes trading strategies built on varying hedging pressure in seasonal wheat and cotton markets. For agriculture commodities, the most evident correlation between inventory and hedging pressure appears during the pre-harvest and harvest seasons. In the pre-harvest season, inventory is low while the commitment of delivery is high so that the market is driven by a net long hedging pressure; short hedging pressure is enhanced with the arrival of new crops and prices of agricultural commodities are depressed until the peak of harvest and then gradually rise with the increasing consumption and the lift of short hedging after harvest peak. Seasonality in agricultural production is then exploited by Cootner for trading strategies built on: (1) peaks and troughs in grain supplies; (2) peaks and troughs in hedging positions; (3) fixed calendar spreads taking advantage of factor (1) and/or (2).

Ever since Cootner's pioneering paper, numerous empirical studies have focused on examining whether net hedging pressure leads to predictable trends in futures prices. Chang (1985) and Carter, Rausser and Schmitz (1983) report the correlation between agricultural futures prices and net hedging positions disclosed in CFTC[2]

[2] The full name of CFTC report is Commitments of Traders in Commodity Futures issued by U. S. Commodity Futures Trading Commission.

report. Bessembinder (1992) studies agricultural and metal markets and finds significant positive mean returns conditional on a net short hedging pressure. In the second part of his paper, he follows Hirshleifer's method (1988) to model net hedging pressure into residuals from the CAPM-type market model regression to capture idiosyncratic risk in futures market. Bessembinder (1992) is the first one that empirically clarifies the influence of net hedging pressure on futures returns. Roon, Goorbergh and Nijman (2000) confirm Bessembinder's findings, and further identify a cross-hedging pressure among futures of related commodities.

From an empirical perspective, Roon, Goorbergh and Nijman (2004) test a trading strategy based on hedging pressure to capture spot premiums and term premiums across 23 futures markets. Dincerler, Khokher and Simin (2005) explain their inventory-withdrawn trading strategy by means of a joint force of inventory and hedging pressure in markets. Till and Eagleeye (2007) clearly point out that the theory of storage and net hedging pressure can be jointly affecting commodity markets, in which "the implications of the theory-of-storage are important for long-horizon investing while the implications of the net-hedging-pressure effect are important for short-horizon trading" (Till and Eagleeye, 2007 pp 56). Although these papers qualitatively clarify the joint influence of both factors on commodity returns, there lacks an empirical paper to test it. The objective of this thesis is to fill this gap.

In the literature of commodity practice, extant empirical papers of commodity trading are mainly divided into passive trading and active trading strategies.

2.3 Passive trading strategy:

Roon, Goorbergh and Nijman (2004) decompose the futures return into spot premium (or basis) and term premium. The effect of hedging pressure on these premiums is isolated through two passive trading strategies: (i) long-only the 1st-nearby futures and (ii) long spread that longs the 1st-nearby futures and shorts distant futures, across 23 futures markets. The significance of the return decomposition is that the basis cannot be earned if futures positions are not held to maturity—not uncommon in practice by commodity investors and speculators who do not expect physical delivery. Thus, the expected return is influenced by both spot and term premiums. In fact, except for the 1st-nearby futures, all delayed futures exhibit term premium as a critical component of their returns. Roon et.al (2004) find that the past hedging pressure explains more variation in the term premium than in the spot premium, and influences both premiums differently—negative for the spot premium and positive for the term premium. Therefore, to long outright futures or take a short calendar spread can be profitable in a net short hedging market; and the opposite can be done in a net long hedging market. The active trading results show that the effect of net hedging pressure can only be isolated through spreads, which coincides with Hirshleifer's (1988) and Bessembinder's (1992) methodology to regress net hedging pressure on residuals of market model instead of directly on commodity returns.

This thesis follows Roon, Nijman and Veld's (1998) methodology for return decomposition via passive trading strategies using high frequency daily data and it will be elaborated further in section 4.1.

2.4 Active trading strategy:

Section 6 focuses on three active trading strategies, including the most widely-used momentum strategy (trading futures contracts based on their past performance) and two others based on convenience yield and net hedging pressure, respectively. A large number of previous research have been found for momentum strategy, but very few for the other two strategies. In fact, no paper has been found with clearly documented replicable strategies on convenience yield and net hedging pressure. Thus in this literature review section, only the momentum trading strategy is covered.

For momentum trading, Roon, Goorbergh and Nijman (2004) test the autocorrelations in futures returns and find a significant momentum effect in term premiums across time and commodity markets, but identify no clear pattern of direction that supports simple active trading strategies to exploit profits in commodity practice.

Miffre and Rallis (2007) use a 25-year long data set to test 13 momentum strategies that generate an average of 9.38% annual excess return, however, their contrarian strategies, proposed to capture the long-term reversal, fail. Another important contribution of their paper is that they associate the momentum strategy of buying winners and selling losers with the option of buying backwardated and selling contangoed markets and suggest such a trading strategy for further research. Based on Miffre and Rallis's (2007) idea, this thesis examines the correlation between

momentum effect and backwardation directly in section 6.2 and empirically tests their suggested trading strategy in section 6.3.

In sum, throughout the literature review, there are some gaps this thesis aims to fill between the commodity trading theories and their corresponding empirical applications. To empirically test the correlation between risk premiums, convenience yield and net hedging pressure and develop applicable active trading strategies accordingly, new correlation tests and trading strategies are conducted in this paper. To our knowledge, this is the first paper to (1) use the VAR Granger-causality model to study relationship between the above-mentioned variables; (2) demonstrate the association between the momentum effect and backwardation through regression; and (3) discuss trading methods and results from information contained in the convenience yield and net hedging pressure in detail. The VAR Granger-causality model is discussed in section 4.3 and 5.3, with regression between the momentum effect and backwardation in section 6.2 and trading strategies of convenience yield and net hedging pressure in section 6.3.

3. Data:

Daily closing prices of NYMEX crude oil, COMEX gold, COMEX copper and CBOT soybean from January 1st 1990 to December 31st 2006 are obtained from the Bloomberg database. Continuous time-series of futures prices are constructed in the order of the 1st-nearby futures, 2nd-nearby futures, etc. up to one-year maturity or the last contract month before the end of a calendar year, such as November for the soybean contract. The one-year maturity is chosen because it covers a sufficiently

long forward period and also has substantial liquidity to deal with. Table 1 lists highlights of four commodity futures.

Insert Table 1 here

The 1st-nearby futures contract is constructed from the next expiring contract until one week before the last trading day of it, at which point the contract is rolled over to the next expiring contract.

The common practice of treating the 1st-nearby futures price as spot price is also adopted since a united spot market for each commodity does not exist. By extension, the 1st-nearby futures is literally the 2nd-nearby futures and by analogy, all the next nearby futures are mapped to their subsequent one interval lagged.

For calendar spreads, only the 1st-nearby futures and futures maturing in six months and in one year are considered because these contracts usually have the longest trading life, normally available for trading 18 months before maturity, so that they are the most widely used contracts for spreads in common practice.

Figure 1 shows the term structures of four commodities based on the average futures prices across maturities.

Insert Figure 1 here

Generally speaking, oil and copper markets are clearly in backwardation, gold market clearly in contango, and soybean market in the majority of time in contango with its sharpest slope appearing in the pre-harvest third quarter—from July to September.

Table 2 lists the Eview-calculated descriptive statistics of the daily returns of spot price and the 1st-nearby futures price. All returns are calculated against the one-day price lag of the same time series and not across contracts with different maturities. Returns of the CRB index (the oldest tradable as well as the most comprehensive commodity index), the Russell 3000 index (a proxy for the U.S. listed equity market portfolio) and the 10-year U.S. Treasury bond (the industry norm of measuring long-term interest rate) are also included as benchmarks of commodity indices and financial assets. Daily returns and standard deviations are roughly annualized by multiplying by 250 and $\sqrt{250}$ respectively.[3]

Insert Table 2 here

From a statistical point of view, no commodity returns are normally distributed, as all of them exhibit negative skew and large excess kurtosis. This shows that commodity returns are more prone to extreme events than expected with the normal distribution. Oil and copper futures exhibit the highest return, but equity tops all commodities in terms of both risk (except for gold) and return. Among commodities, oil futures exhibit the highest volatility while gold futures exhibit the least volatility which is only marginally higher than that of the CRB commodity index.

[3] The annualized standard deviations of commodity returns are possibly elevated since commodity returns are normally autocorrelated and asymmetrically distributed.

4. Methodology:

4.1 A decomposition of futures returns:

Following Roon, Nijman and Veld's (1998), this thesis decomposes futures returns into spot premium and term premium using high frequency daily data by (1) buying a *k*-day contract and (2) buying a *k*-day contract, selling a *n*-day contract and holding the spread for *k* days ($k<n$) where *k* and *n* represent number of days until maturity of the 1st-nearby futures and of distant futures respectively.

From the cost-of-carry model, it is evident that in a structurally contangoed market, a certain yield $y_t^{(n)}$ can be locked in by longing an asset in the spot market and simultaneously shorting it in the futures market to be delivered at time $t+n$.

$$y_t^{(n)} \equiv \frac{f_t^{(n)} - s_t}{n} \quad (4)$$

Lower case *f* and *s* stand for log prices. Similarly, the forward yield $h_t^{(k,n)}$ can be earned from time $t+k$ to $t+n$ by longing the contract to mature at $t+k$ and shorting its equivalent to mature at $t+n$ ($k<n$) and holding the spread for *k* days.

$$h_t^{(k,n)} \equiv \frac{f_t^{(n)} - f_t^{(k)}}{n-k} = \frac{n y_t^{(n)} - k y_t^{(k)}}{n-k} \quad (5)$$

Re-arrange (5) to get:

$$\begin{aligned}(n-k)h_t^{(k,n)} &= n y_t^{(n)} - k y_t^{(k)} \\ &= E_t\left[(n-k) y_{t+k}^{(n-k)}\right] + \Theta_t^{(k,n)}\end{aligned} \quad (6)$$

$$\Theta_t^{(k,n)} \equiv \sum_{i=0}^{k-1} \theta_t^{(n-i)}$$

where $\Theta_t^{(k,n)}$ is risk premium and can be rewritten in terms of log spot price and log futures price as:

$$\Theta_t^{(k,n)} = \left(s_{t+k} - f_t^{(k)}\right) - \left(f_{t+k}^{(n-k)} - f_t^{(n)}\right) \qquad (7)$$

This is the formula we use to calculate the term premium.

For long-only the 1st-nearby futures mature in k days, it is reasonable to assume that term premium $\pi_{y,t}^{(n)}$ is negligible and all the risk premium is explained by spot premium $\pi_{s,t}$, which is, by definition, the expected spot return in excess of the one-period yield.

$$E_t\left[r_{s,t+k}\right] = E_t\left[s_{t+k} - s_t\right] = ky_t^{(k)} + \pi_{s,t} \qquad (8)$$

Rearrange (8) to get the expression of spot premium:

$$\pi_{s,t} = \left(s_{t+k} - f_t^{(k)}\right) \qquad (9)$$

Table 3 lists the SAS-calculated descriptive statistics of both premiums. A brief discussion of results follows in section 5.1.

Insert Table 3 here

4.2 Proxies of convenience yield and net hedging pressure:

Two industry norms are followed to calculate proxies of the convenience yield and net hedging pressure in this thesis.

Convenience yield is defined in terms of the negative of the interest-adjusted basis[4] introduced by Fama and French (1988) with log prices used in the calculation.

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[4] $[F(t,T) - S(t)]/S(t) - R(t,T) = [W(t,T) - C(t,T)]/S(t)$
where F and S are prices of futures and spot markets, R is interest foregone, W is storage cost and C is convenience yield. Interest-adjusted basis in the left-hand-side can be expressed as difference between relative storage cost and relative convenience yield. For a constant storage cost, the variation of relative convenience yield naturally dominates that of the interest-adjusted basis, so that convenience yield can be approximately expressed as the negative of the interest-adjusted basis.

Three most widely used contracts—the 3-month[5], the 6-month and the 12-month futures are used to calculate the short-, intermediate- and long-term convenience yields for each commodity.

The other industry metric for net hedging pressure, H_t, is calculated as the difference between short and long hedge positions of commercial traders divided by their total hedge positions[6], with all position's information from the semi-monthly[7] report of *Commitments of Traders in Commodity Futures* ("CFTC report" hereafter). A positive H_t means a net short hedging market whereas a negative ratio a net long hedging market.

The SAS-calculated statistics of convenience yield and net hedging pressure are listed in Table 4 and Table 5, respectively. A brief discussion on the results follows in section 5.2.

Insert Table 4 & Table 5 here

4.3 VAR (Vector Autoregressive Process) Granger-Causality model, weekly data:

Bessembinder (1992) uses a traditional two-stage methodology of Fama and MacBeth (1973) to capture the effect of net hedging pressure on residual risks of

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[5] Since gold futures only mature in even months and soybean futures only in odd months, different contracts other than the three maturities have to be chosen for both. The 4-month futures is used to calculate the short-term convenience yield for gold, and the 7-month and 11-month contracts are used to calculate the intermediate-term and long-term convenience yields for soybean.

[6] $H_t = \dfrac{\text{short hedge positions - long hedge positions}}{\text{total hedge positions}}$

[7] This report was announced bi-weekly until September 1992. From October 1992 on, it becomes a weekly issue and has been published on every Wednesday.

commodity futures. However, there is an easier and more direct statistic test—the Granger-causality test—to show the relationship between variables.

Granger proposes the concept of causality in 1969 in the following expressions:

$$z_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i} x_{t-i} + \sum_{i=1}^{k} \gamma_{1i} z_{t-i} + \varepsilon_{1,t} \quad (10a)$$

$$x_t = \alpha_1 + \sum_{i=1}^{p} \beta_{2i} x_{t-i} + \sum_{i=1}^{k} \gamma_{2i} z_{t-i} + \varepsilon_{2,t} \quad (10b)$$

He assumes that a cause cannot come after an effect, thus, adding information of the former variable should make prediction of the latter variable more efficient. In mathematics, if the new forecast MSE with information of x_t (z_t) is smaller than its equivalent without adding the same information, x_t (z_t) is said to have Granger-caused z_t (x_t). Granger-causality can be identified from a significant coefficient of β_{1i} or γ_{2i}.

For a correlation matrix between multiple variables, Granger-causality is always a natural and efficient solution. However, the traditional Granger-causality works only on a pair-wise relationship. For a number of variables exceeding two, it needs to be nested into a VAR (Vector Autoregressive Process) model. Granger-causality test nested in VAR is very popular and one of the most widely used applications of VAR these days. The crucial condition is the stationarity of tested variables: with all of them stationary, a purely nondeterministic process (a process without a deterministic component) can be simulated well by a finite order VAR process and then an unrestricted VAR model suffices for the test; otherwise, the error correction model should be used.

4.3.1 Unit Root Test:

The Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are performed by means of Eview on each time-series to check its stationarity. Table 6 lists the *t*-statistics and *p*-value of both tests, with an intercept term, both a trend and intercept term and neither trend nor intercept. Both tests lead to the same conclusion in which the null hypothesis of a unit root is rejected by all the tested time series under all settings at a significance level of 5%. Thus, all the spot premium, term premium, convenience yield and net hedging pressure are stationary in nature and an unrestricted VAR Granger-causality model is appropriate.

Insert Table 6 here

4.3.2 Order of model:

Next, it is critical to decide the number of lags to be used in the test because coefficients of the variables are very sensitive to the lags in a VAR model. There are four widely used information criteria available in Eview to choose the model order and to check the model adequacy. They are: (1) the FPE (final prediction error) criterion; (2) Akaike information criterion (AIC); (3) Schwarz criterion (SC); and (4) HQ (Hannan & Quinn) criterion. Lutkepohl analyzes all the four criteria in his book (1993, Chapter 4, pp 132-133, 138) and shows that: AIC and FPE criteria are more appropriate to deal with small samples and minimize the forecast error (pp 133); SC criterion is most parsimonious and does well in estimating and forecasting low order VAR models (pp 138); and HQ criterion is only used when the consistency of model

estimate is the priority (pp 132). In this thesis, SC criterion is used to choose the model order.

For this specific test, it needs to be clarified that the testing period is from the issue of the first weekly CFTC report[8] on October 6th 1992 to its last issue in 2006 on December 26th, 2006. My data include between 670 and 730 weekly observations across the four markets.

Eview is used to estimate the VAR Granger-causality model with variables of risk premiums, three convenience yields with different maturities and net hedging pressure, using the SC criterion for order selection. Results are listed in Table 7 for spot premiums across markets and from Table 8 to Table 11 for term premium in each commodity market. Results are analyzed in section 5.3.

5. Empirical Results:

5.1 Results of decomposed futures returns:

Using the methodology described in section 4.1, futures returns are decomposed into spot and term premiums. Table 3 lists the SAS-calculated descriptive statistics of both premiums.

From Table 3, it can be observed that only oil and copper markets provide significantly positive spot premiums at an annual level of 7.95% and 11.45%, respectively. Significant term premiums are found in all four markets. Average term

[8] The CFTC report was once published every two weeks until the end of September 1992. Ever since October 1992, this report becomes a weekly issue and has been disclosed on each Wednesday. To keep as much as information intact, weekly data of risk premiums, net hedging pressure and convenience yield are re-calculated and used in this test.

premiums decline as maturities increase in oil and copper markets and rise in longer-dated gold and soybean markets, implying backwardation (contango) of oil and copper (gold and soybean) pictured in Figure 1. A structurally backwardated market carrying an inverse-charge from nearby to distant delivery makes long spread unprofitable—thus, a positive term premium is needed for remuneration, vice versa for a contangoed market.

From a volatility perspective, spot price risk is much higher than spread trading risk. However, spreads in oil and soybean markets are still quite volatile, with annual term volatilities above 9% and ranging from 7% to 12%, respectively.

5.2 Results of convenience yield and net hedging pressure:

Proxy of convenience yield is calculated as the negative of the interest-adjusted basis expressed in Footnote 4. The SAS-calculated statistics of convenience yield is listed in Table 4 under conditions of adequate ("positive" column) and inadequate ("negative" column) inventory levels.

Oil exhibits the highest unconditional convenience yield and gold the lowest and least volatile one. Once inventory is controlled, convenience yields across all four futures are negative when inventory is abundant ("positive" column) and substantially positive when it is scarce ("negative" column); and convenience yield is more volatile at low inventory levels than at high inventory levels; its variation does not increase proportionally but at a decreasing rate with extending term to maturity excluding copper, showing declining price impact along time as implied by the Samuelson hypothesis.

Net hedging pressure is calculated according to expression in Footnote 6 and the SAS-calculated results are listed in Table 5.

For the entire observation period, all the four commodity futures are net short hedging markets, supporting Keynes' insurance perspective hypothesis. Net hedging pressure does vary across time and markets. Copper and soybean futures are net short hedging the majority of time, and oil and gold markets vacillate more often. From 2001 to 2006, a net short hedging pressure has dominated the gold market.

5.3 Results of VAR Granger causality model:

Using the methodology described in section 4.3, VAR Granger causality model is estimated on spot premium and term premium, respectively. Results are analyzed in section 5.3.1 for spot premium and in section 5.3.2 for term premium.

5.3.1 Spot premium vs term structure & net hedging pressure:

Lag length tests show that one lag is appropriate for all VAR models on spot premiums across markets. Lutkepohl (1993, Chapter 3, pp 69) points out that for the stable time series with standard white noise process, when the sample size is not small, the *t* statistics provided by common regression programs can be used to check the significance of individual variables. Coefficients with *t* statistics highlighted by ***, ** and * are significant at 1%, 5% and 10% levels, respectively.

Insert Table 7 here

Surprisingly, across markets, leading effects demonstrate themselves unilaterally from spot premiums towards convenience yield and net hedging pressure; net hedging pressure does not lead spot premium in any market; and convenience yield shows

market-dependent results and leads spot premiums in oil and soybean markets only. And for all the markets excluding copper, the longest convenience yield has the least effect on spot premium.

For other causalities, briefly speaking, mutual causality is detected between term slopes of different horizons in all markets, showing that information contained in each part of the term structure is intertwined and can be used to predict one another. Also metal is the only market that an existing causality between term structure and net hedging pressure has been witnessed: for gold, net hedging pressure unilaterally leads the term structure while for copper, the overall term structure leads net hedging pressure and net hedging pressure counter-effects the short-term slope only.

5.3.2 Term premium vs term structure & net hedging pressure:

For VAR Granger-causality model on term premium, lag length tests show the appropriate order of VAR model for each commodity is: thirteen lags for both oil and soybean spreads and one lag for both of the metal spreads. Limited by the paper length, only results of one spread are included in Table 8 and Table 11 for oil and soybean respectively. Further details can be obtained by contacting the author.

Oil market:

Insert Table 8 here

For all three oil spreads, a leading effect of term premium on the overall term structure and net hedging pressure appears in the 12^{th} and 13^{th} lags, showing that the spread premiums contain information that can be used to forecast the term structure and net hedging pressure in approximately three months away.

The overall term structure improves forecast of term premium across time, but at slightly different lags. In general, the predictive power of term structure shows up in various term premiums during the majority of the third month in the future.

Metal markets—gold and copper:

Insert Table 9 & Table 10 here

The same causality effects of term premium on term structure and net hedging pressure are observed in the gold spread using the 6-month contract and in all the three copper spreads. Negative (positive) coefficients of gold (copper) spreads can be naturally associated with its contangoed (backwardated) shape of convenience yield.

Causality between term structure and net hedging pressure is maintained in both spread markets as it shows in their spot markets: net hedging pressure unilaterally drives gold's term structure and term structure leads copper's net hedging pressure.

Perhaps the most important finding in the metal spread market comes from the significant leading effect of the whole term structure on term premium, in contrast to non-effect of term structure on the corresponding spot premium, reconfirming Roon, Goorbergh and Nijman's (2004) conclusion that term premium should rely more on the term structure risks. Like spot premium, variation of term premium explained by term structure decreases with the horizon so that the latest short-term convenience yield should always contain the most relevant information for predicting future term premiums.

Soybean market:

Insert Table 11 here

Again, limited by the paper length, only results of the second soybean spread[9] are included here in Table 11. Among all the three spreads, this spread displays the largest number of lags in which term structure contains valuable information for predicting future term premium, evenly applicable from one month to three months ahead. In return, all three term premiums clearly lead the term structure by one week, one month and three months ahead.

In sum, both premiums Granger-cause the overall term structure and net hedging pressure, showing the fact that various risk premiums are the major drivers of the commodity futures markets. While the term structure contains information only to predict spot premiums in oil and soybean markets, it does demonstrate predictive power with respect to term premiums in all four of the commodity markets studied, thus the term structure risk should be better captured by term premium than by spot premium. No significant causality of net hedging pressure has been found on either premium.

5.3.3 Robustness test, bi-weekly and monthly data:

To check the robustness, bi-weekly and monthly data are used to re-perform the VAR Granger-causality test. Their results, available upon request, mainly overlap results from the weekly data and thus are exempt from the thesis.

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[9] The reason to display results of the second soybean spread is that the term structure effect is supposed to be most significant in term slope derived from the July contract, since it is the only contract that expires just prior to the upcoming harvest season starting in September. Test results show that it is the case.

6. Active trading strategy:

In this section, active trading strategies are constructed to earn profits from the predictive power of the term structure and net hedging pressure on various premiums found in the previous section. Three active trading strategies are discussed in this section: the momentum/contrarian strategy, the convenience yield strategy and the net hedging pressure strategy.

6.1 Momentum/contrarian strategy:

6.1.1 Portfolio construction:

To create momentum portfolios, bi-weekly data from January 1990 to December 2006 are used to maintain a sufficient number of observations. Briefly speaking, at the end of each period, past spot premiums and term premiums of all the four commodity futures are ranked, then go long futures or futures spreads categorized as the "winner" with the highest premium and go short the counterpart categorized as the "loser" with the lowest premium. Rebalance or rewind the positions after holding for a certain period of time. Continue this process of enter-hold-exit during the testing period. To facilitate presentation, each strategy is named after its ranking (R) and holding (H) periods as the *R–H* strategy, with ranking and holding periods set as one month, three months, six months and twelve months.

When Miffre and Rallis (2007) build momentum portfolios, an overlapping trading strategy is used in the process as they follow their predecessor Moskowitz and Grinblatt (1999) and Jegadeesh and Titman (2001). Jegadeesh and Titman (2001) describe the overlapping trading strategy as follows "in any given month *t*, the

strategies hold a series of portfolios that are selected in the current month as well as in the previous K - 1 months, where K is the holding period.... And the strategy closes out the position initiated in month t –K. Hence, under this trading strategy we revise the weights on $1/K$ of the securities in the entire portfolio in any given month and carry over the rest from the previous month" (Jegadeesh and Titman, 1993, pp 68). The benefit of doing so is to avoid the bid-ask bounce in trading (Miffre and Rallis, 2007, pp 1867, note 7).

This thesis builds trading portfolios in almost the same way as Miffre and Rallis's (2007) except for two differences in premium definition and weight method: (1) Miffre and Rallis rank commodities with "measured futures returns as the change in the logarithms of settlement prices" (Miffre and Rallis, 2007, pp 1864, note 1) and this thesis ranks them with spot premium and term premium defined in section 4.1. By doing so, the test from Miffre and Rallis's (2007) long-only strategy is extended to Roon, Goorbergh and Nijman's (2004) calendar spread strategy. (2) Miffre and Rallis (2007) use the equally-weight method and filter out futures with an average trading volume below 1,000 contracts in order to mitigate illiquidity, whereas this thesis uses the dollar-weight method to invest one dollar in both winner and loser portfolios in each period. This method is good to avoid capital-allocation risk introduced by large differences in unit contract prices across commodity markets.

Finally, in this thesis, returns of winner or loser portfolios are defined as the holding-period returns of longing the corresponding portfolios. For the nature of trading strategies, momentum trading return is defined simply as the difference

between winner portfolio and loser portfolio and contrarian return is defined the opposite. SAS-calculated statistics of momentum trading returns are listed from Table 12 to Table 17 to match six trading strategies—three outright long-only strategies and three calendar spread strategies using contracts or spreads that expire in three months, six months and twelve months. The momentum strategy works when the "Momentum" column in tables is positive and the contrarian strategy works when it is negative. The purpose of using multiple contracts or spreads to build momentum trading portfolios is two-fold: to check robustness and to empirically validate Miffre and Rallis's (2007) assumption that term structure drives momentum effect in commodity markets. According to them, if momentum profits are related to the market structure, trading in long-term futures could generate more profits.

6.1.2 Empirical results:

Insert Table 12, 13 &14 here

Insert Table 15, 16 & 17 here

The test's result is, momentum strategy works under most cases for both outright contracts and calendar spreads, especially when the holding period is under six months, and the shorter the holding period, the larger the momentum profits. Thus a short-term price continuation, close to that found in equity market by Jegadeesh and Titman (1993, 2001), has also been identified in the four commodity markets. In the absence of transaction costs, momentum profits can be maximized by longing the most outperforming futures or calendar spread and shorting its most underperforming counterpart in the previous month, holding the pair for one month and continuously

rolling it over to the next pair selected with the same criterion at each rebalancing point. This strategy works equally well for outright contracts and calendar spreads with different maturities. And it yields an annual return ranging from 51.6% to 88.8% with a corresponding Sharpe ratio from 232.74% to 284.83% for outright contract strategy, and an annual return from 18% to 76.8% with a Sharpe ratio from 118.09% to 217.36% for calendar spread strategy.

Among all six strategies, momentum profits decline rapidly, and sometimes even shrink into losses, with both ranking and holding periods, especially holding period. For outright futures strategy, the significant momentum effect disappears when both periods reach and exceed six months; loser portfolio bounces and outperforms winner portfolio when it is held for twelve months so that a significant contrarian profit occurs in that case; momentum trading with the shortest three-month futures yields the most superior benefits under almost all circumstances, followed by the six-month futures and twelve-month futures. For the calendar spread strategy, momentum profit loses significance and flips into contrarian profit even earlier: excluding the longest spread, significant contrarian profits dominate all scenarios when ranking and holding periods are longer than three months, although they are significantly dwarfed by momentum profits in magnitude. The highest momentum profits come from trading the one-year long spread under all scenarios and decreases with six-month and three-month spreads in that order, just opposite to trading results in outright futures strategy. Miffre and Rallis's (2007) assumption of linkage between

momentum effect and term structure are thus empirically supported through the trading results.

6.1.3 Summary and remark:

In sum, after applying Roon, Nijman and Veld's (1998) risk premiums to Miffre and Rallis's (2007) trading system, this thesis has two major contributions beyond their papers: (1) active momentum trading strategy is successfully extended to calendar spreads and achieves exploitable profits, in contrast to none exploitable profits from Roon, Goorbergh and Nijman's (2004) paper; (2) a significant contrarian effect demonstrates itself in almost all strategies when the holding period is long enough, which is one year for outright futures strategy and as short as three months for calendar spread strategy, in contrast to Miffre and Rallis's (2007) finding of no contrarian effect. Momentum profits are much more substantial than contrarian profits in size.

In this thesis, trading results are comparable only between outright futures strategies or spread strategies but not across both groups, because when calculating spread trading returns, I have to tackle infinitively small denominator due to negligible costs when initiating spreads. The following expression is used to calculate spread returns:

$$R_{cs} = \frac{P_{endf} - P_{openf}}{(|P_{openl}| + |P_{opens}|)/4} \quad (11)$$

where P_{endf} and P_{openf} are ending and opening balances of spread portfolio, $|P_{openl}|$ and $|P_{opens}|$ are opening balances of long and short sides when spread is initialized. Their absolute sum is then divided by 4 to take account of the offsetting

effect of a long-short strategy. The revised calculation solves the problem of an infinitive denominator and makes different calendar spreads comparable across time and markets.

6.2 Momentum strategy vs Backwardation and contango:

Although my active trading results in the previous section show some empirical relationship between momentum effect and term structure, in this section, the following regression on active trading returns of both winner and loser portfolios is run to acquire further and direct evidence that momentum associates with backwardation:

$$R_{f,t} = \alpha_0 + \beta_1 cy_t + \beta_2 H_t + \beta_{3i} \sum_{i=1}^{11} D_i + \varepsilon_t \quad (12)$$

where $R_{f,t}$ is the return of longing (shorting) the winner (loser) portfolio, cy_t the portfolio convenience yield, H_t the portfolio net hedging pressure and D_i the monthly dummy set as 1 for each month, and 0 otherwise. cy_t and H_t are made up of the convenience yield and net hedging pressure of the most outperforming and underperforming commodities included in winner and loser portfolios at each period. Returns are regressed on convenience yield derived from corresponding maturity, i.e., 3-month convenience yield is regressed against returns of long-only the 1st-nearby futures and the shortest calendar spread and so on and so forth.

The effect of backwardation on futures return is complex because according to Till (Till and Eagleeye, 2007), futures excess return is roughly made up of spot

return[10] and roll return, two returns that both correlate with term structure but in opposite directions. Increasing backwardation (contango) should drag down (up) spot return and boost (reduce) roll return. Thus, the overall effect of term structure on portfolio return should be a balance of both forces, either in backwardation or in contango.

6.2.1 Hypotheses:

If Miffre and Rallis's (2007) assumption of linkage between momentum and backwardation is correct, the following evidence is expected:

(1) β_1 should be significantly positive for longing winner and significantly negative for shorting loser for a holding period of 12 months. A positive correlation suggests that winner (loser) wins (loses) more when market becomes more backwardated (contangoed). Since loser is being shorted, corresponding relation becomes negative. This is the simplest case because no rebalancing is performed during one year saves roll yield from being considered.

(2) It is reasonable to have either positive or negative β_1 for portfolio returns under other ranking and holding periods because of the dual forces offsetting each other. However, if the winner (loser) portfolio does have more exposure to backwardated (contangoed) contracts or both, β_1 should, on average, be much larger in absolute value for winner portfolio than that for loser portfolio because

[10] Spot return is defined as distant futures price divided by nearby futures price, and roll return is the difference between futures return and spot return, according to Till (2007).

inventory influences price more in a backwardated market than in a contangoed market.

(3) Since β_1 is determined by the joint correlation between the convenience yield, the spot return and the roll return, the sign of β_1 demonstrates the dominant return explained. For a longed portfolio, in backwardation or contango, spot return always declines with a rising convenience yield while roll return always rises with it, and vice versa for a shorted portfolio. Therefore, a positive β_1 points to an increased term structure effect on roll return (spot return) in a longed (shorted) portfolio and so on and so forth.

6.2.2 Empirical results:

Results are listed from Table 18 to Table 23 for six strategies.

Insert Table 18, 19 & 20 here

Insert Table 21, 22 & 23 here

Generally speaking, it is clear that convenience yield has significant explaining power for momentum trading returns under most of the ranking and holding periods. Following hypothesis one, β_1 is significantly positive and significantly negative for longed winner and shorted loser portfolios that are being held for and beyond six months; following hypothesis two, under most circumstances, β_1 is larger in size for winner portfolios than for loser portfolios; following hypothesis three, both the 6-month and 12-month convenience yields mainly drive roll return of futures, but the 3-month convenience yield drives both: it on average influences more the roll return of winner portfolios but more on the spot return of loser portfolios.

Net hedging pressure is another significant factor of momentum returns in most cases. β_2 is positive for winner portfolios and negative for shorted loser portfolios, which means on average, a rising short hedging pressure boosts both winner and loser returns and a declining short hedging pressure reduces both. The only exception occurs in a scenario with a one-year ranking and one-year holding periods, which could be due to a large number of short hedgers choosing one year as the hedging span and their collective unwinding at the end of one year boosting portfolio returns.

6.2.3 Summary and remark:

In conclusion, both convenience yield and net hedging pressure contain information for momentum strategies, therefore two profitable trading strategies could be formed on basis of these two factors. Strategy one: long portfolio with the highest convenience yield and short portfolio with the lowest convenience yield, in line with Miffre and Rallis's (2007) suggestion of consistently trading the most backwardated and contangoed contracts for profits in their paper. For spread trading, this strategy involves going long the short spread with the highest convenience yield and short the short spread with the lowest convenience yield. Strategy two: long portfolio (short spread) with the highest hedging pressure and short portfolio (short spread) with the lowest hedging pressure.

6.3 Convenience yield strategy & Net hedging pressure strategy:

In this section, the above-mentioned two strategies are implemented to examine whether information contained in convenience yield and net hedging pressure can be capitalized on and exploited into profits.

6.3.1 Portfolio construction:

Relative convenience yield and net hedging pressure are used to organize commodities into portfolios. Relative convenience yield (net hedging pressure) is defined as last period's convenience yield (net hedging pressure) divided by average convenience yield (net hedging pressure) in the ranking period. Each period, these two ratios are calculated and ranked to form two portfolios that have the highest and lowest ratios. A relative ratio is used instead of the average convenience yield (net hedging pressure) because the four commodities have very different historical levels of both factors, which invalidates a direct comparison between each other. Results are listed from Table 24 to Table 31 for four strategies, two outright futures and two spreads with the shortest and longest maturities.

6.3.2 Empirical results:

6.3.2.1 Convenience yield trading strategy:

Insert Table 24, 25, 26 & 27 here

Long-short outright futures fail to capitalize on term structure risk. Long-short the 1st-nearby futures on average incurs a loss, small in size but statistically significant, due mainly to a more profitable low ratio portfolio in most cases. Long-short the 12-month futures on average yields no significant trading results.

In contrast, spread trading provides significantly positive results in most scenarios. And trading long-term spreads yields much higher profits in all circumstances, mainly driven by low ratio portfolios. For both spreads, the highest returns come from strategies with a six- to twelve-month ranking period and a one-month holding period, yielding 7.2% annual return for short-term spread and roughly 14% for long-term spread. Trading profits decrease with declining rebalancing frequency.

In conclusion, the spread strategy produces more consistent profits than the outright futures strategy in capitalizing on convenience yield. The strategy of longing the most backwardated short spread and shorting the most contangoed spread provides an annualized expected return ranging from approximately 6% to 14% when using the long-term spread. The shorter the holding period, the higher the trading profits, in the absence of transaction costs.

6.3.2.2 Net hedging pressure trading strategy:

Insert Table 28, 29, 30 & 31 here

Net hedging pressure strategy delivers very similar results. Long-short the long-term spread outperforms all other strategies and turns out to be the only one with exploitable profits, confirming Roon, Goorbergh and Nijman's (2004) work that the hedging pressure effect can only be isolated through spreads. Low ratio portfolio drives majority of trading profits. And trading profits decrease rapidly with increasing holding period. Hedging pressure strategy yields much less profits than convenience yield strategy under the same circumstances.

Importantly, the effect of transaction costs is not addressed in this thesis, into which further research would be highly recommended.

7. Conclusions:

Convenience yield and net hedging pressure are two unique features of commodity futures markets. Previous literature shows that both contain information for futures risk premium. This thesis is an in-depth empirical study on four commodity returns, their relationship with term structure and net hedging pressure, and a trial on active trading strategies capitalizing on both factors for different types of risk premiums: spot premium and term premium.

VAR Granger-causality model is used to examine the correlation between various premiums, convenience yield and net hedging pressure. Results show that term structure of all the four commodities contain predictive power to corresponding term premiums, but only that of oil and soybean lead their spot premiums. And no significant causality of net hedging pressure is found on either risk premium.

In the active trading part, three trading strategies are addressed. Miffre and Rallis's (2007) overlapping momentum trading portfolios are constructed in a 4*4 scenarios, with ranking (R) and holding (H) periods selected as one month, three months, six months and twelve months. Significant momentum profits are identified in all scenarios for both outright futures and spread trading strategies, especially for continuously rolled-over short-term futures and long-term spread.

Returns of winner and loser portfolios are regressed against their corresponding portfolio convenience yields, portfolio net hedging pressures and monthly dummies.

Results show that both convenience yield and net hedging pressure are responsible for momentum profits. And term structure's dominating effect on the spot return or the roll return can be further distinguished from the sign of factor coefficient.

Based on regression results, two other trading strategies are performed: (i) long the most backwardated futures (short spread) and short the most contangoed futures (short spread); (ii) long the most short hedging futures (short spread) and short the most long hedging futures (short spread). For both strategies, long-short the long-term spreads offers the highest and most significant return, and it offers the only exploitable profits built on the past hedging pressure. On average, spread trading outperforms outright futures trading in capturing the term structure risk and hedging pressure risk, which reaffirms Roon, Goorbergh and Nijman's (2004) indication that term premium is mainly for risk present in term structure and hedging pressure effect needs to be isolated through spreads. However such power of capturing both risks is dampened by trading the short-term spread, which may suggest a shortage of long-term spread providers in comparison with short hedgers that prefer to using long-term spreads to hedge; and the abnormal term premium of long-term spread could probably exist for long before being removed until a close battle between hedgers and speculators moves to the remote end of term structure along with maturity.

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Appendix 1: Terminology

Term structure of commodity yield:

The term structure of commodity shows the relationship between the maturity of a futures contract and the futures price at a specific point in time.

Backwardation and contango:

These terms are used to describe the shape of term structure. Backwardation (contango) refers to a downward (upward) sloping term structure in which futures prices decline (rise) with maturity. According to Keynes (1930) and Hicks (1939), futures markets are used predominantly by short hedgers (producers in underlying commodities) so that futures price should be biased down to remunerate speculators for being long. Current futures price will rise to converge to the spot price as maturity approaches.

Carrying charge and inverse carrying charge:

Also called the "market-determined price of storage", these terms refer to the difference between two contract prices with different maturities. It is evident that a backwardated market anticipates an inverse carrying charge and a contangoed market a carrying charge from nearby to distant futures.

Long spread and short spread:

In commodity trading, a long (short) spread is to long (short) a nearby contract and short (long) a distant contract of the same commodity.

Outright futures strategy:

Outright futures position is a position in a futures contract that is not offset, in contrast to spread trading strategy.

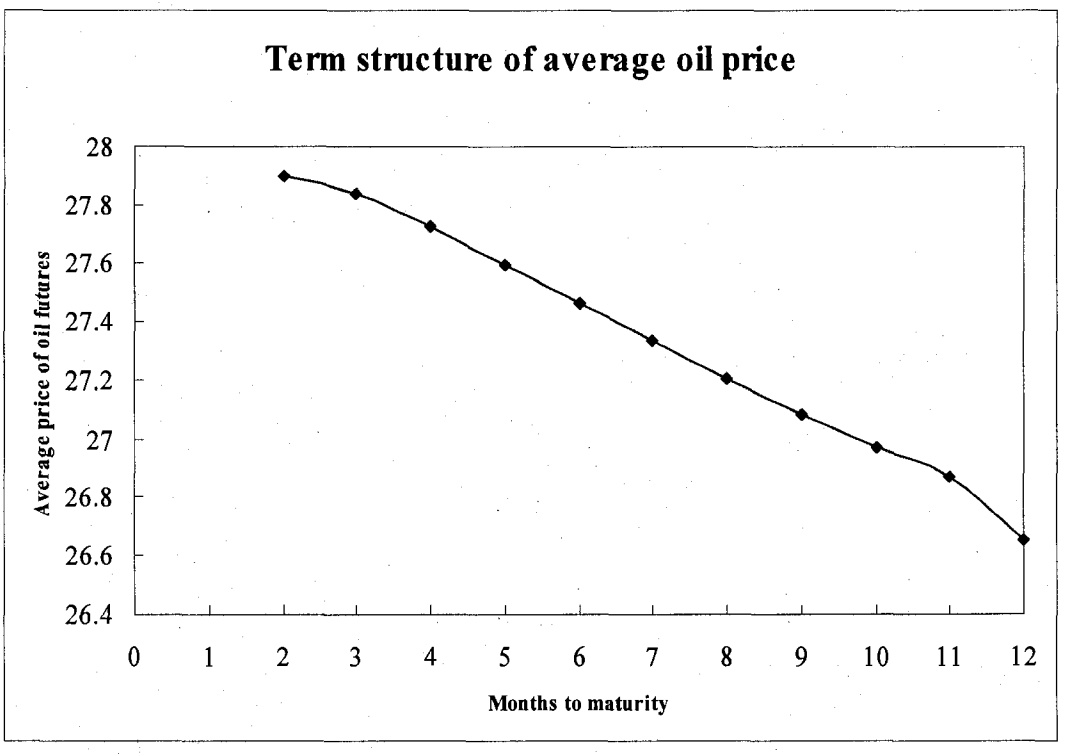
Appendix 2: List of Tables and Figures

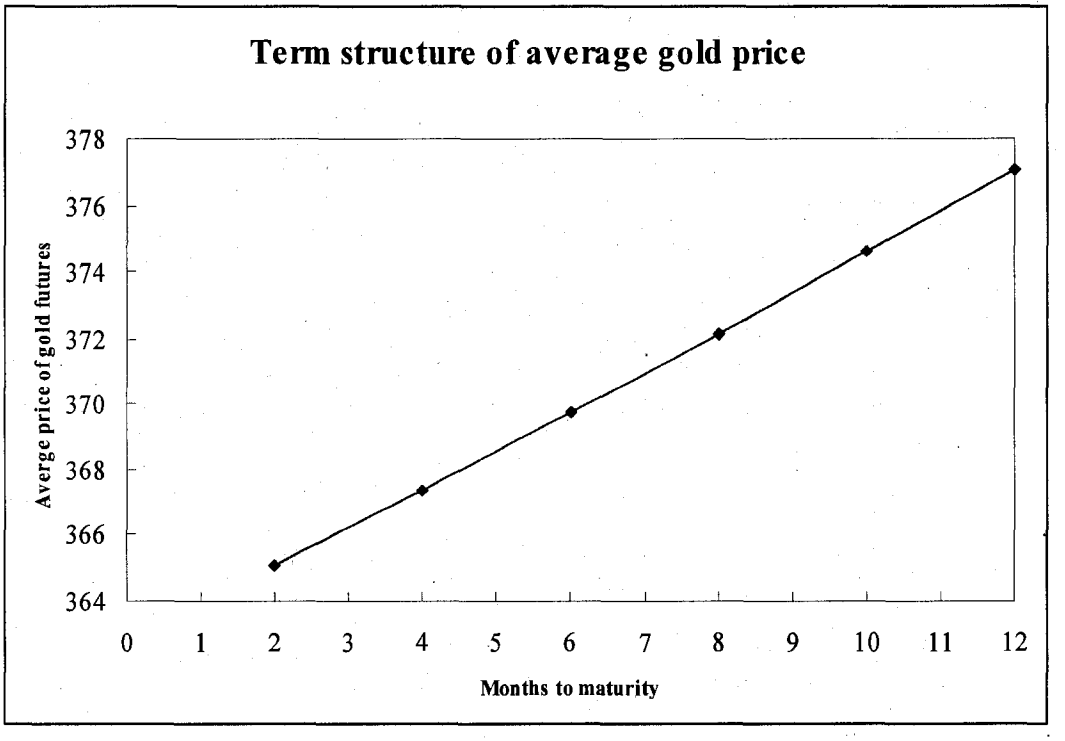
Table 1: Futures contract information

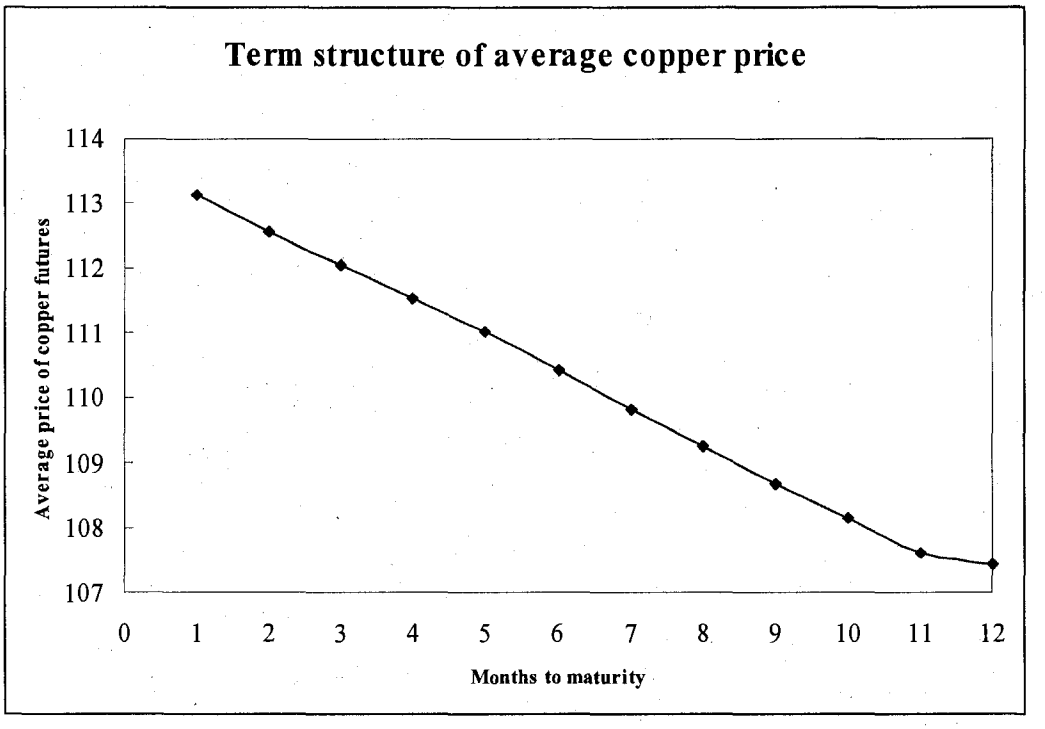
Contract	Exchange	Delivery months	Last trading day
WTI crude oil	New York Mercantile Exchange	All months	The third business day prior to the 25th calendar day of the month preceding the delivery month.
Gold	Commodity Exchange Inc.	2 4 6 8 10 12	The third to last business day of the maturing delivery month.
Copper	Commodity Exchange Inc.	All months	The third to last business day of the maturing delivery month.
Soybean	Chicago Board of Trade	1 3 5 7 9 11[11]	The business day prior to the 15th calendar day of the contract month.

[11] Soybean futures are also traded for delivery in August. We neglect the August contract when constructing the time-series data in order to make data sets evenly spaced.

Figure 1: Term Structure of Average Commodity Futures Prices, daily data






Term structure of average copper price
Average price of copper futures
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113
112
111
110
109
108
107
0 1 2 3 4 5 6 7 8 9 10 11 12
Months to maturity

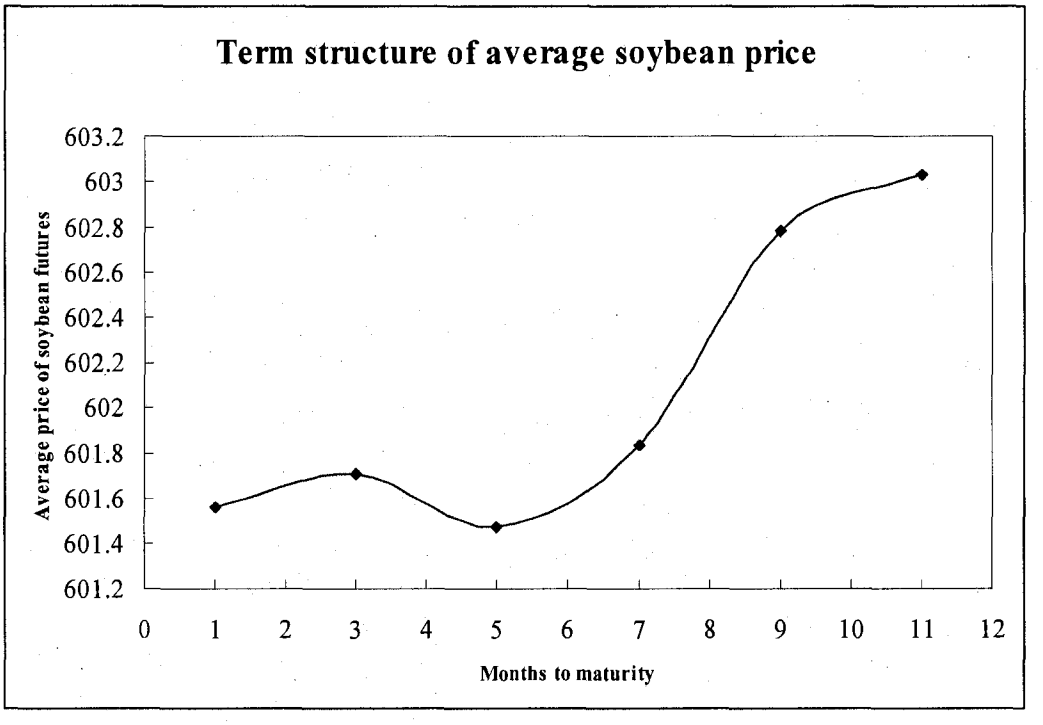
Term structure of average soybean price
Average price of soybean futures
603.2
603
602.8
602.6
602.4
602.2
602
601.8
601.6
601.4
601.2
0 1 2 3 4 5 6 7 8 9 10 11 12
Months to maturity

Table 2: Returns of spot price and the 1st-nearby futures price, daily data

	N	Mean	Median	Std Dev	Skewness	Kurtosis	Maximum	Minimum	Jarque-Bera
return of Oil SP	4262	0.0230%	0.0646%	0.0229	-1.3447	25.1474	0.1357	-0.3841	88390.31
return of Oil F_1	4260	0.0237%	0.0559%	0.0203	-1.2388	21.9776	0.1235	-0.3282	65016.13
return of Gold SP	4258	0.0103%	0.0000%	0.0091	-0.2433	13.1188	0.0889	-0.0773	18207.74
return of Gold F_1	4254	0.0100%	0.0000%	0.0090	-0.2676	12.5845	0.0883	-0.0775	16333.49
return of Copper SP	4260	0.0233%	0.0000%	0.0154	-0.2334	7.1863	0.1119	-0.1167	3149.40
return of Copper F_1	4256	0.0241%	0.0000%	0.0152	-0.2664	7.2954	0.1156	-0.1152	3322.24
return of Soybean SP	4255	0.0036%	0.0000%	0.0147	-3.3217	74.7963	0.0673	-0.3409	921711.00
return of Soybean F_1	4255	0.0036%	0.0000%	0.0139	-1.2417	21.3397	0.0677	-0.2122	60724.67
return of CRB	4250	0.0060%	0.0166%	0.0063	-0.0517	4.6147	0.0374	-0.0291	463.62
return of R3000	4250	0.0345%	0.0557%	0.0098	-0.1226	6.8065	0.0537	-0.0687	2576.4520
10-y T-bond	4172	-0.0006%	0.0000%	0.0006	0.3540	5.1400	0.0039	-0.0023	883.2510

Return of SP refers to return of spot markets; return of F_1 refers to return of the most nearby futures contracts. Return of CRB commodity index, return of Russell 3000 index and return of 10-year U.S. Treasury bond are listed here as benchmarks.

Returns are calculated with daily data from January 1st 1990 to December 31st 2006. All returns are calculated against the one-day price lag of the same time series and not across contracts with different maturities.

Eview is used when calculating statistics.

Annualized mean and standard deviation are calculated by multiplying daily data with 250 and $\sqrt{250}$ respectively.

Return	Oil SP	Oil F_1	Gold SP	Gold F_1	Copper SP	Copper F_1	Soybean SP	Soybean F_1	CRB	R3000	10-y T-bond
Annual mean	5.75%	5.93%	2.58%	2.49%	5.83%	6.03%	0.90%	0.90%	1.50%	8.63%	-0.16%
Annual Std Dev	36.22%	32.09%	14.38%	14.29%	24.40%	24.05%	23.27%	21.97%	10.01%	15.51%	0.92%

Table 3: Summary statistics of spot premium and term premium, daily data

Daily Mean	*Spot premium* $\pi_{s,t}=\left(s_{t+k}-f_t^{(k)}\right)$	*Term premium* $\Theta_t^{(k,n)}=\left(s_{t+k}-f_t^{(k)}\right)-\left(f_{t+k}^{(n-k)}-f_t^{(n)}\right)$									
	k	*p=3*	*p=4*	*p=5*	*p=6*	*p=7*	*p=8*	*p=9*	*p=10*	*p=11*	*p=12*
Oil	1.99%		0.34%	0.32%	0.30%	0.28%	0.27%	0.25%	0.23%	0.23%	0.23%
Gold	0.24%				-0.59%		-0.59%		-0.58%		-0.57%
Copper	1.91%	0.26%	0.24%	0.22%	0.21%	0.20%	0.19%	0.18%	0.18%	0.18%	0.12%
Soybean	-0.07%			-0.19%		-0.16%		-0.17%		-0.19%	

Daily Std Dev	*Spot premium* $\pi_{s,t}=\left(s_{t+k}-f_t^{(k)}\right)$	*Term premium* $\Theta_t^{(k,n)}=\left(s_{t+k}-f_t^{(k)}\right)-\left(f_{t+k}^{(n-k)}-f_t^{(n)}\right)$									
	k	*p=3*	*p=4*	*p=5*	*p=6*	*p=7*	*p=8*	*p=9*	*p=10*	*p=11*	*p=12*
Oil	15.84%		2.85%	3.77%	4.60%	5.35%	5.99%	6.56%	7.11%	7.58%	8.01%
Gold	6.83%				0.41%		0.50%		0.59%		0.70%
Copper	12.08%	1.53%	1.91%	2.19%	2.51%	2.80%	3.13%	3.46%	3.78%	4.10%	9.89%
Soybean	12.59%			4.99%		5.97%		5.97%		6.37%	

Returns are calculated with daily data from January 1st 1990 to December 31st 2006.

Spot premium is obtained by longing the 1st-nearby futures mature in k days and term premium obtained by longing the same futures maturing at $t+k$ and shorting distant futures maturing at $t+n$ ($k<n$) and holding the spread for k days.

p refers to number of months until maturity for contract being shorted. n and k refer to number of days until maturity for contract being shorted and for the 1st-nearby futures being longed in both strategies respectively. In this thesis, the 1st-nearby futures are mature in different months across four markets, i.e. 3 months, 4 months, 2 months and 3 months for oil, gold, copper and soybean respectively.

SAS is used to calculate the statistics of premiums and the t-value of a null hypothesis of a mean equal to zero.

Annualize daily spot premium as: $\pi_{s,t} / (k/250)$ and term premium as: $\Theta_t^{(k,n)} / (n/250 - k/250)$. Likewise, annualize daily spot premium volatility and term premium volatility as: $std(\pi_{s,t}) / \sqrt{k/250}$ and $std(\Theta_t^{(k,n)}) / \sqrt{n/250 - k/250}$.

Annual Mean	***Spot premium*** $\pi_{s,t} = (s_{t+k} - f_t^{(k)})$	***Term premium*** $\Theta_t^{(k,n)} = (s_{t+k} - f_t^{(k)}) - (f_{t+k}^{(n-k)} - f_t^{(n)})$									
	k	***p=3***	***p=4***	***p=5***	***p=6***	***p=7***	***p=8***	***p=9***	***p=10***	***p=11***	***p=12***
Oil	7.95%		4.08%	1.91%	1.20%	0.84%	0.64%	0.49%	0.40%	0.34%	0.30%
Gold	0.72%				-3.54%		-1.76%		-1.16%		-0.86%
Copper	11.45%	3.07%	1.42%	0.88%	0.62%	0.47%	0.38%	0.32%	0.27%	0.24%	0.14%
Soybean	-0.28%			-1.15%		-0.49%		-0.34%		-0.28%	

Annual Std Dev	***Spot premium*** $\pi_{s,t} = (s_{t+k} - f_t^{(k)})$	***Term premium*** $\Theta_t^{(k,n)} = (s_{t+k} - f_t^{(k)}) - (f_{t+k}^{(n-k)} - f_t^{(n)})$									
	k	***p=3***	***p=4***	***p=5***	***p=6***	***p=7***	***p=8***	***p=9***	***p=10***	***p=11***	***p=12***
Oil	31.69%		9.88%	9.22%	9.20%	9.26%	9.28%	9.28%	9.31%	9.28%	9.25%
Gold	11.84%				1.00%		0.86%		0.83%		0.85%
Copper	29.58%	5.30%	4.67%	4.39%	4.34%	4.34%	4.42%	4.52%	4.63%	4.73%	10.83%
Soybean	25.18%			12.22%		10.34%		8.44%		7.80%	

Results of the T-test:

(1) Oil: spot premium and term premiums up to *p=8* are significantly different from zero at 1% level of alpha; term premiums *p=9* and *p=10* are significant at 5% level; the rest are all significant at 10% level.

(2) Gold: spot premium is significantly different from zero at 5% level; the rest are all significant at 1% level.

(3) Copper: term premium *p=12* is not significantly different from zero; the rest are all significant at 1% level.

(4) Soybean: spot premium is not significantly different from zero; term premium *p=5* is significant at 5% level; the rest are all significant at 10% level.

Table 4: Summary statistics of convenience yield under adequate and inadequate inventory levels, daily data

		Unconditional			Annualized Mean		Annualized Std Dev	
		Annualized Mean	Annualized Std Dev	% Positive	Positive	Negative	Positive	Negative
Oil	3-month	5.60%	4.16%	74.75%	-3.48%	8.75%	1.81%	3.54%
	6-month	8.04%	8.38%	73.14%	-5.60%	13.17%	3.56%	6.62%
	12-month	8.94%	10.24%	81.72%	-5.18%	12.18%	4.14%	8.29%
Gold	4-month	2.39%	0.80%	99.95%	-0.20%	2.39%	0.13%	0.80%
	6-month	1.89%	0.79%	99.60%	-0.04%	1.90%	0.02%	0.79%
	12-month	1.40%	0.88%	99.88%	-0.01%	1.40%	0.01%	0.88%
Copper	3-month	6.56%	4.16%	77.69%	-1.52%	13.18%	0.34%	5.04%
	6-month	7.64%	6.14%	76.45%	-1.33%	10.47%	0.50%	5.73%
	12-month	8.23%	10.39%	81.04%	-1.22%	10.68%	0.65%	10.33%
Soybean	3-month	3.49%	6.19%	50.50%	-2.03%	9.05%	0.67%	7.81%
	7-month	3.44%	7.77%	51.29%	-2.47%	9.20%	1.08%	8.88%
	11-month	3.52%	7.68%	55.23%	-2.02%	8.15%	1.28%	7.98%

Convenience yield is the negative of the interest-adjusted basis calculated as $f(t,T)-s(t)-R(t,T)/(T-t)$.

Three contracts—the 3-month futures, the 6-month futures and the 12-month futures are used to calculate the short-term, intermediate-term and long-term convenience yield for the majority of commodities. Since gold market only trades contracts maturing in even month and soybean market only in odd month, different contracts other than the three maturities have to be chosen for both markets. The 4-month futures is used to calculate the short-term convenience yield for gold, and the 7-month and 11-month contracts are used to calculate the intermediate-term and long-term convenience yields for soybean.

Positive (negative) refers to a positive (negative) interest-adjusted basis, in other words a negative (positive) convenience yield, which holds when inventory is adequate (inadequate).

% Positive refers to the percentage of time when convenience yield is positive.

SAS is used to calculate the statistics of convenience yield.

Table 5: Summary statistics of net hedging pressure variable, semi-monthly data

	Mean	Std Dev
Oil	0.57%	5.74%
Gold	12.28%	30.04%
Copper	13.15%	20.91%
Soybean	12.76%	20.99%

		Oil		Gold		Copper		Soybean	
Year	Obs	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
1990	24	-5.36%	3.39%	0.54%	15.64%	3.88%	17.03%	9.70%	10.63%
1991	24	0.82%	4.35%	-7.23%	20.02%	-3.94%	19.46%	19.76%	8.71%
1992	24	-2.12%	5.01%	-6.18%	17.80%	7.83%	20.27%	24.29%	16.50%
1993	24	-3.74%	3.99%	25.79%	25.30%	5.37%	12.55%	42.62%	12.27%
1994	24	3.99%	3.62%	16.89%	19.99%	37.39%	7.15%	16.16%	28.23%
1995	24	5.49%	7.81%	-0.82%	13.99%	14.91%	18.32%	19.68%	18.41%
1996	24	2.43%	3.14%	1.74%	20.18%	18.68%	12.57%	31.26%	12.40%
1997	24	-2.20%	7.03%	-18.10%	11.73%	30.89%	19.66%	12.86%	22.46%
1998	24	-1.87%	4.72%	-9.45%	15.89%	7.58%	13.90%	-9.79%	10.62%
1999	24	7.37%	4.70%	-23.94%	18.10%	19.72%	19.08%	-3.25%	14.78%
2000	24	2.29%	2.58%	-8.19%	16.47%	14.80%	14.22%	27.49%	7.38%
2001	24	-5.31%	4.31%	8.09%	34.04%	-13.88%	10.35%	8.98%	13.53%
2002	24	3.19%	5.62%	40.36%	11.02%	13.30%	14.74%	20.48%	10.06%
2003	24	0.07%	5.37%	47.46%	11.29%	32.01%	15.36%	16.64%	14.55%
2004	24	3.82%	4.00%	45.28%	11.13%	27.12%	9.89%	0.43%	23.34%
2005	24	-0.67%	3.82%	48.73%	15.02%	16.61%	9.72%	-7.55%	13.80%
2006	24	1.44%	2.52%	47.80%	8.04%	-8.76%	12.57%	-12.90%	10.25%

Net hedging pressure is calculated as the difference between short and long hedge positions of commercial traders divided by their total hedge positions.

$$H_t = \frac{\text{short hedge positions - long hedge positions}}{\text{total hedge positions}}$$

Table 6: Unit Root Test by Eview, daily data

	Intercept		Trend & Intercept		None		Intercept		Trend & Intercept		None	
Spot	**t-Stat**	**p-value**	**t-Stat**	**p-value**	**t-Stat**	**p-value**	**t-Stat**	**p-value**	**t-Stat**	**p-value**	**t-Stat**	**p-value**
premium	**ADF**	**ADF**	**ADF**	**ADF**	**ADF**	**ADF**	**PP**	**PP**	**PP**	**PP**	**PP**	**PP**
$oilRF_1$	-5.70	0.00	-5.71	0.00	-5.65	0.00	-5.99	0.00	-6.00	0.00	-5.94	0.00
$goldRF_1$	-6.25	0.00	-6.60	0.00	-6.24	0.00	-6.14	0.00	-6.47	0.00	-6.13	0.00
$coppRF_1$	-5.36	0.00	-5.55	0.00	-5.33	0.00	-5.48	0.00	-5.68	0.00	-5.43	0.00
$soybRF_1$	-5.04	0.00	-5.06	0.00	-5.04	0.00	-5.47	0.00	-5.49	0.00	-5.47	0.00
Term premium												
$oilSPR_1$	-5.76	0.00	-5.83	0.00	-5.72	0.00	-7.33	0.00	-7.39	0.00	-7.28	0.00
$oilSPR_2$	-6.82	0.00	-6.87	0.00	-6.80	0.00	-7.13	0.00	-7.17	0.00	-7.12	0.00
$oilSPR_3$	-6.35	0.00	-6.36	0.00	-6.34	0.00	-6.74	0.00	-6.76	0.00	-6.74	0.00
$goldSPR_1$	-6.64	0.00	-6.62	0.00	-3.55	0.00	-9.95	0.00	-9.95	0.00	-5.49	0.00
$goldSPR_2$	-4.99	0.00	-5.07	0.00	-3.85	0.00	-6.28	0.00	-6.35	0.00	-5.07	0.00
$coppSPR_1$	-9.07	0.00	-9.06	0.00	-8.97	0.00	-8.90	0.00	-8.90	0.00	-8.81	0.00
$coppSPR_2$	-8.62	0.00	-8.63	0.00	-8.62	0.00	-8.28	0.00	-8.30	0.00	-8.29	0.00
$coppSPR_3$	-10.83	0.00	-10.86	0.00	-10.83	0.00	-75.61	0.00	-75.52	0.00	-75.63	0.00
$soybSPR_1$	-6.36	0.00	-6.36	0.00	-6.35	0.00	-6.59	0.00	-6.60	0.00	-6.59	0.00
$soybSPR_2$	-5.80	0.00	-5.81	0.00	-5.80	0.00	-5.93	0.00	-5.94	0.00	-5.93	0.00
$soybSPR_3$	-5.72	0.00	-5.72	0.00	-5.71	0.00	-5.62	0.00	-5.62	0.00	-5.61	0.00
$soybSPR_4$	-5.78	0.00	-5.78	0.00	-5.78	0.00	-5.94	0.00	-5.94	0.00	-5.94	0.00
Convenience yield												
$oilCY_1$	-5.14	0.00	-5.14	0.00	-4.59	0.00	-7.66	0.00	-7.98	0.00	-6.10	0.00
$oilCY_2$	-5.37	0.00	-5.41	0.00	-4.73	0.00	-4.81	0.00	-4.85	0.00	-4.24	0.00
$oilCY_3$	-4.16	0.00	-4.18	0.00	-3.42	0.00	-4.09	0.00	-4.10	0.01	-3.35	0.00
$goldCY_1$	-8.21	0.00	-9.48	0.00	-4.27	0.00	-9.50	0.00	-11.29	0.00	-3.74	0.00
$goldCY_2$	-6.76	0.00	-8.09	0.00	-3.67	0.00	-7.24	0.00	-9.17	0.00	-2.89	0.00
$goldCY_3$	-4.51	0.00	-5.66	0.00	-2.72	0.01	-3.68	0.00	-5.18	0.00	-1.91	0.05
$coppCY_1$	-4.76	0.00	-4.78	0.00	-4.12	0.00	-5.43	0.00	-5.60	0.00	-4.17	0.00
$coppCY_2$	-3.41	0.01	-3.50	0.04	-2.83	0.00	-3.37	0.01	-3.46	0.04	-2.60	0.01
$coppCY_3$	-28.77	0.00	-28.99	0.00	-21.77	0.00	-57.79	0.00	-58.58	0.00	-38.45	0.00
$soybCY_1$	-6.82	0.00	-6.83	0.00	-6.55	0.00	-7.59	0.00	-7.60	0.00	-7.32	0.00
$soybCY_2$	-4.02	0.00	-4.03	0.01	-3.82	0.00	-4.62	0.00	-4.63	0.00	-4.41	0.00
$soybCY_3$	-3.86	0.00	-3.85	0.01	-3.55	0.00	-4.51	0.00	-4.53	0.00	-4.05	0.00
Net hedging pressure												
oil	-6.56	0.00	-6.62	0.00	-6.52	0.00	-6.84	0.00	-6.92	0.00	-6.81	0.00
gold	-4.44	0.00	-5.25	0.00	-4.08	0.00	-4.51	0.00	-5.35	0.00	-4.16	0.00
copper	-5.54	0.00	-5.51	0.00	-4.67	0.00	-5.74	0.00	-5.71	0.00	-4.76	0.00
soybean	-3.45	0.01	-3.83	0.01	-2.94	0.00	-3.72	0.00	-4.01	0.01	-3.17	0.00

Table 7: VAR estimates—spot premiums (RF_1), convenience yield (CY_p) and net hedging pressure (QT), weekly data, from October 1992 to December 2006

OIL						GOLD					
	RF_1	CY_1	CY_2	CY_3	QT		RF_1	CY_1	CY_2	CY_3	QT
$RF_1(-1)$	0.89	0.01	0.03	0.04	0.03	$RF_1(-1)$	0.90	0.00	0.00	0.00	0.20
t-value	*54.32****	*3.27****	*5.60****	*6.56****	*3.90****	*t-value*	*55.01****	*-2.17***	*-1.79**	*-1.14*	*4.24****
$CY_1(-1)$	-1.50	0.75	0.16	0.33	-0.04	$CY_1(-1)$	-0.89	0.11	-0.70	-0.74	-1.86
t-value	*-2.80****	*11.75****	*1.12*	*1.47*	*-0.19*	*t-value*	*-0.59*	*0.78*	*-5.10****	*-5.05****	*-0.43*
$CY_2(-1)$	1.25	0.10	0.75	-0.35	0.09	$CY_2(-1)$	1.04	0.68	1.46	0.57	1.86
t-value	*3.00****	*1.96***	*6.50****	*-1.99***	*0.53*	*t-value*	*0.57*	*4.16****	*8.88****	*3.22****	*0.36*
$CY_3(-1)$	-0.43	-0.02	0.09	1.10	-0.05	$CY_3(-1)$	-0.47	-0.10	-0.06	0.89	-0.82
t-value	*-2.86****	*-1.10*	*2.14***	*17.42****	*-0.76*	*t-value*	*-0.95*	*-2.20***	*-1.38*	*18.34****	*-0.57*
QT(-1)	0.03	0.00	0.00	0.00	0.91	QT(-1)	0.00	0.00	0.00	0.00	0.95
t-value	*0.76*	*-0.32*	*0.19*	*0.28*	*53.21****	*t-value*	*0.19*	*-4.61****	*-5.15****	*-5.83****	*73.54****
C	0.01	0.00	0.00	0.00	0.00	C	0.00	0.00	0.00	0.00	0.02
t-value	*2.73****	*2.02***	*-0.77*	*-0.67*	*0.88*	*t-value*	*1.48*	*8.15****	*8.25****	*8.24****	*1.76**

COPPER						SOYBEAN					
	RF_1	CY_1	CY_2	CY_3	QT		RF_1	CY_1	CY_2	CY_3	QT
$RF_1(-1)$	0.93	0.00	0.01	0.02	0.08	$RF_1(-1)$	0.90	-0.02	0.00	0.01	0.07
t-value	*64.69****	*0.87*	*2.20***	*3.74****	*4.02****	*t-value*	*57.66****	*-2.88****	*0.36*	*1.27*	*5.01****
$CY_1(-1)$	0.05	0.41	-0.27	-0.25	-1.26	$CY_1(-1)$	0.22	0.73	-0.26	-0.26	-0.20
t-value	*0.10*	*5.78****	*-2.77****	*-1.74**	*-1.94**	*t-value*	*3.18****	*26.71****	*-8.13****	*-6.97****	*-3.04****
$CY_2(-1)$	0.09	0.32	1.01	0.02	1.75	$CY_2(-1)$	-0.22	0.10	1.00	0.10	0.02
t-value	*0.20*	*4.56****	*10.41****	*0.16*	*2.75****	*t-value*	*-3.05****	*3.47****	*29.54****	*2.61****	*0.32*
$CY_3(-1)$	-0.05	-0.04	0.04	1.02	-0.62	$CY_3(-1)$	0.08	-0.02	0.02	0.92	0.00
t-value	*-0.35*	*-1.71**	*1.44*	*22.80****	*-3.11****	*t-value*	*1.43*	*-1.00*	*0.88*	*31.01****	*0.03*
QT(-1)	0.01	0.00	0.00	0.00	0.93	QT(-1)	0.00	0.00	0.00	0.01	0.98
t-value	*0.79*	*-2.41***	*-1.52*	*-1.08*	*68.57****	*t-value*	*-0.51*	*0.28*	*1.18*	*1.97***	*126.48****
C	0.00	0.00	0.00	0.00	0.01	C	0.00	0.00	0.00	0.00	0.00
t-value	*0.00*	*2.42***	*1.26*	*1.47*	*3.76****	*t-value*	*0.64*	*1.41*	*1.34*	*1.82**	*1.55*

Table 8: VAR estimates—oil term premium (SPR_p), convenience yield (CY_p) and net hedging pressure (QT), weekly data, from October 1992 to December 2006

	$OILSPR_t$	$OILCY_1$	$OILCY_2$	$OILCY_3$	OILQT
$OILSPR_t(-1)$	0.8629	-0.0001	-0.0173	-0.0429	-0.0304
	[20.8510]***	[-0.01154]	[-0.96186]	[-0.87476]	[-0.36736]
$OILSPR_t(-2)$	0.0579	-0.0078	0.0243	0.0455	-0.1466
	[1.06034]	[-0.67435]	[1.02364]	[0.70274]	[-1.34181]
$OILSPR_t(-3)$	-0.0208	0.0065	-0.0393	-0.0695	0.0217
	[-0.38076]	[0.56520]	[-1.65283]*	[-1.07368]	[0.19822]
$OILSPR_t(-4)$	0.0270	0.0046	0.0271	0.0564	0.0592
	[0.49381]	[0.39589]	[1.14088]	[0.87178]	[0.54207]
$OILSPR_t(-5)$	-0.0383	-0.0031	0.0389	0.0898	0.1827
	[-0.70521]	[-0.26840]	[1.64577]*	[1.39445]	[1.67923]*
$OILSPR_t(-6)$	0.0080	-0.0300	-0.0094	-0.0428	-0.1480
	[0.15077]	[-2.66404]***	[-0.40536]	[-0.67684]	[-1.38518]
$OILSPR_t(-7)$	0.0034	0.0444	-0.0208	-0.0214	0.0897
	[0.06293]	[3.94530]***	[-0.89615]	[-0.33886]	[0.84025]
$OILSPR_t(-8)$	-0.0715	-0.0236	0.0016	-0.0092	0.0801
	[-1.32843]	[-2.07816]**	[0.07039]	[-0.14443]	[0.74364]
$OILSPR_t(-9)$	0.1527	0.0077	0.0423	0.1064	-0.0578
	[2.84413]***	[0.67625]	[1.81338]*	[1.67159]*	[-0.53827]
$OILSPR_t(-10)$	-0.0178	-0.0080	-0.0158	-0.0274	-0.0858
	[-0.32812]	[-0.70057]	[-0.67003]	[-0.42647]	[-0.79092]
$OILSPR_t(-11)$	-0.0815	0.0020	-0.0211	-0.0513	-0.0412
	[-1.51284]	[0.17419]	[-0.90207]	[-0.80374]	[-0.38156]
$OILSPR_t(-12)$	-0.3935	0.6089	1.4206	1.9438	0.7521
	[-7.32435]***	[53.6839]***	[60.8075]***	[30.5306]***	[6.99528]***
$OILSPR_t(-13)$	0.4468	-0.5546	-1.2024	-1.7147	-0.9617
	[3.27030]***	[-19.2274]***	[-20.2352]***	[-10.5890]***	[-3.51701]***
$OILCY_1(-1)$	-0.2564	0.6800	0.2283	0.4046	0.0452
	[-1.48841]	[18.6951]***	[3.04760]***	[1.98165]**	[0.13124]
$OILCY_1(-2)$	-0.2184	0.0432	-0.0708	-0.0797	0.3040
	[-1.17482]	[1.10031]	[-0.87501]	[-0.36166]	[0.81688]
$OILCY_1(-3)$	0.2634	0.1065	-0.0158	-0.2005	-0.0395
	[1.41264]	[2.70573]***	[-0.19485]	[-0.90707]	[-0.10577]
$OILCY_1(-4)$	0.0288	-0.0141	0.1742	0.4929	0.4169
	[0.15420]	[-0.35804]	[2.14198]**	[2.22356]**	[1.11372]
$OILCY_1(-5)$	0.0884	-0.0467	0.0021	0.0912	-0.3183
	[0.47713]	[-1.19322]	[0.02582]	[0.41512]	[-0.85836]
$OILCY_1(-6)$	-0.2142	0.0381	-0.0752	-0.2311	0.3199
	[-1.15749]	[0.97637]	[-0.93406]	[-1.05340]	[0.86372]
$OILCY_1(-7)$	-0.2628	-0.0010	0.0883	0.1885	0.2042
	[-1.41473]	[-0.02588]	[1.09358]	[0.85612]	[0.54926]
$OILCY_1(-8)$	0.4704	0.0000	-0.0267	-0.1218	-0.1592
	[2.52498]**	[-6.0e-05]	[-0.32945]	[-0.55175]	[-0.42698]

	$OILSPR_1$	$OILCY_1$	$OILCY_2$	$OILCY_3$	OILQT
$OILCY_1(-9)$	-0.2291	0.1134	-0.0312	-0.0510	-0.2135
	[-1.22143]	[2.86408]***	[-0.38256]	[-0.22920]	[-0.56874]
$OILCY_1(-10)$	0.2449	-0.0194	-0.0945	-0.1756	0.0574
	[1.29638]	[-0.48617]	[-1.15033]	[-0.78430]	[0.15180]
$OILCY_1(-11)$	-0.4583	-0.0350	0.2484	0.4984	-0.2863
	[-2.42199]**	[-0.87501]	[3.01868]***	[2.22260]**	[-0.75594]
$OILCY_1(-12)$	0.2912	-0.2801	-0.7245	-1.0408	-0.6229
	[1.53487]	[-6.99395]***	[-8.78037]***	[-4.62867]***	[-1.64046]
$OILCY_1(-13)$	0.0448	0.3223	0.4500	0.3926	0.5039
	[0.27531]	[9.37588]***	[6.35452]***	[2.03460]**	[1.54648]
$OILCY_2(-1)$	0.2349	0.1505	0.6965	-0.2873	0.0231
	[1.24933]	[3.79038]***	[8.51630]***	[-1.28914]	[0.06145]
$OILCY_2(-2)$	0.1618	-0.0061	-0.0844	-0.2844	-0.5040
	[0.77419]	[-0.13755]	[-0.92844]	[-1.14773]	[-1.20472]
$OILCY_2(-3)$	-0.3031	-0.0785	0.0669	0.3723	0.7777
	[-1.44761]	[-1.77586]*	[0.73493]	[1.49999]	[1.85576]*
$OILCY_2(-4)$	-0.2053	0.0220	-0.1133	-0.4278	-0.3391
	[-0.97747]	[0.49684]	[-1.24024]	[-1.71833]*	[-0.80666]
$OILCY_2(-5)$	0.2614	0.0654	-0.0707	-0.2142	-0.1284
	[1.25100]	[1.48312]	[-0.77850]	[-0.86514]	[-0.30698]
$OILCY_2(-6)$	-0.0457	-0.0963	0.1258	0.3864	-0.4965
	[-0.21963]	[-2.19099]**	[1.38974]	[1.56655]	[-1.19218]
$OILCY_2(-7)$	0.1789	0.0146	-0.0454	-0.0928	0.4697
	[0.85446]	[0.33139]	[-0.49808]	[-0.37381]	[1.12087]
$OILCY_2(-8)$	-0.2378	-0.0119	0.0259	-0.0282	-0.2481
	[-1.13513]	[-0.26951]	[0.28380]	[-0.11349]	[-0.59165]
$OILCY_2(-9)$	0.3123	-0.0545	0.0426	0.0873	0.3126
	[1.49612]	[-1.23541]	[0.46873]	[0.35273]	[0.74827]
$OILCY_2(-10)$	-0.3246	0.0273	0.0576	0.2285	0.0830
	[-1.54999]	[0.61804]	[0.63251]	[0.92058]	[0.19802]
$OILCY_2(-11)$	0.4438	0.0387	-0.2191	-0.4641	0.2117
	[2.10676]**	[0.86978]	[-2.39128]**	[-1.85890]*	[0.50215]
$OILCY_2(-12)$	-0.5816	0.3402	1.0509	1.5599	0.9653
	[-2.74606]***	[7.60698]***	[11.4091]***	[6.21415]***	[2.27736]**
$OILCY_2(-13)$	0.2641	-0.3865	-0.7382	-0.9594	-0.9092
	[1.48040]	[-10.2598]***	[-9.51349]***	[-4.53679]***	[-2.54613]**
$OILCY_3(-1)$	-0.0762	-0.0510	0.0700	1.0294	0.2696
	[-0.88738]	[-2.81178]***	[1.87412]*	[10.1190]***	[1.56924]
$OILCY_3(-2)$	-0.0714	0.0001	0.0631	0.1854	0.0994
	[-0.65110]	[0.00229]	[1.32284]	[1.42664]	[0.45307]
$OILCY_3(-3)$	0.0997	0.0246	-0.0377	-0.1722	-0.4583
	[0.90971]	[1.06448]	[-0.79023]	[-1.32586]	[-2.08938]**
$OILCY_3(-4)$	0.1338	0.0001	0.0037	0.0677	0.0605
	[1.21752]	[0.00290]	[0.07787]	[0.51957]	[0.27503]
$OILCY_3(-5)$	-0.1805	-0.0367	0.0589	0.1550	0.1576
	[-1.64587]	[-1.58264]	[1.23514]	[1.19225]	[0.71811]

	$OILSPR_1$	$OILCY_1$	$OILCY_2$	$OILCY_3$	OILQT
$OILCY_3(-6)$	0.0918	0.0494	-0.0719	-0.2091	0.2478
	[0.83776]	[2.13636]**	[-1.50886]	[-1.60987]	[1.12990]
$OILCY_3(-7)$	-0.1025	-0.0027	0.0007	-0.0074	-0.3605
	[-0.92944]	[-0.11633]	[0.01497]	[-0.05688]	[-1.63318]
$OILCY_3(-8)$	0.0598	0.0042	0.0090	0.1136	0.2646
	[0.54415]	[0.17943]	[0.18763]	[0.87194]	[1.20242]
$OILCY_3(-9)$	-0.1446	0.0088	-0.0137	-0.0423	-0.2510
	[-1.32030]	[0.38104]	[-0.28734]	[-0.32620]	[-1.14527]
$OILCY_3(-10)$	0.1932	-0.0191	-0.0118	-0.0972	-0.0643
	[1.76624]*	[-0.82509]	[-0.24862]	[-0.74978]	[-0.29351]
$OILCY_3(-11)$	-0.2132	-0.0118	0.0588	0.1166	-0.0099
	[-1.93264]*	[-0.50691]	[1.22479]	[0.89164]	[-0.04474]
$OILCY_3(-12)$	0.2395	-0.0449	-0.2545	-0.4006	-0.3381
	[2.16495]**	[-1.92162]*	[-5.29047]***	[-3.05541]***	[-1.52712]
$OILCY_3(-13)$	-0.0896	0.0722	0.1713	0.2533	0.2710
	[-1.05626]	[4.03371]***	[4.64540]***	[2.51973]**	[1.59636]
OILQT(-1)	0.0088	-0.0022	-0.0153	-0.0117	0.8940
	[0.37064]	[-0.43877]	[-1.47634]	[-0.41580]	[18.7364]***
OILQT(-2)	0.0062	-0.0030	0.0119	0.0054	-0.0398
	[0.19426]	[-0.44165]	[0.86089]	[0.14382]	[-0.62573]
OILQT(-3)	0.0293	0.0097	-0.0157	-0.0395	-0.0594
	[0.93716]	[1.47756]	[-1.15747]	[-1.06566]	[-0.94995]
OILQT(-4)	-0.0160	-0.0066	0.0291	0.0853	0.1243
	[-0.50762]	[-0.98562]	[2.11293]**	[2.27642]**	[1.96422]**
OILQT(-5)	-0.0048	0.0035	-0.0082	-0.0443	-0.0540
	[-0.15239]	[0.52753]	[-0.59291]	[-1.17422]	[-0.84860]
OILQT(-6)	-0.0440	-0.0048	0.0097	0.0235	-0.0716
	[-1.35996]	[-0.69828]	[0.69264]	[0.61249]	[-1.10685]
OILQT(-7)	0.0485	0.0013	-0.0184	-0.0266	0.0425
	[1.48487]	[0.19157]	[-1.29689]	[-0.68536]	[0.64938]
OILQT(-8)	-0.0011	0.0004	0.0107	0.0319	0.0462
	[-0.03453]	[0.06373]	[0.76151]	[0.83218]	[0.71473]
OILQT(-9)	0.0283	0.0098	-0.0072	-0.0362	0.0466
	[0.88597]	[1.45462]	[-0.51730]	[-0.95654]	[0.73035]
OILQT(-10)	-0.0165	-0.0069	-0.0010	0.0071	-0.0518
	[-0.51950]	[-1.03808]	[-0.06930]	[0.18951]	[-0.81790]
OILQT(-11)	-0.0017	-0.0023	0.0264	0.0725	0.0343
	[-0.05264]	[-0.34906]	[1.91758]*	[1.93067]*	[0.54077]
OILQT(-12)	-0.0079	-0.0050	-0.0228	-0.0475	-0.0105
	[-0.24797]	[-0.74530]	[-1.64607]	[-1.25946]	[-0.16419]
OILQT(-13)	0.0081	0.0095	0.0053	-0.0147	-0.0157
	[0.36302]	[2.01569]**	[0.54196]	[-0.55234]	[-0.34938]
C	0.0016	0.0006	0.0011	0.0023	0.0013
	[1.26795]	[2.33118]**	[1.98938]**	[1.56027]	[0.52071]

SPR_1, SPR_2 and SPR_3 are calendar spreads that all long the 1st-nearby futures but short the 2nd-nearby futures, the 6-month futures and the 12-month futures, respectively. Lag length tests show the appropriate order of VAR model for each commodity is: 13 lags for both oil and soybean spreads and 1 lag for both of the metal spreads. Limited by the paper length, only SPR_1 is included in the table. However, it is fair enough to do so since other two spreads show similar results that are already summarized in this thesis. Further details can be obtained by contacting the author.

Rows with numbers in square brackets are *t* statistics. According to Lutkepohl (1993, Chapter 3, pp 69), for the stable time series with standard white noise process, when the sample size is not small, the *t* statistics provided by common regression programs can be used to check the significance of individual variables.

Coefficients with *t* statistics highlighted by ***, ** and * are significant at 1% level, 5% level and 10% level, respectively. From the student *t* table—Table G.2 in the Appendix of Greene's <*Econometric Analysis, Sixth Edition*>, the critical values for a two-sided distribution at a confidence level of 0.99, 0.95 and 0.9 are 2.576, 1.96 and 1.645 respectively with df>100.

Table 9: VAR estimates—gold term premium (SPR_p), convenience yield (CY_p) and net hedging pressure (QT), weekly data, from October 1992 to December 2006

	$GOLDSPR_1$				
	SPR_1	CY_1	CY_2	CY_3	QT
$SPR_1(-1)$	0.7315	-0.0709	-0.0758	-0.0551	-1.9911
	[27.8301]***	[-2.81943]***	[-2.98484]***	[-2.02656]**	[-2.44328]**
$CY_1(-1)$	0.4057	0.2793	-0.5317	-0.6212	-1.6550
	[2.75478]***	[1.98300]**	[-3.73733]***	[-4.07945]***	[-0.36240]
$CY_2(-1)$	-0.6452	0.4235	1.2079	0.3826	0.7087
	[-3.56126]***	[2.44411]**	[6.90206]***	[2.04243]**	[0.12616]
$CY_3(-1)$	0.1840	-0.0250	0.0100	0.9367	-1.0113
	[3.79440]***	[-0.54004]	[0.21287]	[18.6872]***	[-0.67268]
QT(-1)	-0.0003	-0.0021	-0.0023	-0.0027	0.9403
	[-0.63704]	[-5.11399]***	[-5.68145]***	[-6.13351]***	[70.8960]***
C	-0.0013	0.0018	0.0018	0.0021	0.0173
	[-4.48126]***	[6.52379]***	[6.67403]***	[7.12950]***	[1.96945]**
	$GOLDSPR_2$				
	SPR_2	CY_1	CY_2	CY_3	QT
$SPR_2(-1)$	0.8685	-0.0212	-0.0252	-0.0121	-1.2244
	[44.2764]***	[-1.38635]	[-1.63208]	[-0.73294]	[-2.48287]**
$CY_1(-1)$	0.4642	0.2235	-0.5835	-0.6782	-1.2664
	[2.53175]**	[1.56538]	[-4.04539]***	[-4.40100]***	[-0.27476]
$CY_2(-1)$	-0.6127	0.5261	1.3073	0.4801	1.0328
	[-2.77258]***	[3.05684]***	[7.51970]***	[2.58474]***	[0.18591]
$CY_3(-1)$	0.1501	-0.0579	-0.0232	0.9080	-1.4687
	[2.61564]***	[-1.29440]	[-0.51477]	[18.8246]***	[-1.01792]
QT(-1)	-0.0004	-0.0021	-0.0024	-0.0027	0.9331
	[-0.71777]	[-4.78731]***	[-5.38235]***	[-5.64422]***	[66.0697]***
C	-0.0008	0.0020	0.0021	0.0023	0.0229
	[-2.30536]**	[7.72430]***	[7.92011]***	[8.14959]***	[2.74273]***

$GoldSPR_1$ and $GoldSPR_2$ are calendar spreads that both long the 1st-nearby futures but short the 2nd-nearby futures — also the 6-month futures, and the 12-month futures, respectively. For the overlapping of the 2nd-nearby futures and the 6-month futures, only two gold spreads are used in this test.

Table 10: VAR estimates—copper term premium (SPR_p), convenience yield (CY_p) and net hedging pressure (QT), weekly data, from October 1992 to December 2006

	COPPERSPR$_1$				
	SPR_1	CY_1	CY_2	CY_3	QT
$SPR_1(-1)$	0.7593	0.0382	0.1135	0.2018	0.3218
	[29.0232]***	[1.72354]*	[3.71268]***	[4.48076]***	[1.58017]
$CY_1(-1)$	0.0006	0.4372	-0.2032	-0.1146	-0.9030
	[0.00764]	[6.06686]***	[-2.04669]**	[-0.78324]	[-1.36471]
$CY_2(-1)$	-0.0694	0.3140	0.9912	-0.0191	1.5308
	[-0.84661]	[4.51872]***	[10.3517]***	[-0.13562]	[2.39900]**
$CY_3(-1)$	0.0489	-0.0427	0.0303	1.0037	-0.6035
	[1.86253]*	[-1.91832]*	[0.98671]	[22.2095]***	[-2.95365]***
QT(-1)	0.0007	-0.0034	-0.0025	-0.0018	0.9393
	[0.38043]	[-2.27191]**	[-1.19964]	[-0.60090]	[68.3856]***
C	-0.0010	0.0012	0.0011	0.0019	0.0155
	[-2.05030]**	[2.66694]***	[1.83699]*	[2.15841]**	[3.92362]***
	COPPERSPR$_2$				
	SPR_2	CY_1	CY_2	CY_3	QT
$SPR_2(-1)$	0.8402	0.0313	0.0809	0.1437	0.1879
	[39.4657]***	[2.57924]***	[4.85171]***	[5.86461]***	[1.67943]*
$CY_1(-1)$	-0.3079	0.4156	-0.2660	-0.2262	-1.0765
	[-2.47231]**	[5.84497]***	[-2.72683]***	[-1.57870]	[-1.64469]
$CY_2(-1)$	0.2370	0.3352	1.0456	0.0775	1.6559
	[1.93770]*	[4.80095]***	[10.9160]***	[0.55036]	[2.57640]***
$CY_3(-1)$	-0.0496	-0.0464	0.0232	0.9913	-0.6096
	[-1.27489]	[-2.08823]**	[0.76245]	[22.1331]***	[-2.98036]***
QT(-1)	0.0017	-0.0037	-0.0032	-0.0031	0.9374
	[0.66416]	[-2.45755]**	[-1.56672]	[-1.04064]	[68.2793]***
C	0.0001	0.0011	0.0009	0.0016	0.0149
	[0.07883]	[2.57125]**	[1.54231]	[1.80693]*	[3.80901]***
	COPPERSPR$_3$				
	SPR_3	CY_1	CY_2	CY_3	QT
$SPR_3(-1)$	0.8829	0.0156	0.0434	0.0830	0.1161
	[48.6267]***	[2.28550]**	[4.64102]***	[6.09175]***	[1.88915]*
$CY_1(-1)$	-0.5209	0.4014	-0.2784	-0.2510	-1.0843
	[-2.69116]***	[5.53175]***	[-2.79550]***	[-1.72751]*	[-1.65556]*
$CY_2(-1)$	0.4495	0.3311	1.0131	0.0219	1.5050
	[2.37656]**	[4.66935]***	[10.4108]***	[0.15404]	[2.35174]**
$CY_3(-1)$	-0.1186	-0.0396	0.0463	1.0327	-0.5283
	[-1.98860]**	[-1.76895]*	[1.50905]	[23.0581]***	[-2.61727]***
QT(-1)	0.0012	-0.0040	-0.0036	-0.0039	0.9409
	[0.29743]	[-2.59323]***	[-1.68397]*	[-1.25302]	[67.2087]***
C	0.0009	0.0010	0.0006	0.0010	0.0131
	[0.79690]	[2.33555]**	[1.04233]	[1.12918]	[3.31049]***

Table 11: VAR estimates—soybean term premium (SPR_p), convenience yield (CY_p) and net hedging pressure (QT), weekly data, from October 1992 to December 2006

	$SOYBSPR_2$	$SOYBCY_1$	$SOYBCY_2$	$SOYBCY_3$	SOYBQT
$SOYBSPR_2(-1)$	0.6219	0.0247	-0.0128	-0.0382	0.0234
	[13.9118]***	[1.21700]	[-1.37443]	[-1.26347]	[0.26942]
$SOYBSPR_2(-2)$	0.1864	-0.0262	-0.0088	-0.0146	-0.0500
	[3.58179]***	[-1.10859]	[-0.81398]	[-0.41459]	[-0.49493]
$SOYBSPR_2(-3)$	-0.0502	-0.1419	-0.0309	-0.0668	0.0734
	[-0.95476]	[-5.94307]***	[-2.80895]***	[-1.87778]*	[0.71912]
$SOYBSPR_2(-4)$	-0.0180	0.0712	0.0466	0.1340	-0.0280
	[-0.33108]	[2.89196]***	[4.10963]***	[3.65113]***	[-0.26600]
$SOYBSPR_2(-5)$	-0.0819	0.0109	0.0152	0.0001	-0.0021
	[-1.47835]	[0.43210]	[1.31063]	[0.00322]	[-0.01991]
$SOYBSPR_2(-6)$	0.1252	0.0017	0.0167	-0.0075	0.1594
	[2.29432]**	[0.06728]	[1.46899]	[-0.20213]	[1.50596]
$SOYBSPR_2(-7)$	0.1662	0.0550	0.0040	0.0697	0.0109
	[3.04611]***	[2.22104]**	[0.35509]	[1.88837]*	[0.10319]
$SOYBSPR_2(-8)$	0.1256	-0.0030	-0.0270	-0.0289	-0.0122
	[2.29821]**	[-0.11988]	[-2.36819]**	[-0.78214]	[-0.11530]
$SOYBSPR_2(-9)$	-0.0203	-0.0222	0.0030	-0.0123	0.0253
	[-0.37363]	[-0.90006]	[0.26221]	[-0.33562]	[0.24032]
$SOYBSPR_2(-10)$	-0.2213	-0.0537	0.0033	-0.0063	0.0197
	[-4.10077]***	[-2.19427]**	[0.29692]	[-0.17175]	[0.18782]
$SOYBSPR_2(-11)$	-0.0823	-0.0501	-0.0026	-0.0121	0.1334
	[-1.52136]	[-2.04201]**	[-0.23441]	[-0.32979]	[1.27108]
$SOYBSPR_2(-12)$	-0.4011	0.5737	0.9672	0.8490	0.0377
	[-7.40024]***	[23.3338]***	[85.4357]***	[23.1638]***	[0.35872]
$SOYBSPR_2(-13)$	0.8667	-0.2089	-0.2399	1.0506	0.3721
	[3.98997]***	[-2.12077]**	[-5.28836]***	[7.15253]***	[0.88261]
$SOYBSPR_2(-14)$	-0.1523	-0.1988	-0.4664	-1.0929	-0.4037
	[-0.66483]	[-1.91274]*	[-9.74660]***	[-7.05479]***	[-0.90790]
$SOYBCY_1(-1)$	-0.0459	0.6881	0.0155	-0.0097	-0.2731
	[-0.45992]	[15.2019]***	[0.74129]	[-0.14309]	[-1.40996]
$SOYBCY_1(-2)$	-0.0169	0.0583	0.0645	0.0871	0.3958
	[-0.13986]	[1.06133]	[2.54865]**	[1.06314]	[1.68355]*
$SOYBCY_1(-3)$	0.2059	0.0561	-0.0300	-0.0304	0.0235
	[1.76236]*	[1.05822]	[-1.23147]	[-0.38455]	[0.10346]
$SOYBCY_1(-4)$	0.0356	0.0798	0.0203	-0.0260	-0.0482
	[0.30645]	[1.51351]	[0.83448]	[-0.33140]	[-0.21357]
$SOYBCY_1(-5)$	0.3485	0.0185	-0.0531	-0.0470	0.1207
	[3.08921]***	[0.36199]	[-2.25175]**	[-0.61564]	[0.55155]
$SOYBCY_1(-6)$	-0.1347	-0.1987	-0.0141	-0.0193	-0.2736
	[-1.22710]	[-3.99127]***	[-0.61674]	[-0.25966]	[-1.28420]
$SOYBCY_1(-7)$	-0.4282	-0.0718	-0.0163	-0.0743	-0.2781
	[-3.90538]***	[-1.44299]	[-0.71286]	[-1.00193]	[-1.30720]

	$SOYBSPR_2$	$SOYBCY_1$	$SOYBCY_2$	$SOYBCY_3$	SOYBQT
$SOYBCY_1(-8)$	0.0922	0.1201	0.0154	0.0620	0.4601
	[0.83505]	[2.39723]**	[0.66700]	[0.83044]	[2.14690]**
$SOYBCY_1(-9)$	-0.4986	-0.3745	-0.0031	-0.1224	-0.1459
	[-4.59710]***	[-7.61356]***	[-0.13611]	[-1.66940]*	[-0.69314]
$SOYBCY_1(-10)$	0.4020	0.2728	0.0028	0.0064	-0.2023
	[3.55775]***	[5.32376]***	[0.11726]	[0.08431]	[-0.92248]
$SOYBCY_1(-11)$	0.2510	0.0645	-0.0078	0.0133	-0.0899
	[2.18691]**	[1.23878]	[-0.32589]	[0.17158]	[-0.40364]
$SOYBCY_1(-12)$	0.3836	-0.6234	-0.9336	-0.8834	0.0506
	[3.33515]***	[-11.9520]***	[-38.8706]***	[-11.3605]***	[0.22663]
$SOYBCY_1(-13)$	-0.9059	0.2088	0.2327	-0.8745	-0.3031
	[-3.92011]***	[1.99258]**	[4.82247]***	[-5.59691]***	[-0.67582]
$SOYBCY_1(-14)$	0.3401	0.2196	0.4432	1.0348	0.3508
	[1.46108]	[2.08047]**	[9.11799]***	[6.57532]***	[0.77674]
$SOYBCY_2(-1)$	-0.7663	-0.2411	0.2099	-1.9065	-0.5772
	[-2.92341]***	[-2.02845]**	[3.83474]***	[-10.7574]***	[-1.13466]
$SOYBCY_2(-2)$	0.5424	0.2856	0.5249	1.1910	0.1722
	[1.86419]*	[2.16379]**	[8.63748]***	[6.05331]***	[0.30487]
$SOYBCY_2(-3)$	-0.2187	-0.1403	-0.0043	-0.0763	-0.1236
	[-1.64726]*	[-2.32905]**	[-0.15430]	[-0.84957]	[-0.47954]
$SOYBCY_2(-4)$	-0.2151	-0.0099	-0.0586	0.0184	0.3907
	[-1.62369]	[-0.16396]	[-2.11825]**	[0.20485]	[1.51940]
$SOYBCY_2(-5)$	-0.2672	-0.1096	0.0464	-0.0077	-0.1770
	[-1.98362]**	[-1.79361]*	[1.65016]*	[-0.08418]	[-0.67718]
$SOYBCY_2(-6)$	-0.2461	0.1947	0.0319	0.0310	0.1701
	[-1.81892]*	[3.17287]***	[1.12774]	[0.33925]	[0.64769]
$SOYBCY_2(-7)$	0.6625	0.0935	-0.0099	0.0801	0.3255
	[4.94941]***	[1.53926]	[-0.35584]	[0.88468]	[1.25294]
$SOYBCY_2(-8)$	0.1548	-0.0704	-0.0391	-0.0887	-0.5837
	[1.13699]	[-1.13936]	[-1.37387]	[-0.96321]	[-2.20922]**
$SOYBCY_2(-9)$	0.4894	0.3658	0.0098	-0.0544	0.4441
	[3.58624]***	[5.90943]***	[0.34259]	[-0.58931]	[1.67698]*
$SOYBCY_2(-10)$	-0.4775	-0.4060	-0.0037	0.0639	-0.1158
	[-3.39478]***	[-6.36300]***	[-0.12610]	[0.67224]	[-0.42421]
$SOYBCY_2(-11)$	-0.2778	-0.0811	-0.0845	-0.0475	0.3487
	[-1.91343]*	[-1.23194]	[-2.78762]***	[-0.48388]	[1.23745]
$SOYBCY_2(-12)$	-0.4533	0.7759	1.1361	0.9236	-0.2527
	[-3.10126]***	[11.7033]***	[37.2145]***	[9.34550]***	[-0.89079]
$SOYBCY_2(-13)$	1.2631	-0.2379	-0.2499	1.2181	0.5236
	[4.31409]***	[-1.79152]*	[-4.08672]***	[6.15340]***	[0.92164]
$SOYBCY_2(-14)$	-0.6066	-0.1431	-0.5440	-1.2031	-0.3815
	[-2.15659]**	[-1.12133]	[-9.26019]***	[-6.32564]***	[-0.69895]
$SOYBCY_3(-1)$	0.1940	0.0214	0.0380	0.9414	0.3125
	[2.27580]**	[0.55442]	[2.13658]**	[16.3297]***	[1.88878]*
$SOYBCY_3(-2)$	-0.2762	-0.0683	-0.1133	-0.1721	-0.1984
	[-2.76808]***	[-1.50874]	[-5.43454]***	[-2.55034]**	[-1.02452]

	$SOYBSPR_2$	$SOYBCY_1$	$SOYBCY_2$	$SOYBCY_3$	SOYBQT
$SOYBCY_3(-3)$	0.0936	0.0577	0.0288	0.0637	-0.0458
	[1.12705]	[1.53317]	[1.66177]*	[1.13527]	[-0.28427]
$SOYBCY_3(-4)$	0.1792	-0.0642	0.0290	0.0033	-0.1451
	[2.15992]**	[-1.70496]*	[1.67129]*	[0.05870]	[-0.90135]
$SOYBCY_3(-5)$	0.0488	0.0556	0.0111	0.1050	0.0178
	[0.58185]	[1.46281]	[0.63450]	[1.85236]*	[0.10948]
$SOYBCY_3(-6)$	0.2993	0.0058	-0.0181	0.0128	0.0931
	[3.55991]***	[0.15337]	[-1.02874]	[0.22519]	[0.57055]
$SOYBCY_3(-7)$	-0.2093	0.0044	0.0211	-0.0316	-0.1148
	[-2.48238]**	[0.11582]	[1.19663]	[-0.55464]	[-0.70184]
$SOYBCY_3(-8)$	-0.1601	-0.0298	0.0231	-0.0122	0.1448
	[-1.88385]*	[-0.77387]	[1.29982]	[-0.21214]	[0.87829]
$SOYBCY_3(-9)$	-0.0195	-0.0197	-0.0073	0.1362	-0.1823
	[-0.22918]	[-0.51095]	[-0.40850]	[2.36959]**	[-1.10507]
$SOYBCY_3(-10)$	0.0631	0.0968	0.0039	-0.0005	0.2267
	[0.74013]	[2.50445]**	[0.22176]	[-0.00802]	[1.37052]
$SOYBCY_3(-11)$	0.0163	0.0326	0.0925	0.0324	-0.3033
	[0.19059]	[0.84400]	[5.19402]***	[0.56262]	[-1.83296]*
$SOYBCY_3(-12)$	0.0886	-0.1484	-0.2005	-0.0464	0.1817
	[1.01241]	[-3.73861]***	[-10.9698]***	[-0.78405]	[1.06949]
$SOYBCY_3(-13)$	-0.2992	0.0387	0.0039	-0.3491	-0.2170
	[-2.94756]***	[0.83976]	[0.18520]	[-5.08639]***	[-1.10179]
$SOYBCY_3(-14)$	0.2153	-0.0751	0.1044	0.1950	0.0449
	[2.56016]**	[-1.96819]**	[5.94178]***	[3.42932]***	[0.27486]
SOYBQT(-1)	-0.0012	0.0061	-0.0031	0.0115	1.1422
	[-0.05676]	[0.63846]	[-0.71311]	[0.81049]	[27.9909]***
SOYBQT(-2)	0.0032	-0.0044	0.0104	-0.0032	-0.2173
	[0.09948]	[-0.30754]	[1.56435]	[-0.14696]	[-3.53204]***
SOYBQT(-3)	0.0034	0.0013	-0.0059	0.0058	0.0799
	[0.10503]	[0.09231]	[-0.88185]	[0.26666]	[1.28708]
SOYBQT(-4)	0.0025	0.0029	0.0037	0.0200	-0.0009
	[0.07801]	[0.19876]	[0.54942]	[0.92250]	[-0.01423]
SOYBQT(-5)	-0.0387	-0.0221	-0.0048	-0.0411	-0.1049
	[-1.21283]	[-1.52672]	[-0.72623]	[-1.90477]*	[-1.69477]*
SOYBQT(-6)	0.0143	0.0233	0.0050	0.0194	0.0731
	[0.44583]	[1.60063]	[0.74588]	[0.89281]	[1.17118]
SOYBQT(-7)	0.0030	-0.0132	-0.0046	-0.0198	-0.0459
	[0.09397]	[-0.90977]	[-0.68915]	[-0.91041]	[-0.73597]
SOYBQT(-8)	0.0149	0.0090	0.0020	0.0217	0.1109
	[0.46469]	[0.61915]	[0.30382]	[1.00556]	[1.78790]*
SOYBQT(-9)	-0.0111	-0.0127	-0.0024	-0.0145	-0.0353
	[-0.34740]	[-0.87659]	[-0.35585]	[-0.67259]	[-0.56977]
SOYBQT(-10)	0.0146	0.0078	-0.0007	0.0008	-0.0276
	[0.45994]	[0.54233]	[-0.10870]	[0.03711]	[-0.44629]
SOYBQT(-11)	0.0079	-0.0088	-0.0050	-0.0271	-0.0284
	[0.25047]	[-0.60910]	[-0.75439]	[-1.26668]	[-0.46137]

	$SOYBSPR_2$	$SOYBCY_1$	$SOYBCY_2$	$SOYBCY_3$	SOYBQT
SOYBQT(-12)	-0.0318	0.0110	0.0083	0.0216	0.0159
	[-1.00747]	[0.77207]	[1.25317]	[1.01240]	[0.25997]
SOYBQT(-13)	0.0153	0.0026	-0.0007	0.0071	0.0050
	[0.48688]	[0.18490]	[-0.10948]	[0.33602]	[0.08167]
SOYBQT(-14)	0.0044	-0.0009	-0.0013	0.0035	0.0101
	[0.21269]	[-0.09213]	[-0.30526]	[0.25017]	[0.25405]
C	0.0011	0.0015	0.0028	0.0093	0.0076
	[0.50975]	[1.51331]	[6.31710]	[6.50632]	[1.84185]

$SoybSPR_2$ is the calendar spread that longs the 1st-nearby futures and shorts the 7-month futures. For the same reason as the oil calendar spreads, it is the only soybean spread the results of which are included in this thesis. Further details can be obtained by contacting the author.

The reason to display results of the second soybean spread is that the term structure effect is supposed to be most significant in term slope derived from the July contract, since it is the only contract that expires just prior to the upcoming harvest season starting in September. The test results show that it is the case. Among all the three spreads, in this spread I have found the largest number of lags of the overall term structure that contains valuable information for predicting future term premiums.

Table 12: Summary statistics of momentum trading returns, long-only the 1st-nearby futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT
Panel A: ranking period of 1 month												
Mean	45.60%	-48.00%	88.80%	32.40%	-24.00%	57.60%	15.60%	-8.00%	23.00%	9.20%	-3.00%	11.90%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.0086*	*<.0001*
Std Dev	24.94%	24.25%	31.18%	24.40%	20.80%	28.20%	24.75%	21.78%	30.69%	23.80%	20.30%	27.80%
SharpeR	182.83%	-197.95%	284.83%	132.79%	-115.38%	204.26%	63.03%	-36.73%	74.95%	38.66%	-14.78%	42.81%
Panel B: ranking period of 3 months												
Mean	39.60%	-36.00%	73.20%	18.80%	-12.00%	31.60%	9.80%	-2.00%	11.40%	5.80%	0.90%	4.90%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.2992*	*<.0001*	*<.0001*	*0.3359*	*0.0006*
Std Dev	25.29%	24.60%	33.26%	26.20%	22.40%	32.20%	25.46%	21.50%	31.96%	23.60%	19.80%	28.50%
SharpeR	156.60%	-146.37%	220.11%	71.76%	-53.57%	98.14%	38.50%	-9.30%	35.67%	24.58%	4.55%	17.19%
Panel C: ranking period of 6 months												
Mean	24.00%	-12.00%	38.40%	10.80%	-4.00%	14.00%	6.80%	3.60%	3.40%	2.70%	6.10%	-3.00%
*Prob**	*<.0001*	*0.0003*	*<.0001*	*<.0001*	*0.1151*	*<.0001*	*0.0003*	*0.0091*	*0.1128*	*0.0232*	*<.0001*	*0.0096*
Std Dev	28.41%	21.82%	33.95%	27.40%	20.40%	32.00%	27.15%	19.23%	30.26%	23.80%	19.00%	26.60%
SharpeR	84.49%	-54.99%	113.11%	39.42%	-19.61%	43.75%	25.04%	18.72%	11.23%	11.34%	32.11%	-11.28%
Panel D: ranking period of 12 months												
Mean	20.40%	-12.00%	30.00%	10.00%	-4.00%	12.80%	4.80%	3.60%	1.20%	0.00%	7.30%	-7.00%
*Prob**	*<.0001*	*0.0057*	*<.0001*	*<.0001*	*0.2022*	*<.0001*	*0.0083*	*0.0079*	*0.583*	*0.8887*	*<.0001*	*<.0001*
Std Dev	25.98%	21.82%	31.52%	25.20%	20.80%	30.00%	25.88%	19.66%	29.56%	23.60%	18.70%	27.30%
SharpeR	78.52%	-54.99%	95.17%	39.68%	-19.23%	42.67%	18.55%	18.31%	4.06%	0.00%	39.04%	-25.64%

MMT refers to momentum. Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 13: Summary statistics of momentum trading returns, long-only the 6-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT
Panel A: ranking period of 1 month												
Mean	38.40%	-36.00%	69.60%	26.00%	-20.00%	45.60%	14.00%	-4.00%	19.00%	8.90%	0.30%	8.60%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.7664*	*<.0001*
Std Dev	21.82%	20.09%	25.98%	21.40%	17.00%	24.00%	23.05%	17.25%	25.60%	24.20%	17.50%	26.10%
Sharpe R	175.95%	-179.18%	267.89%	121.50%	-117.65%	190.00%	60.73%	-23.18%	74.23%	36.78%	1.71%	32.95%
Panel B: ranking period of 3 months												
Mean	31.20%	-24.00%	52.80%	17.20%	-8.00%	26.40%	10.00%	0.80%	9.20%	5.70%	3.20%	2.40%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.561*	*<.0001*	*<.0001*	*0.0002*	*0.0699*
Std Dev	22.52%	18.71%	27.02%	22.40%	17.60%	26.00%	23.48%	18.10%	26.16%	23.80%	17.30%	27.10%
Sharpe R	138.56%	-128.30%	195.41%	76.79%	-45.45%	101.54%	42.60%	4.42%	35.16%	23.95%	18.50%	8.86%
Panel C: ranking period of 6 months												
Mean	15.60%	-12.00%	24.00%	11.20%	0.00%	12.00%	6.60%	4.40%	2.20%	3.30%	6.20%	-3.00%
*Prob**	*<.0001*	*0.0032*	*<.0001*	*<.0001*	*0.6286*	*<.0001*	*<.0001*	*0.0003*	*0.2154*	*0.0046*	*<.0001*	*0.0188*
Std Dev	23.56%	16.63%	26.67%	23.40%	16.80%	26.00%	22.49%	17.11%	26.16%	23.20%	17.00%	25.20%
Sharpe R	66.23%	-72.17%	89.98%	47.86%	0.00%	46.15%	29.35%	25.71%	8.41%	14.22%	36.47%	-11.90%
Panel D: ranking period of 12 months												
Mean	13.20%	0.00%	18.00%	9.20%	1.60%	7.60%	5.60%	5.00%	0.60%	2.60%	6.10%	-3.00%
*Prob**	*0.0004*	*0.1287*	*<.0001*	*<.0001*	*0.3257*	*0.0028*	*0.0004*	*<.0001*	*0.7713*	*0.0161*	*<.0001*	*0.0065*
Std Dev	21.82%	16.63%	25.63%	20.80%	17.60%	25.40%	22.20%	16.69%	26.16%	21.80%	17.30%	25.60%
Sharpe R	60.48%	0.00%	70.22%	44.23%	9.09%	29.92%	25.22%	29.96%	2.29%	11.93%	35.26%	-11.72%

MMT refers to momentum. Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 14: Summary statistics of momentum trading returns, long-only the 12-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT
Panel A: ranking period of 1 month												
Mean	28.80%	-24.00%	51.60%	22.00%	-16.00%	36.40%	13.00%	-4.00%	17.20%	7.70%	0.10%	7.60%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.8895*	*<.0001*
Std Dev	18.71%	16.28%	22.17%	18.60%	13.80%	21.60%	20.93%	14.00%	22.34%	22.80%	14.90%	22.80%
Sharpe R	153.96%	-147.41%	232.74%	118.28%	-115.94%	168.52%	62.11%	-28.57%	76.98%	33.77%	0.67%	33.33%
Panel B: ranking period of 3 months												
Mean	24.00%	-12.00%	39.60%	14.80%	-8.00%	22.40%	9.80%	0.00%	10.40%	6.60%	2.00%	4.50%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.4913*	*<.0001*	*<.0001*	*0.0045*	*<.0001*
Std Dev	19.40%	15.24%	23.21%	19.20%	13.80%	22.60%	21.64%	14.57%	22.77%	23.10%	14.50%	23.20%
Sharpe R	123.72%	-78.73%	170.62%	77.08%	-57.97%	99.12%	45.29%	0.00%	45.68%	28.57%	13.79%	19.40%
Panel C: ranking period of 6 months												
Mean	12.00%	-12.00%	19.20%	8.00%	0.00%	9.60%	6.20%	2.60%	3.80%	4.80%	4.00%	0.80%
*Prob**	*0.0007*	*0.0008*	*<.0001*	*<.0001*	*0.1685*	*<.0001*	*<.0001*	*0.014*	*0.0205*	*<.0001*	*<.0001*	*0.444*
Std Dev	19.75%	13.86%	22.52%	19.80%	14.00%	22.00%	21.35%	14.85%	22.77%	22.90%	15.10%	21.80%
Sharpe R	60.77%	-86.60%	85.27%	40.40%	0.00%	43.64%	29.03%	17.51%	16.69%	20.96%	26.49%	3.67%
Panel D: ranking period of 12 months												
Mean	9.60%	0.00%	10.80%	7.20%	2.00%	5.20%	5.60%	3.20%	2.40%	3.30%	4.60%	-1.00%
*Prob**	*0.0018*	*0.9421*	*0.0085*	*0.0002*	*0.1632*	*0.0262*	*0.0003*	*0.001*	*0.1817*	*0.0038*	*<.0001*	*0.2646*
Std Dev	18.71%	14.90%	22.86%	19.60%	15.00%	23.20%	21.78%	13.72%	24.75%	22.70%	14.30%	24.30%
Sharpe R	51.32%	0.00%	47.24%	36.73%	13.33%	22.41%	25.71%	23.33%	9.70%	14.54%	32.17%	-4.12%

MMT refers to momentum. Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 15: Summary statistics of momentum trading returns, calendar spread that longs the 1st-nearby futures and shorts the 2nd-nearby futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT
Panel A: ranking period of 1 month												
Mean	9.60%	-12.00%	18.00%	4.00%	-4.00%	8.00%	0.00%	0.00%	0.00%	0.10%	0.00%	0.40%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*0.0007*	*<.0001*	*<.0001*	*0.3904*	*0.5024*	*0.6051*	*0.7208*	*0.1471*	*0.2627*
Std Dev	12.47%	8.31%	15.24%	12.20%	7.60%	14.40%	15.84%	6.93%	17.39%	6.20%	3.90%	7.00%
Sharpe R	76.98%	-144.34%	118.09%	32.79%	-52.63%	55.56%	0.00%	0.00%	0.00%	1.61%	0.00%	5.71%
Panel B: ranking period of 3 months												
Mean	4.80%	-48.00%	54.00%	0.00%	-4.00%	2.00%	-2.00%	-6.00%	4.80%	0.00%	-3.00%	2.90%
*Prob**	*0.041*	*<.0001*	*<.0001*	*0.4077*	*<.0001*	*0.1337*	*0.0129*	*<.0001*	*<.0001*	*0.4*	*<.0001*	*<.0001*
Std Dev	14.20%	16.28%	16.97%	12.20%	2.60%	12.60%	9.33%	7.35%	7.92%	7.10%	5.60%	6.90%
Sharpe R	33.80%	-294.82%	318.13%	0.00%	-153.85%	15.87%	-21.43%	-81.59%	60.61%	0.00%	-53.57%	42.03%
Panel C: ranking period of 6 months												
Mean	0.02%	0.00%	0.02%	-4.00%	0.80%	-4.00%	-2.00%	2.00%	-4.00%	-1.00%	0.70%	-2.00%
*Prob**	*0.9923*	*0.9987*	*0.9929*	*0.0076*	*0.0064*	*0.0011*	*<.0001*	*<.0001*	*<.0001*	*0.0008*	*<.0001*	*<.0001*
Std Dev	14.20%	3.46%	14.90%	11.00%	2.80%	11.20%	7.78%	5.94%	9.48%	5.70%	2.6%	6.00%
Sharpe R	0.17%	0.03%	0.15%	-36.36%	28.57%	-35.71%	-25.71%	33.67%	-42.22%	-17.54%	26.92%	-33.33%
Panel D: ranking period of 12 months												
Mean	0.00%	0.12%	0.00%	0.00%	0.80%	-4.00%	-2.00%	1.00%	-2.00%	-1.00%	1.20%	-2.00%
*Prob**	*0.9026*	*0.839*	*0.8643*	*0.1203*	*0.006*	*0.0245*	*0.0061*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*
Std Dev	13.51%	3.46%	13.86%	11.00%	3.20%	11.40%	8.06%	2.69%	8.34%	5.30%	3.20%	6.00%
Sharpe R	0.00%	3.46%	0.00%	0.00%	25.00%	-35.09%	-24.81%	37.22%	-23.97%	-18.87%	37.50%	-33.33%

MMT refers to momentum. Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 16: Summary statistics of momentum trading returns, calendar spread that longs the 1st-nearby futures and shorts the 6-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT
Panel A: ranking period of 1 month												
Mean	24.00%	-12.00%	42.00%	24.40%	-8.00%	34.00%	2.20%	-2.00%	3.80%	1.30%	-1.00%	2.20%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.0464*	*0.0598*	*0.0043*	*0.0355*	*0.0409*	*0.0034*
Std Dev	18.36%	14.90%	23.56%	24.80%	11.20%	22.80%	16.26%	12.02%	19.23%	12.60%	8.50%	14.90%
Sharpe R	130.72%	-80.56%	178.30%	98.39%	-71.43%	149.12%	13.53%	-16.64%	19.76%	10.32%	-11.76%	14.77%
Panel B: ranking period of 3 months												
Mean	12.00%	-12.00%	22.80%	2.80%	-4.00%	6.80%	0.00%	1.80%	-2.00%	0.00%	0.80%	-1.00%
*Prob**	*0.002*	*<.0001*	*<.0001*	*0.2224*	*<.0001*	*0.003*	*0.6227*	*0.0228*	*0.1015*	*0.7761*	*0.0346*	*0.1936*
Std Dev	22.86%	11.43%	25.98%	22.40%	5.20%	23.60%	18.24%	10.89%	20.65%	13.70%	7.50%	15.20%
Sharpe R	52.49%	-104.97%	87.76%	12.50%	-76.92%	28.81%	0.00%	16.53%	-9.69%	0.00%	10.67%	-6.58%
Panel C: ranking period of 6 months												
Mean	3.60%	0.00%	6.00%	0.00%	0.00%	0.40%	-4.00%	2.40%	-6.00%	-1.00%	1.50%	-2.00%
*Prob**	*0.3512*	*0.1777*	*0.1932*	*0.6675*	*0.5545*	*0.8873*	*0.002*	*<.0001*	*<.0001*	*0.1543*	*<.0001*	*0.0005*
Std Dev	23.56%	7.97%	25.29%	22.00%	23.80%	32.40%	15.56%	7.50%	17.25%	13.10%	6.60%	14.10%
Sharpe R	15.28%	0.00%	23.73%	0.00%	0.00%	1.23%	-25.71%	32.02%	-34.78%	-7.63%	22.73%	-14.18%
Panel D: ranking period of 12 months												
Mean	1.20%	0.00%	2.40%	0.00%	0.80%	0.00%	-2.00%	2.20%	-4.00%	-2.00%	3.10%	-5.00%
*Prob**	*0.685*	*0.5578*	*0.5614*	*0.6625*	*0.1638*	*0.3901*	*0.0432*	*<.0001*	*0.0001*	*0.0007*	*<.0001*	*<.0001*
Std Dev	22.17%	7.62%	23.21%	20.20%	6.80%	21.20%	14.85%	6.22%	15.98%	10.80%	8.30%	12.50%
Sharpe R	5.41%	0.00%	10.34%	0.00%	11.76%	0.00%	-13.47%	35.36%	-25.03%	-18.52%	37.35%	-40.00%

MMT refers to momentum. Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 17: Summary statistics of momentum trading returns, calendar spread that longs the 1st-nearby futures and shorts the 12-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT	Winner	Loser	MMT
Panel A: ranking period of 1 month												
Mean	42.00%	-36.00%	76.80%	25.20%	-20.00%	43.60%	11.40%	-4.00%	16.00%	6.00%	-2.00%	8.20%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.0022*	*<.0001*	*<.0001*	*0.0068*	*<.0001*
Std Dev	27.71%	24.25%	35.33%	31.00%	19.00%	35.20%	24.75%	21.50%	30.97%	22.70%	16.30%	27.50%
Sharpe R	151.55%	-148.46%	217.36%	81.29%	-105.26%	123.86%	46.06%	-18.61%	51.66%	26.43%	-12.27%	29.82%
Panel B: ranking period of 3 months												
Mean	27.60%	-24.00%	46.80%	13.60%	-4.00%	17.20%	4.80%	1.20%	3.60%	2.10%	0.40%	1.70%
*Prob**	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.0005*	*<.0001*	*0.0069*	*0.4157*	*0.1061*	*0.068*	*0.6227*	*0.2149*
Std Dev	30.14%	22.52%	37.76%	31.80%	11.40%	34.60%	25.31%	20.93%	31.82%	23.30%	15.70%	28.00%
Sharpe R	91.58%	-106.59%	123.94%	42.77%	-35.09%	49.71%	18.96%	5.73%	11.31%	9.01%	2.55%	6.07%
Panel C: ranking period of 6 months												
Mean	19.20%	-12.00%	27.60%	6.40%	-4.00%	9.20%	1.00%	1.40%	0.00%	-1.00%	2.40%	-4.00%
*Prob**	*0.0007*	*0.0031*	*<.0001*	*0.0293*	*0.0376*	*0.0031*	*0.6032*	*0.1948*	*0.8646*	*0.2535*	*0.002*	*0.0068*
Std Dev	32.22%	17.32%	36.03%	29.40%	14.20%	31.60%	26.02%	14.42%	30.12%	22.30%	15.50%	27.10%
Sharpe R	59.60%	-69.28%	76.61%	21.77%	-28.17%	29.11%	3.84%	9.71%	0.00%	-4.48%	15.48%	-14.76%
Panel D: ranking period of 12 months												
Mean	13.20%	0.00%	15.60%	4.80%	0.80%	3.60%	1.00%	3.80%	-2.00%	-2.00%	5.30%	-7.00%
*Prob**	*0.0172*	*0.2755*	*0.0086*	*0.0867*	*0.5081*	*0.2215*	*0.5549*	*0.0001*	*0.1745*	*0.1119*	*<.0001*	*<.0001*
Std Dev	31.18%	14.90%	34.29%	28.00%	14.40%	31.40%	25.46%	14.00%	28.85%	20.60%	17.90%	25.70%
Sharpe R	42.34%	0.00%	45.49%	17.14%	5.56%	11.46%	3.93%	27.14%	-6.93%	-9.71%	29.61%	-27.24%

MMT refers to momentum. Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 18: Estimate of momentum trading returns with the 1st-nearby futures vs convenience yield, net hedging pressure and monthly dummies, bi-weekly data

	Holding period of 1 month		Holding period of 3 month		Holding period of 6 month		Holding period of 12 month	
	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser
Panel A: ranking period of 1 month								
Variable								
Intercept	0.0190	0.0543	0.0311	0.0807	0.0490	0.0595	0.0753	0.0533
	(0.1253)	(<.0001)***	(0.1391)	(<.0001)***	(0.1135)	(0.0249)**	(0.0748)*	(0.1296)
CY3MONTH	0.4123	0.4727	0.5175	0.3895	0.9506	-0.1883	1.3192	-0.4617
	(0.0225)**	(<.0001)***	(0.0906)*	(0.0248)**	(0.0348)**	(0.4733)	(0.032)**	(0.1857)
HP	0.0440	-0.0964	0.1434	-0.1359	0.1469	-0.1329	0.1550	-0.1396
	(0.014)**	(<.0001)***	(<.0001)***	(<.0001)***	(<.0001)***	(0.0004)***	(0.011)**	(0.0049)***
Panel B: ranking period of 3 months								
Variable								
Intercept	0.0016	0.0501	-0.0106	0.0402	-0.0044	0.0218	0.0077	0.0083
	(0.9007)	(<.0001)***	(0.6505)	(0.0308)**	(0.8903)	(0.3963)	(0.8573)	(0.8093)
CY3MONTH	0.4717	0.4158	1.4735	0.3379	2.2020	0.3270	1.4925	-0.5818
	(0.0153)**	(0.0002)	(<.0001)***	(0.0553)*	(<.0001)***	(0.1799)	(0.0202)**	(0.073)*
HP	0.0339	-0.0724	0.0891	-0.1543	0.1101	-0.1665	-0.0456	-0.0991
	(0.0625)*	(<.0001)***	(0.0066)***	(<.0001)***	(0.015)**	(<.0001)***	(0.4482)	(0.047)**
Panel C: ranking period of 6 months								
Variable								
Intercept	-0.0228	0.0219	-0.0385	0.0311	-0.0040	0.0167	-0.0671	-0.0771
	(0.1168)	(0.0378)**	(0.1125)	(0.0593)*	(0.9065)	(0.4569)	(0.1081)	(0.0175)**
CY3MONTH	0.4152	0.0426	0.9454	0.1601	2.0764	0.1193	2.7722	-0.6207
	(0.048)**	(0.7499)	(0.0071)***	(0.443)	(<.0001)***	(0.6754)	(<.0001)***	(0.1309)
HP	0.0446	-0.0853	0.0929	-0.1680	0.1111	-0.1795	0.0066	-0.1803
	(0.0286)**	(<.0001)***	(0.0063)***	(<.0001)***	(0.0193)**	(<.0001)***	(0.9105)	(0.0003)***
Panel D: ranking period of 12 months								
Variable								
Intercept	-0.0034	0.0177	0.0058	0.0369	-0.0026	-0.0102	-0.0689	-0.1035
	(0.7949)	(0.0973)*	(0.7972)	(0.0368)**	(0.9361)	(0.6611)	(0.0905)*	(0.0007)***
CY3MONTH	0.0043	0.0068	0.5904	-0.8578	1.8458	-0.3157	2.6517	-0.8330
	(0.9817)	(0.9754)	(0.0654)*	(0.0185)**	(<.0001)***	(0.51)	(<.0001)***	(0.1804)
HP	0.0581	-0.0749	0.0610	-0.1024	0.0097	-0.1993	-0.1332	-0.3999
	(0.0015)***	(<.0001)***	(0.0505)*	(0.0004)***	(0.8272)	(<.0001)***	(0.018)**	(<.0001)***

Numbers in parentheses are *p-value*. Coefficients with *p-value* highlighted by ***, ** and * are significant at 1%, 5% and 10% levels, respectively.

Table 19: Estimate of momentum trading returns with 6-month futures vs convenience yield, net hedging pressure and monthly dummies, bi-weekly data

	Holding period of 1 month		Holding period of 3 month		Holding period of 6 month		Holding period of 12 month	
	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser
Panel A: ranking period of 1 month								
Variable								
Intercept	0.0082	0.0341	0.0126	0.0822	0.0258	0.0630	0.0230	0.0302
	(0.4526)	(0.0003)***	(0.4975)	(<.0001)***	(0.3604)	(0.0021)***	(0.5877)	(0.309)
CY6MONTH	0.1073	0.1020	0.3371	0.0864	0.5630	-0.3869	1.0634	-0.5210
	(0.0615)*	(0.0733)*	(0.0006)***	(0.301)	(0.0002)***	(0.0018)***	(<.0001)***	(0.0039)***
HP	0.0370	-0.0831	0.0650	-0.1341	0.1368	-0.1307	0.0004	-0.1729
	(0.0218)**	(<.0001)***	(0.018)**	(<.0001)***	(0.0011)***	(<.0001)***	(0.9944)	(<.0001)***
Panel B: ranking period of 3 months								
Variable								
Intercept	-0.0004	0.0214	-0.0179	0.0511	-0.0092	0.0395	-0.0124	-0.0085
	(0.9718)	(0.0205)**	(0.3604)	(0.0004)***	(0.7517)	(0.066)*	(0.7669)	(0.7707)
CY6MONTH	0.0279	0.0056	0.4652	-0.1472	0.7903	-0.2260	1.2236	-0.6058
	(0.6306)	(0.934)	(<.0001)***	(0.165)	(<.0001)***	(0.1544)	(<.0001)***	(0.0053)***
HP	0.0324	-0.0502	0.0427	-0.1413	0.1010	-0.1501	-0.0376	-0.1530
	(0.0591)*	(<.0001)***	(0.1413)	(<.0001)***	(0.019)**	(<.0001)***	(0.5459)	(0.0002)***
Panel C: ranking period of 6 months								
Variable								
Intercept	-0.0220	0.0084	-0.0418	0.0331	-0.0200	0.0043	-0.0280	-0.0667
	(0.0648)*	(0.2771)	(0.042)**	(0.0126)**	(0.4769)	(0.8248)	(0.4958)	(0.0191)**
CY6MONTH	0.1504	-0.3284	0.3496	-0.3668	0.5524	-0.2516	0.9385	-0.3660
	(0.0112)**	(0.0002)***	(0.0007)***	(0.0139)**	(<.0001)***	(0.2538)	(<.0001)***	(0.2516)
HP	0.0657	-0.0768	0.1009	-0.1586	0.0203	-0.2146	-0.0744	-0.2492
	(0.0002)***	(<.0001)***	(0.001)***	(<.0001)***	(0.6297)	(<.0001)***	(0.2255)	(<.0001)***
Panel D: ranking period of 12 months								
Variable								
Intercept	-0.0146	0.0046	-0.0109	0.0086	-0.0420	-0.0033	-0.0345	-0.1032
	(0.1804)	(0.5465)	(0.5529)	(0.5387)	(0.1274)	(0.8557)	(0.3514)	(<.0001)***
CY6MONTH	0.0718	-0.5205	0.2927	-0.8010	0.7103	-0.7245	1.1294	-1.0110
	(0.1926)	(<.0001)***	(0.0017)***	(<.0001)***	(<.0001)***	(0.0024)***	(<.0001)***	(0.0018)***
HP	0.0707	-0.0719	0.0795	-0.1307	0.0005	-0.2130	-0.2083	-0.4637
	(<.0001)***	(<.0001)***	(0.0035)***	(<.0001)***	(0.9903)	(<.0001)***	(0.0002)***	(<.0001)***

Table 20: Estimate of momentum trading returns with 12-month futures vs convenience yield, net hedging pressure and monthly dummies, bi-weekly data

	Holding period of 1 month		Holding period of 3 month		Holding period of 6 month		Holding period of 12 month	
	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser
Panel A: ranking period of 1 month								
Variable								
Intercept	0.0026	0.0177	-0.0056	0.0554	-0.0169	0.0638	0.0096	0.0562
	(0.791)	(0.0228)**	(0.7329)	(<.0001)***	(0.5169)	(<.0001)***	(0.8114)	(0.0225)**
CY12MONTH	0.0512	0.0128	0.2090	-0.0066	0.4555	-0.0776	0.7284	-0.3272
	(0.0741)*	(0.7385)	(<.0001)***	(0.8996)	(<.0001)***	(0.3184)	(<.0001)***	(0.0073)***
HP	0.0348	-0.0603	0.0188	-0.1413	0.0358	-0.1604	-0.0873	-0.1977
	(0.0145)**	(<.0001)***	(0.4326)	(<.0001)***	(0.3464)	(<.0001)***	(0.1385)	(<.0001)***
Panel B: ranking period of 3 months								
Variable								
Intercept	-0.0030	0.0096	-0.0584	0.0284	-0.0329	0.0397	-0.0380	-0.0013
	(0.7701)	(0.1865)	(0.0006)***	(0.0099)***	(0.2297)	(0.0164)**	(0.362)	(0.9557)
CY12MONTH	0.0741	-0.0574	0.3468	-0.1542	0.5627	-0.1087	0.8006	-0.4202
	(0.0129)**	(0.1798)	(<.0001)***	(0.017)**	(<.0001)***	(0.2619)	(<.0001)***	(0.003)***
HP	0.0310	-0.0556	0.0250	-0.1211	0.0124	-0.1799	-0.1300	-0.1719
	(0.0379)**	(<.0001)***	(0.3086)	(<.0001)***	(0.7564)	(<.0001)***	(0.033)**	(<.0001)***
Panel C: ranking period of 6 months								
Variable								
Intercept	-0.0252	0.0051	-0.0755	0.0153	-0.0702	0.0009	-0.0707	-0.0479
	(0.0164)**	(0.4304)	(<.0001)***	(0.1732)	(0.0103)**	(0.9566)	(0.0917)*	(0.0523)*
CY12MONTH	0.1097	-0.2263	0.3128	-0.3330	0.6136	-0.3747	0.7427	-0.3108
	(0.0003)***	(0.0002)***	(<.0001)***	(0.0015)***	(<.0001)***	(0.0194)**	(<.0001)***	(0.1765)
HP	0.0414	-0.0651	0.0412	-0.1198	0.0093	-0.1574	-0.1788	-0.2492
	(0.0044)***	(<.0001)***	(0.0993)*	(<.0001)***	(0.8043)	(<.0001)***	(0.0022)***	(<.0001)***
Panel D: ranking period of 12 months								
Variable								
Intercept	-0.0204	0.0107	-0.0586	-0.0022	-0.0719	0.0209	-0.0815	-0.0442
	(0.0361)**	(0.125)	(0.0006)***	(0.857)	(0.0079)***	(0.1657)	(0.0368)**	(0.0352)**
CY12MONTH	0.1067	-0.2420	0.3631	-0.3530	0.6280	-0.1880	0.9508	-0.5483
	(0.0003)***	(<.0001)***	(<.0001)***	(0.0004)***	(<.0001)***	(0.1343)	(<.0001)***	(0.0018)***
HP	0.0597	-0.0604	0.0621	-0.1199	-0.0197	-0.1984	-0.2405	-0.3629
	(<.0001)***	(<.0001)***	(0.0124)**	(<.0001)***	(0.6161)	(<.0001)***	(<.0001)***	(<.0001)***

Table 21: Estimate of momentum trading returns of calendar spread that longs the 1st-nearby futures and shorts the 2nd-nearby futures vs convenience yield, net hedging pressure and monthly dummies, bi-weekly data

	Holding period of 1 month		Holding period of 3 month		Holding period of 6 month		Holding period of 12 month	
	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser
Panel A: ranking period of 1 month								
Variable								
Intercept	0.0019	0.0067	0.0003	0.0044	0.0006	0.0211	-0.0068	0.0009
	(0.7467)	(0.091)*	(0.9774)	(0.4848)	(0.9774)	(0.0105)**	(0.5405)	(0.8909)
CY3MONTH	0.1350	0.1713	0.2284	0.0330	0.7779	-0.1915	0.6178	-0.3060
	(0.1022)	(<.0001)***	(0.1079)	(0.6035)	(0.0053)***	(0.0207)**	(<.0001)***	(<.0001)***
HP	0.0084	-0.0072	0.0370	-0.0233	0.0147	-0.0188	0.0160	-0.0128
	(0.3331)	(0.2618)	(0.014)**	(0.023)**	(0.6164)	(0.1572)	(0.3256)	(0.2316)
Panel B: ranking period of 3 months								
Variable								
Intercept	0.0087	0.0326	-0.0039	0.0098	-0.0092	0.0358	-0.0232	0.0239
	(0.199)	(<.0001)***	(0.7078)	(<.0001)***	(0.4267)	(<.0001)***	(0.0737)*	(0.0112)**
CY3MONTH	-0.1937	0.2045	0.3286	-0.0717	0.3703	0.1144	0.5461	-0.3726
	(0.0109)**	(0.0628)*	(0.0047)***	(0.0261)**	(0.0044)***	(0.3564)	(0.0002)***	(0.006)***
HP	0.0120	0.0371	-0.0060	-0.0151	0.0006	-0.0044	0.0243	-0.0223
	(0.2753)	(0.002)***	(0.7194)	(<.0001)***	(0.9761)	(0.744)	(0.2472)	(0.1299)
Panel C: ranking period of 6 months								
Variable								
Intercept	0.0121	0.0045	0.0050	-0.0015	-0.0231	0.0000	-0.0168	-0.0089
	(0.0656)*	(0.0094)***	(0.5881)	(0.508)	(0.0135)**	(0.9957)	(0.0988)*	(0.0423)**
CY3MONTH	-0.3646	-0.2931	-0.1338	-0.3707	0.2448	-0.6072	0.2491	-0.5983
	(<.0001)***	(<.0001)***	(0.1346)	(<.0001)***	(0.0072)***	(0.0066)***	(0.0119)**	(<.0001)***
HP	0.0255	0.0023	0.0376	-0.0026	-0.0096	-0.0451	-0.0051	-0.0159
	(0.0139)**	(0.4029)	(0.0091)***	(0.4608)	(0.5088)	(<.0001)***	(0.7501)	(0.0212)**
Panel D: ranking period of 12 months								
Variable								
Intercept	0.0120	0.0017	0.0130	0.0006	-0.0159	-0.0017	-0.0113	-0.0193
	(0.052)*	(0.3048)	(0.1408)	(0.822)	(0.0774)*	(0.584)	(0.2203)	(0.0005)***
CY3MONTH	-0.3886	-0.3376	-0.2096	-0.5377	0.2591	-0.5458	0.0139	-0.4056
	(<.0001)***	(<.0001)***	(0.0154)**	(<.0001)***	(0.0033)***	(<.0001)***	(0.8769)	(0.0341)**
HP	0.0274	-0.0040	0.0589	-0.0028	0.0663	0.0000	-0.0071	-0.0143
	(0.0081)***	(0.0838)*	(<.0001)***	(0.4172)	(<.0001)***	(0.9977)	(0.6445)	(0.065)*

Table 22: Estimate of momentum trading returns of calendar spread that longs the 1st-nearby futures and shorts the 6-month futures vs convenience yield, net hedging pressure and monthly dummies, bi-weekly data

	Holding period of 1 month		Holding period of 3 month		Holding period of 6 month		Holding period of 12 month	
	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser
Panel A: ranking period of 1 month								
Variable								
Intercept	0.0001	0.0108	0.0430	0.0127	0.0244	0.0241	0.0011	0.0472
	(0.9866)	(0.148)	(0.0366)**	(0.1828)	(0.1912)	(0.0948)*	(0.9554)	(0.0011)***
CY6MONTH	0.4079	0.0391	0.7072	0.0331	0.6923	-0.2776	0.9454	-0.3126
	(<.0001)***	(0.3028)	(<.0001)***	(0.4932)	(<.0001)***	(0.0002)***	(<.0001)***	(<.0001)***
HP	0.0020	-0.0108	0.0506	-0.0277	0.0339	-0.0253	0.0490	-0.0488
	(0.877)	(0.3381)	(0.1173)	(0.0531)*	(0.2481)	(0.2422)	(0.1253)	(0.0235)**
Panel B: ranking period of 3 months								
Variable								
Intercept	-0.0132	0.0088	-0.0316	0.0156	-0.0204	0.0086	-0.0593	-0.0023
	(0.2169)	(0.1161)	(0.0783)*	(0.0003)***	(0.3275)	(0.505)	(0.0077)***	(0.8564)
CY6MONTH	0.3275	0.0420	0.7220	-0.0897	0.8748	-0.0345	1.0685	-0.2815
	(<.0001)***	(0.2159)	(<.0001)***	(0.0007)***	(<.0001)***	(0.6606)	(<.0001)***	(0.0003)***
HP	0.0091	-0.0282	-0.0032	-0.0254	0.0290	-0.0413	-0.0015	-0.0404
	(0.6023)	(0.0009)***	(0.914)	(0.0001)***	(0.3922)	(0.0347)**	(0.966)	(0.0347)**
Panel C: ranking period of 6 months								
Variable								
Intercept	-0.0042	0.0069	-0.0242	-0.0028	-0.0197	-0.0045	-0.0520	-0.0229
	(0.7253)	(0.0736)*	(0.1945)	(0.8899)	(0.3014)	(0.6024)	(0.0223)**	(0.0414)**
CY6MONTH	0.1077	-0.1284	0.4878	-0.2059	0.4290	-0.2404	0.7422	-0.4286
	(0.0423)**	(0.0027)***	(<.0001)***	(0.3639)	(<.0001)***	(0.0123)**	(<.0001)***	(0.0006)***
HP	0.0362	-0.0079	0.0549	0.0680	-0.0152	-0.0457	-0.0057	-0.0439
	(0.0517)*	(0.194)	(0.0582)*	(0.0369)**	(0.6063)	(0.0009)***	(0.8721)	(0.0138)**
Panel D: ranking period of 12 months								
Variable								
Intercept	-0.0017	0.0070	-0.0077	0.0053	-0.0259	-0.0115	-0.0354	-0.0459
	(0.8787)	(0.0468)**	(0.6522)	(0.3379)	(0.1469)	(0.1232)	(0.0586)*	(0.0012)***
CY6MONTH	0.0806	-0.2694	0.2842	-0.4381	0.3387	-0.5401	0.4372	-0.4041
	(0.1249)	(<.0001)***	(0.0005)***	(<.0001)***	(<.0001)***	(<.0001)***	(<.0001)***	(0.0304)**
HP	0.0465	-0.0080	0.0853	-0.0096	-0.0079	0.0000	-0.0839	-0.0837
	(0.0109)**	(0.114)	(0.0025)***	(0.2273)	(0.7873)	(0.9997)	(0.0069)***	(<.0001)***

Table 23: Estimate of momentum trading returns of calendar spread that longs the 1st-nearby futures and shorts the 12-month futures vs convenience yield, net hedging pressure and monthly dummies, bi-weekly data

	Holding period of 1 month		Holding period of 3 month		Holding period of 6 month		Holding period of 12 month	
	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser	Long Winner	Short Loser
Panel A: ranking period of 1 month								
Variable								
Intercept	-0.0054	0.0464	0.0264	0.0451	0.0538	0.0384	0.0967	-0.0278
	(0.68)	(0.0002)***	(0.3105)	(0.0085)***	(0.0619)*	(0.1531)	(0.0081)***	(0.0003)***
CY12MONTH	0.2963	-0.0041	0.3342	0.0112	0.5377	-0.1554	0.8795	-0.0857
	(<.0001)***	(0.9167)	(<.0001)***	(0.8321)	(<.0001)***	(0.0611)*	(<.0001)***	(<.0001)***
HP	-0.0045	-0.0282	0.0670	-0.0458	0.1658	-0.0350	0.0740	-0.0398
	(0.8194)	(0.1166)	(0.0862)*	(0.0619)*	(0.0001)***	(0.3626)	(0.1747)	(<.0001)***
Panel B: ranking period of 3 months								
Variable								
Intercept	-0.0283	0.0218	-0.0295	0.0260	-0.0046	-0.0139	-0.0359	0.0335
	(0.0534)*	(0.0494)**	(0.2549)	(0.0072)***	(0.8798)	(0.5777)	(0.3506)	(0.2052)
CY12MONTH	0.2707	0.0287	0.7154	-0.0997	0.6557	-0.2415	0.8850	-0.2696
	(<.0001)***	(0.4737)	(<.0001)***	(0.0044)***	(<.0001)***	(0.0078)***	(<.0001)***	(0.005)***
HP	0.0020	-0.0373	0.0185	-0.0377	0.0800	-0.0907	-0.0344	-0.1523
	(0.9235)	(0.0182)**	(0.6193)	(0.0061)***	(0.0645)*	(0.0111)**	(0.5327)	(<.0001)***
Panel C: ranking period of 6 months								
Variable								
Intercept	-0.0302	0.0213	-0.0438	0.0221	-0.0333	-0.0016	-0.1412	-0.0189
	(0.0791)*	(0.0126)**	(0.0928)*	(0.0631)*	(0.2959)	(0.9266)	(0.0004)***	(0.4739)
CY12MONTH	0.1752	0.0040	0.4544	-0.0427	0.6743	-0.1091	0.8035	-0.2653
	(0.0002)***	(0.9182)	(<.0001)***	(0.4328)	(<.0001)***	(0.1697)	(<.0001)***	(0.0285)**
HP	0.0469	-0.0314	0.0990	-0.0761	0.1081	-0.0865	-0.0402	-0.1108
	(0.0481)**	(0.0105)**	(0.0061)***	(<.0001)***	(0.0141)**	(0.0006)***	(0.459)	(0.0037)***
Panel D: ranking period of 12 months								
Variable								
Intercept	-0.0147	0.0182	0.0220	0.0386	-0.0411	-0.0172	-0.1429	-0.0956
	(0.3658)	(0.0106)**	(0.3707)	(0.0009)***	(0.1867)	(0.3004)	(<.0001)***	(0.0015)***
CY12MONTH	0.1468	-0.1738	0.3579	-0.3807	0.5946	-0.4400	0.8284	-0.3626
	(0.0022)***	(<.0001)***	(<.0001)***	(<.0001)***	(<.0001)***	(<.0001)***	(<.0001)***	(0.0458)**
HP	0.0418	-0.0226	0.0041	-0.0451	-0.0459	-0.0014	-0.2335	-0.2400
	(0.0883)*	(0.0434)**	(0.9116)	(0.014)**	(0.3301)	(0.9573)	(<.0001)***	(<.0001)***

Table 24: Summary statistics of convenience yield trading returns using the 1st-nearby futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	2.40%	3.60%	0.00%	1.60%	2.80%	0.00%	3.20%	3.20%	0.00%	2.60%	5.20%	-3.00%
*Prob**	*0.5784*	*0.2766*	*0.7506*	*0.4913*	*0.2296*	*0.6602*	*0.0513*	*0.0465*	*0.9499*	*0.0142*	*<.0001*	*0.0506*
Std Dev	25.29%	21.82%	30.83%	22.60%	23.80%	29.80%	22.77%	23.19%	29.70%	21.50%	21.40%	26.30%
Sharpe R	9.49%	16.50%	0.00%	7.08%	11.76%	0.00%	14.05%	13.80%	0.00%	12.09%	24.30%	-11.41%
Panel B: ranking period of 3 months												
Mean	0.00%	3.60%	-12.00%	2.40%	6.00%	-4.00%	2.20%	5.80%	-4.00%	2.40%	6.40%	-4.00%
*Prob**	*0.6232*	*0.2696*	*0.2655*	*0.321*	*0.0091*	*0.21*	*0.1803*	*0.0002*	*0.0756*	*0.023*	*<.0001*	*0.002*
Std Dev	27.02%	20.44%	32.22%	23.00%	23.40%	30.60%	23.19%	22.06%	29.56%	21.40%	21.20%	25.70%
Sharpe R	0.00%	17.61%	-37.25%	10.43%	25.64%	-13.07%	9.49%	26.29%	-13.53%	11.21%	30.19%	-15.56%
Panel C: ranking period of 6 months												
Mean	0.00%	7.20%	-12.00%	0.40%	5.60%	-4.00%	2.60%	4.60%	-2.00%	3.00%	6.80%	-4.00%
*Prob**	*0.7791*	*0.0547*	*0.1257*	*0.8671*	*0.0082*	*0.0775*	*0.1083*	*0.0034*	*0.3108*	*0.004*	*<.0001*	*0.0043*
Std Dev	26.33%	21.13%	31.52%	24.60%	22.00%	30.60%	22.49%	22.06%	28.43%	21.20%	21.50%	26.30%
Sharpe R	0.00%	34.07%	-38.07%	1.63%	25.45%	-13.07%	11.56%	20.85%	-7.04%	14.15%	31.63%	-15.21%
Panel D: ranking period of 12 months												
Mean	4.80%	6.00%	0.00%	8.00%	2.00%	5.60%	8.00%	3.20%	4.80%	6.50%	5.90%	0.50%
*Prob**	*0.2421*	*0.1261*	*0.8529*	*<.0001*	*0.3126*	*0.0262*	*<.0001*	*0.0305*	*0.0072*	*<.0001*	*<.0001*	*0.6685*
Std Dev	22.86%	20.78%	28.06%	19.60%	21.60%	26.00%	19.09%	21.64%	25.17%	20.80%	20.90%	25.00%
Sharpe R	20.99%	28.87%	0.00%	40.82%	9.26%	21.54%	41.90%	14.79%	19.07%	31.25%	28.23%	2.00%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 25: Summary statistics of convenience yield trading returns using the 12-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	7.20%	0.00%	9.60%	4.00%	1.60%	2.80%	4.20%	2.80%	1.40%	3.30%	3.60%	0.00%
*Prob**	*0.0197*	*0.3893*	*0.0129*	*0.011*	*0.3259*	*0.1864*	*0.0007*	*0.0105*	*0.3435*	*<.0001*	*<.0001*	*0.7573*
Std Dev	17.67%	14.55%	21.48%	16.40%	15.00%	20.60%	17.82%	15.70%	21.64%	16.90%	15.40%	18.50%
Sharpe R	40.75%	0.00%	44.70%	24.39%	10.67%	13.59%	23.57%	17.84%	6.47%	19.53%	23.38%	0.00%
Panel B: ranking period of 3 months												
Mean	3.60%	0.14%	3.60%	2.80%	3.60%	0.00%	5.00%	3.60%	1.40%	4.00%	4.30%	0.00%
*Prob**	*0.2029*	*0.9557*	*0.3189*	*0.0673*	*0.0261*	*0.7963*	*<.0001*	*0.0011*	*0.3359*	*<.0001*	*<.0001*	*0.7589*
Std Dev	17.67%	15.24%	21.82%	16.40%	16.00%	20.80%	17.54%	15.56%	20.79%	18.10%	15.80%	19.20%
Sharpe R	20.38%	0.94%	16.50%	17.07%	22.50%	0.00%	28.51%	23.14%	6.73%	22.10%	27.22%	0.00%
Panel C: ranking period of 6 months												
Mean	4.80%	0.52%	3.60%	2.80%	2.40%	0.15%	4.40%	2.20%	2.20%	3.20%	3.70%	-1.00%
*Prob**	*0.1534*	*0.8429*	*0.3191*	*0.1019*	*0.0799*	*0.9397*	*0.0001*	*0.0427*	*0.1125*	*0.0001*	*<.0001*	*0.5609*
Std Dev	17.32%	15.24%	21.82%	16.40%	14.40%	20.40%	15.84%	15.27%	19.37%	16.50%	15.00%	17.90%
Sharpe R	27.71%	3.39%	16.50%	17.07%	16.67%	0.75%	27.78%	14.40%	11.35%	19.39%	24.67%	-5.59%
Panel D: ranking period of 12 months												
Mean	3.60%	0.09%	3.60%	5.60%	2.00%	3.60%	6.20%	2.60%	3.40%	4.90%	4.20%	0.60%
*Prob**	*0.164*	*0.9741*	*0.2915*	*0.0005*	*0.1763*	*0.0858*	*<.0001*	*0.0127*	*0.0095*	*<.0001*	*<.0001*	*0.4896*
Std Dev	16.28%	15.24%	21.13%	15.80%	15.20%	20.20%	15.13%	15.13%	19.09%	16.40%	15.00%	18.20%
Sharpe R	22.11%	0.56%	17.04%	35.44%	13.16%	17.82%	40.97%	17.18%	17.81%	29.88%	28.00%	3.30%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 26: Summary statistics of convenience yield trading returns using calendar spread that shorts the 1st-nearby futures and longs the 2nd-nearby futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	0.00%	0.00%	1.20%	1.20%	0.00%	2.40%	0.80%	0.00%	1.80%	0.30%	-1.00%	1.00%
*Prob**	*0.8314*	*0.3731*	*0.5219*	*0.1149*	*0.1568*	*0.0364*	*0.061*	*0.0646*	*0.0092*	*0.1789*	*0.0021*	*0.0015*
Std Dev	7.27%	11.78%	13.86%	7.20%	9.80%	12.00%	6.22%	7.35%	9.62%	4.40%	4.70%	6.40%
Sharpe R	0.00%	0.00%	8.66%	16.67%	0.00%	20.00%	12.86%	0.00%	18.72%	6.82%	-21.28%	15.63%
Panel B: ranking period of 3 months												
Mean	3.60%	26.40%	-24.00%	1.60%	1.60%	0.00%	1.60%	3.00%	-2.00%	0.60%	1.30%	-1.00%
*Prob**	*0.0523*	*<.0001*	*<.0001*	*0.1342*	*<.0001*	*0.9997*	*0.0001*	*<.0001*	*0.0039*	*0.0013*	*<.0001*	*0.0035*
Std Dev	9.35%	16.63%	17.32%	10.00%	3.80%	10.60%	5.94%	7.78%	6.51%	4.00%	5.30%	4.60%
Sharpe R	38.49%	158.77%	-138.56%	16.00%	42.11%	0.00%	26.94%	38.57%	-30.74%	15.00%	24.53%	-21.74%
Panel C: ranking period of 6 months												
Mean	3.60%	0.00%	7.20%	3.20%	-4.00%	6.40%	1.60%	-2.00%	3.20%	0.40%	-1.00%	1.40%
*Prob**	*0.003*	*0.0365*	*0.0005*	*<.0001*	*0.0003*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.047*	*<.0001*	*<.0001*
Std Dev	7.97%	9.01%	12.12%	7.20%	8.80%	11.60%	5.80%	5.66%	7.78%	4.20%	4.10%	5.80%
Sharpe R	45.18%	0.00%	59.38%	44.44%	-45.45%	55.17%	27.59%	-35.36%	41.14%	9.52%	-24.39%	24.14%
Panel D: ranking period of 12 months												
Mean	3.60%	0.00%	7.20%	0.80%	0.00%	2.80%	0.18%	0.00%	1.20%	0.00%	-1.00%	0.70%
*Prob**	*0.0022*	*0.0489*	*0.0011*	*0.1587*	*0.0207*	*0.0101*	*0.5451*	*0.0129*	*0.0165*	*0.6421*	*0.0002*	*0.0071*
Std Dev	6.58%	10.39%	12.12%	7.00%	8.20%	11.20%	4.24%	5.66%	6.93%	3.10%	3.90%	5.00%
Sharpe R	54.70%	0.00%	59.38%	11.43%	0.00%	25.00%	4.15%	0.00%	17.32%	0.00%	-25.64%	14.00%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 27: Summary statistics of convenience yield trading returns using calendar spread that shorts the 1st-nearby futures and longs the 12-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	2.40%	0.00%	7.20%	3.20%	-8.00%	9.60%	0.00%	-6.00%	5.60%	1.40%	-5.00%	6.30%
*Prob**	*0.5589*	*0.1365*	*0.168*	*0.1481*	*0.0003*	*0.0005*	*0.8296*	*<.0001*	*0.0018*	*0.1048*	*<.0001*	*<.0001*
Std Dev	25.98%	19.05%	31.52%	23.00%	18.00%	28.00%	21.21%	17.39%	25.17%	17.40%	16.00%	22.40%
Sharpe R	9.24%	0.00%	22.84%	13.91%	-44.44%	34.29%	0.00%	-34.49%	22.25%	8.05%	-31.25%	28.13%
Panel B: ranking period of 3 months												
Mean	6.00%	-12.00%	14.40%	5.20%	5.60%	0.00%	0.40%	-8.00%	8.00%	0.60%	-5.00%	6.10%
*Prob**	*0.2156*	*0.0028*	*0.0074*	*0.021*	*<.0001*	*0.8685*	*0.7399*	*<.0001*	*<.0001*	*0.4185*	*<.0001*	*<.0001*
Std Dev	27.71%	17.32%	31.87%	21.80%	12.80%	25.00%	18.38%	17.96%	24.47%	16.10%	16.10%	21.60%
Sharpe R	21.65%	-69.28%	45.18%	23.85%	43.75%	0.00%	2.18%	-44.54%	32.70%	3.73%	-31.06%	28.24%
Panel C: ranking period of 6 months												
Mean	8.40%	0.00%	14.40%	6.00%	-8.00%	12.00%	0.40%	-4.00%	5.00%	1.90%	-5.00%	6.70%
*Prob**	*0.0791*	*0.0395*	*0.0102*	*0.0064*	*<.0001*	*<.0001*	*0.8065*	*<.0001*	*0.0021*	*0.0168*	*<.0001*	*<.0001*
Std Dev	26.67%	16.63%	31.52%	21.80%	15.60%	25.60%	19.52%	14.14%	23.19%	15.60%	14.40%	20.90%
Sharpe R	31.49%	0.00%	45.68%	27.52%	-51.28%	46.88%	2.05%	-28.28%	21.56%	12.18%	-34.72%	32.06%
Panel D: ranking period of 12 months												
Mean	4.80%	-12.00%	13.20%	0.00%	-8.00%	6.80%	-4.00%	-6.00%	1.80%	0.00%	-6.00%	6.00%
*Prob**	*0.2353*	*0.0018*	*0.0066*	*0.8043*	*<.0001*	*0.0056*	*0.0034*	*<.0001*	*0.2645*	*0.5827*	*<.0001*	*<.0001*
Std Dev	23.56%	16.63%	29.44%	19.80%	15.80%	24.80%	18.67%	14.85%	24.18%	15.40%	19.40%	24.70%
Sharpe R	20.38%	-72.17%	44.83%	0.00%	-50.63%	27.42%	-21.43%	-40.41%	7.44%	0.00%	-30.93%	24.29%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 28: Summary statistics of hedging pressure trading returns using the 1st-nearby futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	4.80%	8.40%	0.00%	3.20%	6.80%	-4.00%	4.40%	4.00%	0.40%	4.20%	3.70%	0.50%
*Prob**	*0.1867*	*0.0733*	*0.5752*	*0.114*	*0.0043*	*0.2211*	*0.0044*	*0.0169*	*0.8214*	*0.0002*	*0.0001*	*0.697*
Std Dev	21.48%	25.98%	31.87%	21.00%	24.40%	30.00%	21.92%	23.33%	29.27%	22.50%	19.20%	26.20%
Sharpe R	22.35%	32.33%	0.00%	15.24%	27.87%	-13.33%	20.07%	17.14%	1.37%	18.67%	19.27%	1.91%
Panel B: ranking period of 3 months												
Mean	2.40%	7.20%	0.00%	1.20%	6.40%	-4.00%	4.00%	2.60%	1.40%	3.70%	3.30%	0.30%
*Prob**	*0.5148*	*0.093*	*0.388*	*0.6341*	*0.004*	*0.0637*	*0.0076*	*0.0803*	*0.4284*	*0.0012*	*0.0005*	*0.7773*
Std Dev	21.82%	24.60%	31.18%	22.00%	22.80%	30.00%	21.78%	21.07%	26.73%	22.60%	19.10%	24.70%
Sharpe R	11.00%	29.27%	0.00%	5.45%	28.07%	-13.33%	18.37%	12.34%	5.24%	16.37%	17.28%	1.21%
Panel C: ranking period of 6 months												
Mean	2.40%	4.80%	0.00%	2.40%	4.00%	0.00%	4.60%	2.80%	1.60%	4.70%	3.60%	1.10%
*Prob**	*0.4585*	*0.2846*	*0.7483*	*0.275*	*0.0597*	*0.4827*	*0.0013*	*0.058*	*0.3308*	*<.0001*	*0.0004*	*0.3553*
Std Dev	21.48%	23.90%	30.48%	20.60%	22.40%	28.00%	20.36%	21.78%	24.75%	22.30%	20.50%	23.40%
Sharpe R	11.17%	20.08%	0.00%	11.65%	17.86%	0.00%	22.59%	12.86%	6.46%	21.08%	17.56%	4.70%
Panel D: ranking period of 12 months												
Mean	4.80%	2.40%	1.20%	4.80%	6.00%	0.00%	6.40%	4.40%	2.00%	6.60%	3.40%	3.20%
*Prob**	*0.2282*	*0.4467*	*0.7683*	*0.0098*	*0.0017*	*0.6205*	*<.0001*	*0.0009*	*0.2548*	*<.0001*	*0.0001*	*0.0031*
Std Dev	20.44%	21.48%	28.75%	18.80%	19.40%	25.40%	21.07%	18.95%	24.32%	22.40%	17.60%	21.80%
Sharpe R	23.49%	11.17%	4.17%	25.53%	30.93%	0.00%	30.37%	23.22%	8.22%	29.46%	19.32%	14.68%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 29: Summary statistics of hedging pressure trading returns using the 12-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	6.00%	4.80%	0.47%	4.80%	5.20%	0.00%	5.40%	3.00%	2.40%	4.90%	3.10%	1.70%
*Prob**	*0.0481*	*0.0974*	*0.9043*	*0.0028*	*0.0031*	*0.9137*	*<.0001*	*0.0092*	*0.1137*	*<.0001*	*<.0001*	*0.078*
Std Dev	16.63%	18.36%	22.52%	16.20%	17.20%	21.40%	17.82%	16.83%	21.35%	18.70%	15.00%	20.00%
Sharpe R	36.08%	26.14%	2.08%	29.63%	30.23%	0.00%	30.30%	17.83%	11.24%	26.20%	20.67%	8.50%
Panel B: ranking period of 3 months												
Mean	3.60%	3.60%	0.36%	3.20%	4.00%	0.00%	4.80%	1.80%	3.00%	4.40%	2.60%	1.80%
*Prob**	*0.1436*	*0.2109*	*0.924*	*0.0587*	*0.0137*	*0.6892*	*0.0001*	*0.1143*	*0.0392*	*<.0001*	*0.0008*	*0.062*
Std Dev	16.28%	17.32%	22.17%	17.00%	16.60%	22.00%	17.54%	15.56%	20.65%	18.70%	15.50%	19.50%
Sharpe R	22.11%	20.78%	1.62%	18.82%	24.10%	0.00%	27.37%	11.57%	14.53%	23.53%	16.77%	9.23%
Panel C: ranking period of 6 months												
Mean	4.80%	2.40%	2.40%	3.60%	2.80%	0.80%	5.20%	2.40%	2.80%	5.00%	2.90%	2.10%
*Prob**	*0.1001*	*0.4337*	*0.5444*	*0.0192*	*0.0907*	*0.643*	*<.0001*	*0.0299*	*0.0433*	*<.0001*	*0.0003*	*0.0217*
Std Dev	16.28%	17.32%	22.17%	16.20%	16.60%	21.20%	16.83%	16.12%	19.52%	18.60%	16.30%	18.50%
Sharpe R	29.48%	13.86%	10.83%	22.22%	16.87%	3.77%	30.90%	14.89%	14.35%	26.88%	17.79%	11.35%
Panel D: ranking period of 12 months												
Mean	6.00%	0.82%	6.00%	6.00%	3.20%	2.80%	6.40%	2.80%	3.60%	6.60%	2.50%	4.10%
*Prob**	*0.0164*	*0.7578*	*0.1146*	*<.0001*	*0.0181*	*0.1567*	*<.0001*	*0.0045*	*0.0051*	*<.0001*	*0.0003*	*<.0001*
Std Dev	15.59%	15.24%	20.44%	14.80%	14.00%	19.00%	16.97%	14.00%	18.67%	19.00%	14.20%	17.80%
Sharpe R	38.49%	5.35%	29.36%	40.54%	22.86%	14.74%	37.71%	20.00%	19.28%	34.74%	17.61%	23.03%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 30: Summary statistics of hedging pressure trading returns using calendar spread that shorts the 1st-nearby futures and longs the 2nd-nearby futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	0.00%	0.00%	0.00%	0.00%	0.00%	0.40%	0.00%	0.00%	0.20%	0.00%	0.00%	0.00%
*Prob**	*0.1564*	*0.2082*	*0.8388*	*0.5811*	*0.1466*	*0.6263*	*0.4434*	*0.0892*	*0.6534*	*0.3011*	*0.1804*	*0.9509*
Std Dev	9.01%	8.31%	12.47%	8.20%	6.80%	10.60%	6.93%	5.37%	8.91%	5.20%	3.70%	6.20%
Sharpe R	0.00%	0.00%	0.00%	0.00%	0.00%	3.77%	0.00%	0.00%	2.24%	0.00%	0.00%	0.00%
Panel B: ranking period of 3 months												
Mean	0.00%	6.00%	-12.00%	0.80%	0.40%	0.40%	0.00%	0.60%	0.00%	0.00%	0.20%	0.00%
*Prob**	*0.4784*	*0.0146*	*0.0054*	*0.1551*	*0.1305*	*0.5637*	*0.6445*	*0.1774*	*0.0989*	*0.7916*	*0.2807*	*0.2474*
Std Dev	7.62%	14.20%	14.20%	6.00%	3.00%	6.80%	6.36%	6.65%	7.21%	4.10%	4.40%	5.00%
Sharpe R	0.00%	42.25%	-84.49%	13.33%	13.33%	5.88%	0.00%	9.03%	0.00%	0.00%	4.55%	0.00%
Panel C: ranking period of 6 months												
Mean	0.00%	0.00%	0.50%	0.40%	0.00%	0.80%	0.00%	0.00%	0.05%	0.00%	0.00%	0.30%
*Prob**	*0.9524*	*0.5687*	*0.7393*	*0.3716*	*0.551*	*0.2903*	*0.6477*	*0.4812*	*0.9301*	*0.5623*	*0.0406*	*0.3099*
Std Dev	6.58%	5.89%	8.66%	6.00%	5.00%	8.00%	6.08%	4.95%	7.78%	3.90%	3.80%	5.40%
Sharpe R	0.00%	0.00%	5.82%	6.67%	0.00%	10.00%	0.00%	0.00%	0.62%	0.00%	0.00%	5.56%
Panel D: ranking period of 12 months												
Mean	0.74%	0.00%	1.07%	0.34%	0.00%	0.80%	0.13%	0.00%	0.60%	0.00%	0.00%	0.20%
*Prob**	*0.4256*	*0.75*	*0.4435*	*0.5252*	*0.2457*	*0.2244*	*0.6707*	*0.0892*	*0.119*	*0.2391*	*0.016*	*0.4615*
Std Dev	5.54%	5.89%	7.97%	5.40%	4.80%	7.40%	4.24%	4.81%	6.36%	3.90%	3.50%	5.10%
Sharpe R	13.42%	0.00%	13.40%	6.37%	0.00%	10.81%	2.97%	0.00%	9.43%	0.00%	0.00%	3.92%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.

Table 31: Summary statistics of hedging pressure trading returns using calendar spread that shorts the 1st-nearby futures and longs the 12-month futures, bi-weekly data

	Holding period of 1 month			Holding period of 3 month			Holding period of 6 month			Holding period of 12 month		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Panel A: ranking period of 1 month												
Mean	0.00%	-12.00%	8.40%	0.80%	-8.00%	7.20%	0.07%	-4.00%	4.20%	0.00%	-2.00%	2.10%
*Prob**	*0.7402*	*0.0294*	*0.1442*	*0.7378*	*0.0079*	*0.0215*	*0.9577*	*0.0106*	*0.0444*	*0.6783*	*0.0062*	*0.1032*
Std Dev	20.09%	25.29%	33.26%	20.20%	25.40%	32.40%	18.95%	22.77%	29.42%	18.90%	18.30%	25.90%
SharpeR	0.00%	-47.45%	25.26%	3.96%	-31.50%	22.22%	0.37%	-17.57%	14.28%	0.00%	-10.93%	8.11%
Panel B: ranking period of 3 months												
Mean	1.15%	32.40%	-36.00%	2.40%	-4.00%	6.40%	0.00%	4.40%	-6.00%	0.00%	1.00%	-1.00%
*Prob**	*0.7495*	*0.0042*	*0.0058*	*0.1924*	*0.0097*	*0.0119*	*0.6085*	*0.0171*	*0.0097*	*0.8502*	*0.3239*	*0.283*
Std Dev	21.13%	65.82%	65.82%	19.00%	15.80%	26.00%	17.54%	26.73%	28.00%	17.00%	20.90%	22.20%
SharpeR	5.45%	49.23%	-54.70%	12.63%	-25.32%	24.62%	0.00%	16.46%	-21.43%	0.00%	4.78%	-4.50%
Panel C: ranking period of 6 months												
Mean	2.40%	-12.00%	8.40%	1.20%	-4.00%	6.00%	0.00%	-2.00%	2.20%	-1.00%	-3.00%	2.00%
*Prob**	*0.5698*	*0.1011*	*0.0976*	*0.449*	*0.0253*	*0.025*	*0.7524*	*0.0584*	*0.1916*	*0.2126*	*0.001*	*0.0891*
Std Dev	19.75%	24.25%	30.83%	16.60%	20.80%	26.40%	15.98%	19.23%	24.04%	16.80%	18.70%	24.10%
SharpeR	12.15%	-49.49%	27.25%	7.23%	-19.23%	22.73%	0.00%	-10.40%	9.15%	-5.95%	-16.04%	8.30%
Panel D: ranking period of 12 months												
Mean	2.40%	-12.00%	9.60%	0.26%	-8.00%	8.00%	-2.00%	-4.00%	3.20%	-2.00%	-3.00%	1.20%
*Prob**	*0.3602*	*0.0888*	*0.0579*	*0.8726*	*0.0001*	*0.0023*	*0.1495*	*<.0001*	*0.0404*	*0.0297*	*<.0001*	*0.2508*
Std Dev	18.36%	21.13%	28.06%	16.20%	19.80%	26.00%	16.55%	17.11%	22.91%	16.60%	15.30%	21.20%
SharpeR	13.07%	-56.79%	34.21%	1.58%	-40.40%	30.77%	-12.09%	-23.38%	13.97%	-12.05%	-19.61%	5.66%

Mean and standard deviation are annualized by multiplying by 250 and $\sqrt{250}$ respectively.