Commodity Investing

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Abstract

This article reviews the literature on commodities from the perspective of an investor. We re-examine some of the early papers in the literature using recent data and find that the empirical support for the theory of normal backwardation as an explanation for the commodity risk premium is weak and that the evidence is more consistent with storage decisions. We then review the behavior of the main participants in the commodity futures markets with a particular focus on their impact on prices. Although there is continued disagreement in the literature about the role of speculative activity, our results show that money managers are generally momentum (positive feedback) traders, while producers are net short and contrarian (negative feedback) traders. There is less evidence that index traders and swap dealers trade based on past futures returns.

1. INTRODUCTION

Over the past decade commodity markets have experienced a dramatic increase in investor interest. In their March 2011 "Commodities Trading" report, TheCityUK estimates that commodity assets under management reached approximately $380 billion in 2010 (TheCityUK 2011). According to a Commodity Futures Trading Commission (CFTC, 2008) staff report and Masters (2008), the total value of commodity index investments increased from $15 billion in 2003 to more than $200 billion by the end of 2008.

Although the academic literature on commodity markets is extensive, much of the literature has focused on the production and storage decisions and the role of commodities in international trade. The view of commodities from an investor perspective is more recent, with the exception of precious metals, which have traditionally been viewed as a store of wealth. There are a variety of ways in which investors can take exposure to commodities, including physical markets (e.g., gold, timberland), equity markets (shares of commodity producers, users of commodities), and derivatives (futures, forward, swaps, options). In this review, we mainly concentrate on the derivatives markets, in particular the commodity futures markets. The futures markets provide the building blocks for investments in commodity indices, mutual funds, exchange-traded notes and funds, and swaps.

The increase in investment demand for commodities has sparked a renewed interest in several longstanding questions in the academic literature on commodity futures and has additionally raised some new questions. First and foremost is the debate on whether commodity futures prices embed a risk premium, as conjectured by Keynes (1923) with his theory of normal backwardation. According to Keynes, futures prices are on average set below future spot prices due to selling pressure by short hedgers—primarily commodity producers—providing the economic incentive necessary for speculators to assume the price risk. The empirical detection of a risk premium in commodity futures has long been hindered by a lack of good data, compounded by the statistical difficulty of measuring average returns in markets where prices are volatile. It is partly for this reason that the academic literature on equity markets has concentrated on measuring the risk premium at the aggregate market level, instead of at the individual stock level. The evolution of commodities into an asset class has led to an increased interest in measuring the aggregate market-wide risk premium, in addition to the premiums in individual commodity markets.

The second set of questions concerns the fundamental drivers of the risk premium. On the one hand, if the commodity risk premium compensates speculators for providing price insurance to hedgers, can the premium be expected to decline as a result of the increased supply of insurance offered by the growing investor base? On the other hand, modern financial theory predicts that commodity risk premiums are a compensation for the systematic component of price movements of commodity futures markets. Is the commodities risk premium consistent with traditional asset pricing theory? To the extent that increased investor interest in commodities has led to a financialization of commodity markets and driven up the return correlations with other risky assets, will this increase the risk of a commodity futures investment and influence the compensation for risk that investors will demand going forward?

The third set of questions asks whether increased investor interest has influenced price behavior in commodity markets. As shown in **Figure 1** (see color insert) for crude oil, the proportion of open interest represented by non-commercial traders has gradually increased over the past decade, an increase that has come at the expense of the share of smaller traders. For example, the aforementioned CFTC staff report shows that as of 2008, commodity index investment accounted for approximately 15% and 40% of the total open interests for oil and wheat, respectively. The coincidence of growing investor interest with a peak in the price of crude oil has refueled the debate on the role of speculators in commodity futures markets to an intensity not seen since the congressional ban on onion futures trading in 1958. The main focus of attention in the current debate is whether investment demand influences the level of commodity prices as well as the joint distribution (correlation) of commodity returns.

We review the literature on commodity futures from the perspective of an investor against the background of these three sets of questions. We examine the trading positions of market participants using publicly available data from the CFTC. Using the traditional distinction in the literature, which associates commercials with hedgers and views trading by non-commercials as predominantly speculative, we show that some of the results documented in the earlier empirical literature on the theory of normal backwardation may have been period specific. For example, we do not find evidence that non-commercial traders have earned positive average returns by simply taking the opposite side of commercials positions, or that variation in hedging pressure predicts commodity futures returns. The empirical results show that non-commercials are momentum (positive feedback) traders, and commercials are on average contrarian (negative feedback) traders. The positions of index traders and swap dealers show very little sensitivity to futures returns at relatively short horizons. We find that past returns have short-term predictive power for changes in trader positions, but find no direct evidence that changes in positions of traders help to predict futures returns during the most recent period. This is inconsistent with the notion that speculative activity has been an important driver of prices in commodity markets.

The remainder of this review is organized as follows. In Section 2, we discuss the literature on the theory of normal backwardation with a focus on the determinants of risk premiums. Section 3 presents a re-examination of some of the existing papers on trader positions and risk premiums. Section 4 reviews the theory of storage and its relation to futures risk premiums. Section 5 reviews some of the recent literature on positions of traders and their impacts on commodity prices. Section 6 concludes.

2. THE THEORY OF NORMAL BACKWARDATION

Advanced by Keynes (1923) and Hicks (1939), the theory of normal backwardation describes the transfer of price risk between hedgers and speculators in commodity futures markets. Hedgers use futures markets to offset a position in physical markets where they are met by speculators who seek positive expected returns. Although hedging demand for futures can be either long or short depending on spot market positions, Keynes postulated that short hedgers will likely outnumber long hedgers, implying that the aggregate futures position of hedgers would be net short. To entice speculators to take the opposite long side of the contract, the futures price would have to be set below the expected future spot price to offer speculators a positive expected return for assuming the price risk. This situation is referred to as normal backwardation.[1] The downward bias of futures prices relative to future spot prices yields the central prediction of the theory, namely that commodity futures prices on average rise over the life of their contract.

[1]Normal backwardation is to be distinguished from backwardation, which is used to describe a situation where futures prices are below current spot prices.

Early empirical work on the theory of normal backwardation focused on testing for a nonzero (positive) risk premium in a long futures position. Working (1949), Telser (1958), and Dusak (1973) use data for individual commodity futures and generally fail to reject the hypothesis that futures prices are unbiased predictors of future spot prices. Cootner (1960) finds evidence to support the theory. Working (1949) suggests that the bias may be too small to detect statistically. Because commodity price volatility is high relative to their average returns, tests for a nonzero risk premium for individual commodities are plagued by low power. For example, Kolb (1992) looks at 29 commodity and financial futures contracts between 1959 and 1988 and documents that only 9 commodities exhibit statistically significant positive average returns, and 4 commodities have statistically significant negative returns. Portfolio tests have more power because the noise of individual commodity returns is diversified away in portfolios. Bodie & Rosansky (1980), Fama & French (1987), and Gorton & Rouwenhorst (2006) report a positive risk premium for a diversified portfolio of futures. Erb & Harvey (2006) measure the premium using geometric averages and argue that part of the arithmetic average risk premium is a diversification return (see also Gorton & Rouwenhorst 2005 for a discussion).

Under the assumption that hedgers are net short, the theory of normal backwardation predicts that speculators can on average earn positive returns by taking a long position, but this prediction does not directly link the risk premium to positions of hedgers and speculators. This is relevant in situations when positions of hedgers are not net short on average or when hedgers vary their positions strategically in an attempt to anticipate futures returns. Subsequent empirical papers on the theory of normal backwardation examine the profitability of market participants, in particular whether speculators earn on average positive returns by merely taking the opposite side of hedgers. Rockwell (1967) measures normal backwardation by the return to a naive strategy that is long one unit in futures markets when hedgers are net short and short one unit when hedgers are net long. He finds that the returns on this naive strategy are close to zero for cotton and wheat. He also reports that large speculators earn profits but attributes this to their ability to forecast returns in futures markets, i.e., market timing, rather than a reward for bearing risk. Chang (1985) re-examines Rockwell's evidence using the formal statistical framework proposed by Henriksson & Merton (1981). He compares the returns of speculators in wheat, corn, and soybeans between 1951 and 1980 to the naive strategy proposed by Rockwell. Chang finds that speculators earn positive returns but that these profits are not significantly different from those earned by naive speculators. He interprets the speculative profits as a compensation for risk rather than the result of the ability of speculators to forecast prices. The conclusions of both Chang and Rockwell are based on monthly trader positions data published by the CFTC, aggregated across all maturities, and not based on actual trades. Hartzmark (1987) uses disaggregated daily trade data differentiated by contacts for reportable (large) traders and examines seven commodity markets over a four and a half year period ending in 1981 and finds no systematic gains or losses to either commercials or non-commercials over this period.

The theory of normal backwardation predates modern asset pricing theory, which postulates that risk premiums on risky assets are driven by the covariance of their returns with measures of systematic risk. The traditional capital asset pricing model (CAPM) predicts that risk premiums of commodity futures should be linked to the covariance of futures returns with excess returns on the market portfolio. Dusak (1973) finds that the systematic risk in three agricultural commodity markets is not significantly different from zero and cannot reject a zero risk premium in corn, wheat, and soybeans over a 16-year period between 1952 and 1967. Carter, Rausser & Schmitz (1983) find support for systematic risk of commodity futures when the market portfolio is amended to include them. Hirshleifer (1988) argues that limited participation of commodity producers in equity markets will cause the risk premium on futures to depend on their covariance with non-marketed endowments in addition to the market portfolio, along the lines of the modified CAPM of Mayers (1972). The resulting futures risk premiums from his equilibrium model depend on both systematic risk (beta with market portfolio) and the hedging pressure. This prediction is tested by Bessembinder (1992) who examines the uniformity of risk pricing in commodity and financial futures in a Fama-MacBeth (Fama & MacBeth 1973) framework. He finds that the premiums for systematic risk do not significantly differ across markets. He also shows that returns in foreign currency and agricultural futures vary with the positions of hedgers, which implies a degree of market segmentation of the futures market. This is consistent with the prediction of Hirshleifer (1988), and supports the hedging pressure as a determinant of futures premiums.

More recently, Erb & Harvey (2006) and Gorton & Rouwenhorst (2006) document that correlations of diversified portfolios of commodity futures with equities are close to zero over the past 50 years, and therefore market exposures are unlikely to explain their positive average (arithmetic) returns in the traditional CAPM framework. Dhume (2010) finds that risk premiums can be explained in the context of a consumption-based asset pricing model that includes durable consumption growth.

3. REVISITING THE EARLY EMPIRICAL LITERATURE

We re-examine the early literature on normal backwardation using a recent sample of commodity futures markets for the period January 1986 to October 2010. Data on futures prices of individual commodities were obtained from the Pinnacle Corp. for 28 commodities that are traded on four North American exchanges (NYMEX, NYBOT, CBOT, and CME). We also obtain the positions of large traders in each of the 28 US traded futures contracts as reported by the CFTC from 1986 to 2010.[2] Publicly available CFTC position data in commodity futures markets do not distinguish between hedgers and speculators, but instead categorize large market participants as either commercials or non-commercials (and small participants as non-reportables). We follow the empirical literature, which has traditionally associated commercials with hedgers and non-commercials with speculators.[3]

Monthly futures excess returns are calculated as $r_t := \dfrac{F(t,T) - F(t-1,T)}{F(t-1,T)}$, where $F(t,T)$ is the futures contract with nearest maturity T not maturing in month t. Hedging pressure is defined as $H_t = \dfrac{Short_t - Long_t}{OpenInterest_t}$, where $Short_t$ and $Long_t$ represent the short and long positions from commercials at time t, respectively.

Table 1 summarizes our data. Column 3 of **Table 1** shows that on average commercial large traders have been net short in 25 out of 28 markets. To the extent that commercial

[2]Note that 1986 is the earliest year that CFTC provides the position data. The positions are with a monthly frequency from 1986 to 1992 and with a weekly frequency from 1993 to 2010.

[3]Ederington & Lee (2002) show that this association is weak for heating oil. This match has become less accurate over the past decade with the growth of swap dealers who are classified as commercials but are merely taking long speculative positions in futures on behalf of their swap counterparties. See also Section 5 of this review.

Table 1 Summary of hedger and speculator's net-long positions[a]

Commodities	Start date	Mean (hedging pressure)	Std (hedging pressure)	Mean (excess return)	Std (excess return)	*t*-stat (excess return)	Average basis
Chicago wheat	Jan-86	9.20%	15.91%	−2.3%	24.8%	−0.47	−4.7%
Kansas wheat	Jan-86	4.50%	14.36%	1.9%	23.8%	0.39	−1.3%
Minneapolis wheat	Jan-86	3.20%	13.50%	3.5%	25.4%	0.69	−1.0%
Corn	Jan-86	−0.20%	13.46%	−6.0%	25.0%	−1.18	−10.7%
Oats	Jan-86	34.90%	17.55%	−1.1%	35.4%	−0.15	−8.2%
Soybeans	Jan-86	12.60%	16.65%	3.2%	21.9%	0.72	−1.1%
Soybean oil	Jan-86	12.30%	17.57%	−1.3%	23.7%	−0.27	−6.5%
Soybean meal	Jan-86	14.50%	14.81%	9.1%	23.7%	1.90	4.4%
Rough rice	Oct-94	15.70%	22.28%	−6.3%	26.9%	−1.09	−10.5%
Crude oil	Jan-86	0.50%	7.97%	14.7%	33.4%	2.17	3.3%
Heating oil	Jan-86	7.80%	9.29%	11.5%	31.5%	1.80	0.8%
Natural gas	Apr-90	1.80%	10.30%	0.8%	50.2%	0.07	−17.6%
Unleaded gasoline/RBOB	Jan-86	8.00%	11.89%	22.6%	41.1%	2.72	−9.1%
Cotton	Jan-86	4.90%	22.22%	0.6%	25.2%	0.13	−4.5%
Orange juice	Jan-86	15.80%	24.96%	0.6%	29.4%	0.10	−5.9%
Lumber	Jan-86	18.30%	18.64%	−3.2%	29.3%	−0.53	−7.1%
Cocoa	Jan-86	8.50%	16.37%	−3.6%	27.8%	−0.64	−8.0%
Sugar	Jan-86	16.70%	20.46%	7.9%	33.0%	1.17	1.3%
Coffee	Jan-86	14.80%	14.83%	−3.0%	36.6%	−0.41	−7.9%
Platinum	Jan-86	42.30%	23.86%	8.6%	22.3%	1.91	0.2%
Palladium	Jan-86	35.80%	28.05%	11.5%	32.6%	1.74	0.4%
Silver	Jan-86	45.50%	14.26%	2.9%	24.9%	0.58	−4.6%
Copper	Jul-89	9.50%	21.68%	10.8%	26.5%	1.88	4.3%
Gold	Jan-86	14.70%	29.30%	2.1%	14.7%	0.69	−4.1%
Lean hogs	Jan-86	−0.80%	11.66%	1.1%	23.2%	0.24	−5.7%
Live cattle	Jan-86	10.70%	11.45%	3.9%	12.7%	1.52	2.0%
Feeder cattle	Jan-86	−15.60%	11.54%	3.9%	12.9%	1.47	2.4%
Pork belly	Jan-86	5.80%	14.94%	−0.5%	33.1%	−0.07	5.6%
Average		12.56%	16.78%	3.4%	28.5%	3.08	−3.3%

[a]The table lists the average hedging pressure (columns 3 and 4) and average excess returns (columns 5 to 7) for 28 individual commodity futures. The hedging pressure is defined as $H_t = \frac{Short_t - Long_t}{OpenInterest_t}$ for the commercial traders. Columns 3 and 4 list the average annualized hedging pressure for different commodities and their standard deviation. Column 5 shows the average annualized arithmetic returns for different commodities (in percentage). Column 6 shows the annualized standard deviation. Column 7 gives the *t*-statistic for the hypothesis that the mean excess return given in column 5 is zero. The final column gives the average annualized futures basis, measured as the annualized difference between the log of the nearby contract price and the log of the second-maturity contract. All data are from 1986 to 2010 at the monthly frequency.

positions are representative of hedging activity, the direction of hedging positions is broadly consistent with the assumption of the theory of normal backwardation. If all commercials were short and non-commercials long, our hedging pressure variable would be 100%. An average net position across commodities of 12.6% therefore indicates that there is considerable heterogeneity between the positions of traders, and commercials can be either long or short in a given point in time. This could be because either for a large fraction of the commercials the hedging demand is naturally long (airlines), or commercials that are naturally long only selectively sell futures based on private information. For example, the net positions of commercials in crude oil average 0.5% with a standard deviation of 8.0%, indicating that commercials are net long approximately half of the time.

3.1. Average Risk Premiums

Columns 5–7 of **Table 1** summarize the annualized average excess returns (sample risk premiums) for each commodity. While 19 out of 28 commodities have positive excess returns, for only 2 can we reject the hypothesis of a zero risk premium. For an equally weighted index of the commodities in our sample, the arithmetic average risk premium was 3.4% per annum ($t = 3.1$). These findings are consistent with the results in the literature that the hypothesis of a zero risk premium is hard to reject at the individual commodity level but that tests for risk premium in portfolios have more power. The final column of **Table 1** summarizes the average basis, which is defined as the annualized percentage price difference between the front month and next to maturity contracts. The table shows that the average basis has been negative for most commodities—which implies an upward sloping futures curve (contango) in most markets.

3.2. Do Speculators Earn Profits?

Chang (1985) tests the ability of speculators to forecast futures returns, based on positions data from the CFTC using the nonparametric method of Henriksson & Merton (1981). In this context, market timing means that the net speculative positions of market participants at time $t-1$ predict the change of futures prices at time t: $R(t) := F(t, T) - F(t-1, T)$. If $P_1(t)$ and $P_2(t)$ denote the respective conditional probabilities of a correct forecast when the futures price falls and rises, Henriksson & Merton (1981) show that a necessary and sufficient condition for a speculator to have no forecast ability is that the sum of the two conditional probabilities are equal to 1, i.e., $P_1(t) + P_2(t) = 1$. We test for market timing ability by non-commercials at the individual commodity level using weekly data between 1993 and 2010 and monthly data between 1986 and 2010. **Table 2** summarizes the test results for timing ability of non-commercial traders. Panel A examines a hypothetical trader who takes a one-unit-long (short) futures position when non-commercial traders buy (sell). Panel B reports the results for a hypothetical trader who takes the opposite side of positions by commercials (the Rockwell test). **Table 2A** shows that the average t-statistic of the null hypothesis of no timing ability is close to zero across 28 markets, for both weekly as well as monthly data. The individual commodity results show significant market timing ability in 4 out of 28 markets at the 5% level, and 3 out of 28 markets in the monthly dataset. There is no consistent pattern between the weekly and monthly test results: Markets that suggest timing ability at the weekly level are different from those that

Table 2 Results of Chang's (1985) test[a]

Panel A: Conditional probability of a correct market position for the naive actual speculator

	Down market	Up market	All market	*t*-stat
Weekly				
Average across 28 commodities	0.307	0.695	1.002	0.018
Monthly				
Average across 28 commodities	0.321	0.689	1.010	0.192

Panel B: Conditional probability of a correct market position for the naive hypothetical speculator

	Down market	Up market	All market	*t*-stat
Weekly				
Average across 28 commodities	0.291	0.711	1.002	−0.008
Monthly				
Average across 28 commodities	0.306	0.711	1.018	0.278

[a]The table lists the conditional probabilities of a correct market position of speculators given that $R(t) \leq 0$ and $R(t) > 0$. Weekly data are from January 1993 to October 2010; monthly data are from January 1986 to October 2010. Let $P_1(t)$ and $P_2(t)$ stand for the respective conditional probabilities of a correct forecast when the futures price falls and rises, respectively; the null hypothesis is $P_1(t) + P_2(t) = 1$, and the alternative hypothesis is $P_1(t) + P_2(t) > 1$. In this table, we report two panels: the probabilities of a correct market position for "naive actual speculators" and "naive hypothetical speculators," respectively. The naive actual speculator and naive hypothetical speculator are defined as traders, who take one unit of futures with identical trading direction (buy or sell) to non-commercial traders and with opposite trading direction to commercial traders, respectively.

indicate monthly level. The findings in **Table 2B** are qualitatively similar to those in panel A. In summary, using a much broader and more recent sample than Chang's (1985), which focuses on three commodities (wheat, corn, and soybeans), our results are inconsistent with his earlier findings and the predictions of the theory of normal backwardation.

3.3. Risk Premiums, Hedging Pressure, and Systematic Risk

In the theory of normal backwardation, the risk premium stems from downward price pressure caused by short hedgers, and speculators can earn this premium by simply taking the opposite side of these hedging positions. Absent systematic hedging pressure, the risk premium would be zero. Bessembinder (1992) tests for the integration of commodity, currency, and equity markets in a multifactor model. He tests for equality of the price of risk across markets, against the alternative hypothesis proposed by Hirshleifer (1988) that idiosyncratic risk is priced due to the presence of non-marketable risks and hedging demands. In a Fama-MacBeth framework, he tests for nonzero average slope coefficients (γ and λ) in the following cross-sectional regression:

$$r_{i,t} = \alpha_t + \gamma_t \hat{\beta}_{i,t-1} + \lambda_t S_{i,t-1} \hat{v}_{i,t-1} + \varepsilon_t, \tag{1}$$

where $\hat{\beta}_{i,t-1}$ and $\hat{v}_{i,t-1}$ represent the usual CAPM beta and the standard deviation of residual observed at $t-1$, respectively; $S_{i,t-1}$ is a dummy variable observed at $t-1$ that

Table 3 Results of Bessembinder's (1992) test[a]

	Model 1		Model 2		Model 3		Model 4	
	Coef. (×100)	*t*-stat	Coef. (×100)	*t*-stat	Coef. (×100)	*t*-stat	Coef. (×100)	*t*-stat
Monthly								
intercept	0.165	0.762	0.085	0.383	−0.079	−0.333	−0.089	−0.327
$\hat{\beta}$	−0.349	−0.678	−0.152	−0.273	−0.365	−0.709	−0.168	−0.302
$S\hat{v}$			0.834	0.475			−0.770	−0.231
D					0.503	2.298	0.515	2.246
Weekly								
intercept	0.038	0.656	0.031	0.513	0.100	1.402	0.128	1.724
$\hat{\beta}$	0.049	0.313	0.064	0.386	0.012	0.069	0.050	0.277
$S\hat{v}$			−0.306	−0.316			−1.580	−0.873
D					0.157	2.411	0.159	2.423

[a]The table lists the regression results for four models:

$$r_{i,t} = \alpha_t + \gamma_t \hat{\beta}_{i,t-1} + \varepsilon_t, \qquad \text{(Model 1)}$$

$$r_{i,t} = \alpha_t + \gamma_t \hat{\beta}_{i,t-1} + \lambda_t S_{i,t-1} \hat{v}_{i,t-1} + \varepsilon_t, \qquad \text{(Model 2)}$$

$$r_{i,t} = \alpha_t + \gamma_t \hat{\beta}_{i,t-1} + \theta_t D_{t-1} + \varepsilon_t, \text{ and} \qquad \text{(Model 3)}$$

$$r_{i,t} = \alpha_t + \gamma_t \hat{\beta}_{i,t-1} + \lambda_t S_{i,t-1} \hat{v}_{i,t-1} + \theta_t D_{t-1} + \varepsilon_t, \qquad \text{(Model 4)}$$

where $\hat{\beta}_{i,t-1}$ and $\hat{v}_{i,t-1}$ are estimated by running a market model for futures returns, using five years (60 months) for monthly data and one year (52 weeks) for weekly data before t. $S_{i,t-1}$ is set to 1 when hypothetical speculators at $t-1$ are net long and -1 when hypothetical speculators are net short. D_{t-1} is a dummy variable that equals 1 when the basis is ranked to the higher half; it equals zero when it is in the lower half. We use the Fama-MacBeth (Fama & MacBeth 1973) method to first estimate a cross-sectional regression for the 28 commodities at each t and then calculate the statistics of the parameters α, γ, λ and θ, respectively. The table lists results with a monthly frequency from January 1986 to October 2010 and with a weekly frequency from January 1993 to October 2010, respectively. Note that the 95% confidence level corresponds to a *t*-statistic of 1.65 (a one-sided test).

is 1 when non-commercials are net long and −1 when net short.[4] The results are in **Table 3**. The first specification shows that we cannot reject a zero price of beta risk in a single-factor model. The second specification shows that we do not find that non-marketable risks are priced in the cross section of commodity returns. These results are therefore different from the previous findings by Bessembinder, albeit in a very different sample of futures. By contrast, we also show results for two specifications that include an additional dummy variable in the cross-sectional regressions, which equals one when the futures basis of commodity i ranks in the top half of the sample of commodities at the end of month $t-1$ and is zero otherwise. This is to contrast the cross-sectional predictability of commodity risk premiums with the basis as is predicted by the theory of storage, which is the subject of the next section of this review. As can be seen from the last two specifications in **Table 3**, cross-sectional differences in the basis are compensated in average commodity futures excess returns.

[4]For brevity we only examine a single beta model, using the SP500 as our proxy for the market. Bessembinder shows results for several multifactor specifications. A second difference is that we only use data on commodity futures in our test, whereas Bessembinder includes financial futures as well.

De Roon, Nijman & Veld (2000) take a time-series approach to examine the role of hedging pressure in futures markets by estimating the following regression of excess returns on the SP500 and hedging pressure:

$$r_{i,t} = \alpha_i + \beta_i r_t^{SP500} + \theta_i H_{i,t-1} + \varepsilon_{i,t}, \qquad (2)$$

where $r_{i,t}$ is the excess return for the i^{th} futures at time t, r_t^{SP500} is the SP500 index return, and $H_{i,t-1}$ is the hedging pressure for the i^{th} futures.[5] The theory of normal backwardation implies that a larger hedging pressure will result in a larger risk premium. The test proposed by De Roon, Nijman & Veld (2000) is whether θ is significantly positive, and they report significant exposures for seven out of a sample of nine commodities between 1986 and 1994. **Table 4** lists the results of weekly and monthly data from 1986 to 2010. In tests using weekly data, only two commodities have a significant exposure to hedging pressure, but the coefficients have the wrong sign. At the monthly frequency, 4 of 28 slope coefficients are significant, of which 3 have a positive sign. Our tests are based on a larger cross section of commodities and a longer time period, and we find results that are considerably weaker than reported in the literature.

Taken together, we conclude that the empirical support for the theory of normal backwardation is weak. Although there is some portfolio-level evidence that futures prices have historically been downward biased relative to future spot prices, attempts to link the bias to trader positions are not easily replicated out of sample.

4. THE THEORY OF STORAGE

An alternative approach to explaining risk premiums on commodity futures prices is in the context of the theory of storage. In its original formulation by Kaldor (1939), Working (1949), and Brennan (1958) the theory links commodity prices for current and future delivery through the storage decisions of inventory holders. Prices for future delivery, F, exceed prices for immediate spot delivery, S, by the cost of storage minus a convenience yield: $F - S = rS + w - c$. Storage costs include the interest cost rS and the marginal cost of warehousing w (including insurance, etc.). Absent a convenience yield, c, futures prices would exceed spot prices by the cost of storage to compensate inventory holders for carrying the commodity. The convenience yield is introduced as a marginal benefit to inventory holders to explain why stocks are held over the harvest when spot prices are expected to fall. The convenience yield is assumed to be a declining function of the level of physical inventories. Building on Deaton & Laroque (1992, 1996), Routledge, Seppi & Spatt (2000) derive the negative inventory-convenience yield relation endogenously from the non-negativity constraint on physical stocks. The convenience yield can be thought of as a real option that fluctuates in value with the probability of a stock-out, which is decreasing in the level of inventories. The prediction of these models is that the volatility of spot prices increases as inventories decline, and their ability to act as a buffer to demand and supply shocks is diminished.

Deaton & Laroque (1992) and Routledge, Seppi & Spatt (2000) study inventory decisions using a model set in a risk-neutral economy that provides no prediction for risk premiums. Gorton, Hayashi & Rouwenhorst (2012) study a model where the increased

[5]The SP500 index data is obtained from Datastream.

Table 4 Results of De Roon, Nijman & Veld's (2000) test[a]

	Weekly		Monthly	
Commodity	Coef.	*t*-stat	Coef.	*t*-stat
Chicago wheat	−0.008	−0.974	−0.003	−0.096
Kansas wheat	0.000	0.040	0.011	0.385
Minneapolis wheat	0.008	0.813	0.049	1.541
Corn	−0.001	−0.060	0.008	0.242
Oats	−0.021	−2.362	−0.052	−1.541
Soybeans	0.001	0.237	0.004	0.192
Soybean oil	−0.004	−0.694	0.007	0.298
Soybean meal	0.000	−0.041	0.009	0.323
Rough rice	0.008	1.457	0.065	2.763
Crude oil	0.017	0.810	0.086	1.232
Heating oil	−0.010	−0.615	0.031	0.532
Natural gas	0.029	1.282	0.198	2.145
Unleaded gasoline/RBOB	0.000	−0.014	−0.005	−0.092
Cotton	0.000	0.034	0.029	1.544
Orange juice	−0.007	−1.157	0.023	1.142
Lumber	0.001	0.068	0.033	1.285
Cocoa	−0.013	−1.515	0.009	0.299
Sugar	−0.003	−0.457	0.013	0.486
Coffee	−0.022	−1.874	−0.039	−0.950
Platinum	0.003	0.598	0.014	0.905
Palladium	0.005	1.119	0.031	1.704
Silver	−0.017	−2.064	−0.045	−1.545
Copper	0.004	0.745	0.008	0.362
Gold	0.003	1.052	0.016	1.937
Lean hogs	−0.005	−0.482	0.000	0.006
Live cattle	0.006	0.893	0.038	2.049
Feeder cattle	−0.008	−1.529	−0.042	−2.211
Pork belly	−0.015	−1.383	−0.044	−1.248
Average	−0.002	−0.217	0.016	0.489

[a]The table lists the coefficients and corresponding *t*-statistics of the regression:

$$r_{i,t} = \alpha_i + \beta_i r_t^{SP500} + \theta_i H_{i,t-1} + \varepsilon_{i,t},$$

where $H_t = \dfrac{Short_t - Long_t}{OpenInterest_t}$; *Short* and *Long* represent the short and long positions of commercial traders, respectively; and *OpenInterest* stands for the open interest. The weekly data sample is from January 1993 to October 2010 and the monthly sample from January 1986 to October 2010. The null hypothesis is $\theta_i = 0$ with the alternative hypothesis $\theta_i > 0$. For brevity, the table only reports the statistics of θ_i and omits reporting other parameters. Note that the 95% confidence level corresponds to a *t*-statistic of 1.65 (a one-sided test).

volatility of spot prices can lead to fluctuations in risk premiums when investors are risk averse and producers have a hedging motive. Acharya, Lochstoer & Ramadorai (2009) model the risk premium through the interaction of risk-averse firms and risk-constrained speculators who face limits to arbitrage. They build on an intuition developed in a model by Etula (2009), where risk premiums are determined by the interaction between financial intermediaries and households that seek to hedge their commodity price risk. Fluctuations in the premium result from a combination of limits to arbitrage on behalf of broker-dealers triggered by shocks to their balance sheet that affect their capacity to take risk.

Brennan (1991) and Pindyck (1994) empirically document a negative relationship between the convenience yield and the level of inventories of metals and several other commodities. Gorton, Hayashi & Rouwenhorst (2012) find that the slope of the futures curve varies positively with inventories for a large group of commodities. Carbonez, Nguyen & Sercu (2009, 2010) compare the strength of the basis-inventory relationship of corn, wheat, and oats between 1885 and 1935 to the recent 20-year period ending in 2005 and find it was stronger in the early sample.

Fama & French (1988) show that the volatility of spot prices for metals increases relative to futures prices when the basis is high, and Ng & Pirrong (1994) additionally document a positive relationship between the basis and spot price volatility. Although neither of these studies uses inventory data, the negative effect of inventories on the basis and volatility is implicit in these tests.

A separate strand of papers links the basis to the commodity futures risk premiums. Fama & French (1987) show that the futures basis has forecast power for the risk premium in univariate time-series regressions. Gorton & Rouwenhorst (2006); Gorton, Hayashi & Rouwenhorst (2012); and Erb & Harvey (2006) form portfolios by cross-sectionally sorting commodities on the basis and find significant differences between high and low basis portfolios. Taken together, these results suggest a link between the level of inventories, the basis, future spot price risk and the risk premium on commodity futures.

Dincerler, Khoker & Titman (2003) directly examine the effect of storage on expected futures returns of natural gas between 1994 and 2001. Dincerler, Khoker & Simin (2004) compare the role of inventories and hedging pressure for risk premiums in futures of gold, copper, crude oil, and natural gas between 1995 and 2004 and find inventories to be more important than hedging pressure. Gorton, Hayashi & Rouwenhorst (2012) collect inventory data for a broad cross section of commodities and directly examine the negative relation between inventories and the risk premium. They document that sorting commodities into portfolios based on beginning of period inventories significantly spreads their average returns. According to Gorton, Hayashi & Rouwenhorst, the futures of commodities earn on average a higher risk premium when their inventories are low, and the higher average returns of portfolios of commodity futures sorted on the futures basis and one-year price momentum can be in part attributed to the return for the increased volatility risk associated with low inventories.

In summary, the empirical evidence of a link between the expected risk premium and storage fundamentals is stronger than the link with hedging pressure. An important open question in the literature remains how to explain commodity futures risk premiums within a modern asset pricing framework. On the one hand, in addition to the aforementioned papers, Bailey & Chan (1993) document common factors in the futures basis of many commodities that are related to the business cycle and suggest the presence of a common risk factor. On the other hand, average correlations of diversified portfolios of commodity futures returns with traditional assets have been very low (Erb & Harvey 2006, Gorton & Rouwenhorst 2006), which suggests that much of the portfolio variance of commodities has been idiosyncratic. This could point to historical segmentation of futures markets from other markets. Tang & Xiong (2010) argue that recent financialization of commodity markets may alter the risk characteristics of commodity investments going forward.

In addition to the literature on the theory of normal backwardation and the theory of storage, which trace predictability of futures excess returns to hedging pressure and storage decisions, there are several papers that document other sources of return predictability. Pirrong (2005); Erb & Harvey (2006); Miffre & Rallis (2007); and Shen, Szakmary & Sharma (2007) document momentum in commodity futures returns at horizons up to one year, which is similar to momentum returns documented in equity markets. Hong & Yogo (2010) document return predictability at the commodity portfolio level using the yield spread, short-term interest rates, and the growth in aggregate open interest. De Roon et al. (2009) document the predictability of commodity spreads.

5. THE IMPACT OF TRADER BEHAVIOR ON FUTURES PRICES

The behavior of speculators in commodity markets was first examined by Houthakker (1957), who notes that speculative positions positively covary with commodity prices. Following the congressional ban of 1958 on onion futures to protect onion growers from speculators, Working (1960) and Gray (1963) find that the volatility of onion prices was lower when speculators were active in futures markets than during periods when speculative activity was low. Interest in the role of speculators was recently renewed by the rise of crude oil prices to $147 a barrel in July of 2008 and the public debate that followed it. Instead of the traditional question of whether futures prices are biased downward relative to future spot prices as a result of hedging pressure, researchers and policy makers have asked whether the increase in speculative interest in commodities has exerted upward pressure on the level of both spot and futures prices. One category of speculative investors has received special attention in the debate, namely the index investors. For two sides of the debate on the influence of index investors, see Masters (2008) and Verleger (2010).

In response to this increased interest, the CFTC has expanded the scope of its report on trader positions. The traditional Commitment of Traders (CoT) report of the CFTC classifies reporting traders as commercials or non-commercials. With the rise in popularity of commodity index investing, these traditional classifications have increasingly become confounded by positions of swap dealers, which substitute for speculative (non-commercial) long positions on behalf of their clients but are themselves classified as commercials. This has motivated a more detailed split of the traditional trader categories in the disaggregate CFTC reports (Disaggregated Commitment of Traders, DCoT): commercials into producers, merchants, processors, user and swap dealers and non-commercials into managed money and other reportables. In addition, the CFTC publishes a Commodity Index Trader (CIT) supplement, which reports the allocations of index traders to 12 agricultural commodities—index traders consist of the subset of swap dealer positions that offset index investments by their clients as well as direct futures investments by index funds. Finally there is a growing body of papers coauthored by CFTC research staff that uses more detailed trader classifications that are not in the public domain.

Speculative positions will covary with futures excess returns if speculators chase returns, but this does not establish causality from changes in positions to price changes.

Using the CoT dataset, Wang (2003); Sanders, Boris & Manfredo (2004); and Irwin, Sanders & Merrin (2009) show that non-commercial positions do not help to forecast prices. Büyüksahin & Harris (2011) use a more refined classification than provided in the CoT reports and show that non-commercial and swap dealer positions do not Granger cause changes in oil futures prices, but that price changes precede position changes instead. Brunetti, Büyüksahin & Harris (2011) study the separate impact of trading by merchants; manufacturers; floor brokers; swap dealers; and hedge funds in oil, corn, and natural gas between 2005 and 2009 and conclude that speculators react to market conditions in ways to provide liquidity to the market and lower overall price volatility.

We study the contemporaneous relationship between trader positions as defined by the CoT reports and returns using weekly data:

$$Q_t = a_0 + a_1 r_t + a_2 b_t + \varepsilon_t, \tag{3}$$

where $Q_t := \dfrac{NetLong_t - NetLong_{t-1}}{OpenInterest_{t-1}}$ is defined as the change of net-long (long minus short) position scaled by open interest, r_t is the futures excess return, and b_t is the basis as an additional control variable. We estimate Equation 3 for the 28 individual commodities listed in **Table 1** and report the average slope coefficients and their *t*-statistics across regressions in **Table 5**.[6] The first two rows of **Table 5** show that between 1993 and 2010 commercial positions are strongly negatively correlated with price changes and that non-commercial positions strongly positively covary with returns. These results confirm the earlier findings of Houthakker (1957). If we use the DCoT data that are available since 2006, we find that the covariance of hedgers is primarily driven by producers and merchants, whereas the covariance of speculative positions stems from money managers. Interestingly, positions of swap dealers show a low contemporaneous covariance with returns. If we repeat these same regressions using the subset of commodities covered by the CIT data (agriculture and livestock), we find that positions of index traders have a much lower covariance with returns than speculators overall. In summary, we find that the positions of index investors and the swap dealers exhibit the least comovement with prices.

Büyüksahin & Harris (2011) report that oil futures returns help to predict positions in oil markets. We estimate the relationship between positions and past returns for individual commodities,

$$Q_t = c_0 + c_1 Q_{t-1} + c_2 r_{t-1} + c_3 b_{t-1} + \varepsilon_t, \tag{4}$$

and report the average of the coefficients across commodities in **Table 6**. The average coefficient on lagged returns is significantly positive for non-commercials and negative for commercials. As was the case with the contemporaneous responses, the feedback of non-commercial positions to past returns is driven primarily by the money managers, and the behavior of producers and merchants accounts for the delayed response of the commercials. Both swap dealers and index investors have small coefficients on past returns and display no significant response of positions to past performance. We note that the delayed response in **Table 6** is more pronounced in weekly than in monthly data—in the latter case, the feedback from returns to prices is much weaker. Apparently traders adjust their positions in response to prices but do so relatively quickly: money managers increase

[6] Detailed results are available from Ke Tang.

Table 5 Contemporaneous regressions of traders' positions on futures returns[a]

Traders	Intercept			r_t			b_t			R^2
	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	
Commercials (CoT)	0.00	0.14	0	−0.65	−15.79	28	0.01	−0.01	4	22%
Non-commercials (CoT)	0.00	−0.07	0	0.53	14.61	28	−0.01	−0.07	3	20%
Commercials (CIT)	0.00	0.52	2	−0.38	−10.66	12	−0.02	−0.60	2	33%
Non-commercials (CIT)	0.00	−0.85	2	0.31	8.98	12	0.02	0.78	3	26%
Index traders (CIT)	0.00	1.05	2	0.03	2.34	7	0.00	−0.44	2	4%
Producers and merchant users (DCoT)	0.00	−0.02	1	−0.33	−7.91	26	−0.01	−0.24	2	24%
Money managers (DCoT)	0.00	−0.01	2	0.30	7.49	27	0.01	0.09	2	22%
Swap dealers (DCoT)	0.00	0.41	1	−0.02	−0.03	16	−0.01	−0.05	1	5%
Other reportables (DCoT)	0.00	−0.19	0	−0.01	−0.92	11	0.00	0.21	0	3%

[a]The table lists the coefficients and corresponding *t*-statistics of the regression:

$$Q_t = a_0 + a_1 r_1 + a_2 b_t + \varepsilon_t,$$

where $Q_t := \frac{NetLong_t - NetLong_{t-1}}{OpenInterest_{t-1}}$ is defined as the change of net-long positions of different traders relative to open interest; r_t is the futures excess return at time t; and b_t is the basis. The CoT dataset covers the period from 1993 to 2010. Both CIT and DCoT samples are from 2006 to 2010. All three datasets are at the weekly frequency. The CoT data categorizes traders into commercials (hedgers), non-commercials (speculators) and non-reportables for all 28 commodities shown in **Table 1**. The CIT data classify traders into commercials, non-commercials, index traders, and non-reportables for 12 agricultural commodities: wheat, Kansas wheat, corn, soybeans, soybean oil, cotton, cocoa, sugar, coffee, lean hogs, live cattle, and feeder cattle. The DCoT data classifies traders into producers and merchant users, swap dealers, managed money, other reportables, and non-reportables for 28 commodities. For brevity, this table only reports the average coefficients and *t*-statistics across all commodities. Columns 4, 7, and 10 show the number of commodities for which the coefficient is significantly different from zero using a 95% confidence level.

their long positions following price increases while producers/merchants increase their shorts (hedges). This evidence is consistent with the traditional view of futures markets where money managers (speculators) and producers, rather than swap dealers and index investors, are the marginal investors in determining the short-term behavior of prices in futures markets.

We also run a regression that is the complement of Equation 4, to see whether futures returns can be predicted using past returns, past positions, and the basis:

$$r_t = c_0 + c_1 Q_{t-1} + c_2 r_{t-1} + c_3 b_{t-1} + \varepsilon_t. \tag{5}$$

The results are given in **Table 7** and show that for weekly CoT data, the coefficient on the change in the net-long position of non-commercials is insignificantly different from zero for 22 out of 28 commodities, and that for the remaining six commodities the sign is significantly negative. This finding is inconsistent with the hypothesis that positions of non-commercials have positively influenced prices. In the more recent DCoT data three commodities have an unexpected negative sign, and we find no significant predictive power for the remaining 25 commodities. Moreover, for monthly CoT and DCoT

Table 6 Predictive regression for traders' positions[a]

Traders	Intercept			Q_{t-1}			r_{t-1}			b_{t-1}			R^2
	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	
Weekly													
Commercials (CoT)	0.00	0.00	0	0.13	3.47	22	−0.19	−3.82	26	−0.01	−0.97	9	6%
Non-commercials (CoT)	0.00	0.01	0	0.11	3.16	22	0.21	4.75	28	0.01	0.95	7	7%
Commercials (CIT)	0.00	0.75	1	0.21	2.82	10	−0.11	−1.77	3	−0.04	−1.27	1	11%
Non-commercials (CIT)	0.00	−1.12	1	0.20	2.79	8	0.12	2.20	5	0.04	1.53	3	12%
Index traders (CIT)	0.00	0.94	0	0.23	3.54	10	0.01	0.40	1	0.00	−0.52	0	7%
Producers and merchant users (DCoT)	0.00	0.19	0	0.17	2.16	16	−0.15	−2.12	14	−0.03	−0.80	1	11%
Money managers (DCoT)	0.00	−0.31	0	0.16	2.21	17	0.14	2.20	18	0.03	0.74	1	10%
Swap dealers (DCoT)	0.00	0.40	0	0.13	2.07	15	0.01	0.44	5	−0.01	−0.12	4	6%
Other reportables (DCoT)	0.00	0.06	0	−0.02	−0.30	9	−0.02	−0.91	9	0.01	−0.04	2	3%
Monthly													
Commercials (CoT)	−0.01	−0.35	1	−0.10	−1.17	8	0.06	0.37	2	−0.02	−1.04	6	4%
Non-commercials (CoT)	0.00	0.35	1	−0.12	−1.43	7	−0.01	−0.11	2	0.02	0.97	4	4%
Commercials (CIT)	0.00	0.55	2	0.00	0.07	2	0.07	0.55	2	−0.03	−0.79	2	7%
Non-commercials (CIT)	0.00	−0.58	2	−0.04	−0.20	0	−0.03	−0.26	0	0.03	0.57	2	5%
Index traders (CIT)	0.00	0.12	1	0.07	0.60	2	0.00	−0.17	2	0.00	0.37	2	8%
Producers and merchant users (DCoT)	0.00	0.03	2	−0.03	−0.12	3	0.00	0.04	2	−0.07	−0.42	1	7%
Money managers (DCoT)	0.00	0.00	1	−0.11	−0.58	4	0.05	0.02	1	0.05	0.19	2	7%
Swap dealers (DCoT)	0.00	0.30	1	0.00	0.02	0	0.01	0.44	3	0.01	−0.02	1	7%
Other reportables (DCoT)	0.00	−0.15	0	−0.03	−0.23	0	−0.01	0.08	1	0.01	0.26	2	5%

[a]The table lists the coefficients and corresponding *t*-statistics of the regression:

$$Q_t = c_0 + c_1 Q_{t-1} + c_2 r_{t-1} + c_3 b_{t-1} + \varepsilon_t,$$

where $Q_t := \dfrac{NetLong_t - NetLong_{t-1}}{OpenInterest_{t-1}}$ is defined as the change of position relative to open interest, r_{t-1} is the futures excess return at time $t-1$, and b_{t-1} is the basis. The CoT dataset covers the period from 1993 to 2010. Both CIT and DCoT samples are from 2006 to 2010. All three datasets are at the weekly frequency. The CoT data categorize traders into commercials (hedgers), non-commercials (speculators), and non-reportables for all 28 commodities shown in **Table 1**. The CIT data classify traders into commercials, non-commercials, index traders, and non-reportables for 12 agricultural commodities: wheat, Kansas wheat, corn, soybeans, soybean oil, cotton, cocoa, sugar, coffee, lean hogs, live cattle and feeder cattle. The DCoT report classifies traders into producers and merchant users, swap dealers, managed money, other reportables, and non-reportables for 28 commodities. This table reports results for both weekly and monthly frequency. For brevity, this table only reports the average coefficients and *t*-statistics across all commodities. Columns 4, 7, 10, and 13 show the number of commodities for which the coefficient is significantly different from zero using a 95% confidence level.

Table 7 Predictive regressions for futures returns[a]

Traders	Intercept			Q_{t-1}			r_{t-1}			b_{t-1}			R^2
	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	Coef.	*t*-stat	No. Com.	
Weekly													
Commercials (CoT)	0.00	0.70	5	0.03	1.05	7	0.01	0.29	5	0.02	2.64	16	2%
Non-commercials (CoT)	0.00	0.70	5	−0.04	−0.99	6	0.01	0.23	2	0.02	2.64	16	2%
Commercials (CIT)	0.00	−0.47	0	0.07	0.48	1	0.04	0.54	1	0.04	1.76	5	3%
Non-commercials (CIT)	0.00	−0.49	0	−0.05	−0.51	1	0.04	0.53	1	0.04	1.76	5	3%
Index traders (CIT)	0.00	−0.52	0	−0.10	−0.14	1	0.02	0.31	0	0.05	1.82	6	3%
Producers and merchant users (DCoT)	0.00	−0.07	2	0.01	0.28	2	0.02	0.22	2	0.01	1.11	10	3%
Money managers (DCoT)	0.00	−0.08	2	−0.01	−0.28	3	0.02	0.21	2	0.01	1.11	10	3%
Swap dealers (DCoT)	0.00	−0.08	2	0.08	−0.09	2	0.01	0.04	0	0.01	1.12	9	3%
Other reportables (DCoT)	0.00	−0.09	2	0.04	0.11	3	0.01	0.15	0	0.01	1.12	9	3%
Monthly													
Commercials (CoT)	0.01	0.78	4	0.01	0.12	0	0.03	0.41	6	0.05	2.46	17	8%
Non-commercials (CoT)	0.01	0.79	4	0.00	−0.04	0	0.03	0.37	5	0.05	2.46	17	7%
Commercials (CIT)	−0.01	−1.00	2	−0.07	−0.19	0	−0.03	−0.10	1	0.07	1.30	4	11%
Non-commercials (CIT)	−0.01	−0.99	2	0.09	0.16	0	−0.03	−0.11	1	0.07	1.31	4	11%
Index traders (CIT)	−0.01	−0.99	2	−0.19	−0.18	0	0.00	0.00	2	0.07	1.39	4	12%
Producers and merchant users (DCoT)	0.00	−0.11	0	−0.12	−0.20	1	−0.08	−0.55	2	0.03	0.60	2	6%
Money managers (DCoT)	0.00	−0.13	0	0.13	0.43	0	−0.05	−0.62	2	0.02	0.54	3	7%
Swap dealers (DCoT)	0.00	−0.08	0	−2.62	−0.40	3	−0.06	−0.47	2	0.03	0.62	3	8%
Other reportables (DCoT)	0.00	−0.15	0	−0.19	−0.24	1	−0.07	−0.51	2	0.03	0.61	3	6%

[a]The table lists the coefficients and corresponding *t*-statistics of the regression:

$$Q_t = c_0 + c_1 Q_{t-1} + c_2 r_{t-1} + c_3 b_{t-1} + \varepsilon_t,$$

where $Q_t := \frac{NetLong_t - NetLong_{t-1}}{OpenInterest_{t-1}}$ is defined as the change of position relative to open interest, r_{t-1} is the futures excess return at time $t-1$, and b_{t-1} is the basis. The CoT dataset covers the period from 1993 to 2010. Both CIT and DCoT samples are from 2006 to 2010. All three datasets are at the weekly frequency. The CoT dataset categorizes traders into commercials (hedgers), non-commercials (speculators), and non-reportables for all 28 commodities shown in **Table 1**. The CIT data classify traders into commercials, non-commercials, index traders and non-reportables for 12 agricultural commodities: wheat, Kansas wheat, corn, soybeans, soybean oil, cotton, cocoa, sugar, coffee, lean hogs, live cattle and feeder cattle. The DCoT report classifies traders into producers and merchant users, swap dealers, managed money, other reportables, and non-reportables for 28 commodities. This table reports results for both weekly and monthly frequency. For brevity, this table only reports the average coefficients and *t*-statistics across all commodities. Columns 4, 7, 10, and 13 show the number of commodities for which the coefficient is significantly different from zero using a 95% confidence level.

datasets, we find changes of non-commercial positions fail to predict futures returns for all 28 commodities.

As mentioned before, the behavior of index traders is of particular interest when it comes to predictability of prices. Masters & White (2008) argue that commodity index flows comove with price levels of commodities, and Singleton (2011) finds that the growth rate of money flows into commodity indexes had significant impacts on the oil futures prices. Their conclusions are based on an indirect estimate of the money flows into oil futures that is based on the flows into indexed agricultural commodities and covered by the CIT data. Mou (2010) shows that the commodity index flows impact the futures prices during the periods when the index rolls. In contrast, Stoll & Whaley (2010) report no impact of flows during the rolls, and similar to Sanders & Irwin (2011a,b) find that Granger causality tests fail to find a link between commodity index investment activity and commodity futures prices. Our findings in **Table 7** are consistent with the latter papers: Changes of positions by index traders cannot predict futures returns for 11 out of 12 commodities using weekly CIT data, and for one commodity the slope coefficient is significantly negative. Similarly, index position changes have no predictive power at the monthly frequency.

Tang & Xiong (2010) document that during the period of growth of commodity index investing the correlation of commodities with other risk assets (such as the US dollar exchange rate and the emerging equities) increased. The effect is also illustrated in **Figure 2** (see color insert), which gives the three-year rolling correlation of monthly returns between the equally weighted commodity index of Gorton & Rouwenhorst (2006) and the total return of the SP500 and the return long-term government bonds from Ibbotson SBBI (2011). Tang & Xiong argue that the correlation among different commodities increased also, which **Figure 3** (see color insert) illustrates with the rolling one-year and three-year average pair-wise correlation among individual commodity futures. Tang & Xiong argue that the increase in these correlations is attributable to index investors, and that index investing has introduced an additional channel of volatility spillover from equity and currency markets into commodities markets.

6. CONCLUSIONS AND FUTURE RESEARCH

In the first part of this review, we summarize the empirical evidence on the return characteristics of commodity futures, in particular the presence and determinants of risk premiums. We re-examine traditional tests that found support for the theory of normal backwardation using a more recent dataset from 1986 to 2010 with broad commodity coverage. In contrast to the prior literature, we find that traditional market timing and hedging pressure tests provide little support for the theory in the more recent sample. Although on average (across all commodities and months) futures prices were biased downward relative to future spot prices, our empirical evidence to link the risk premium to (short) positions of hedgers is weaker than reported in the previous literature. There is some empirical support for a link between premiums and storage decisions, but much of the evidence is in reduced form and does not follow from an equilibrium model that can explain the cross section of commodity returns.

In the second part of this review, we investigate the behavior of traders in commodity markets and study their impact on the futures prices. Using the publicly available CFTC classifications, we find that the non-commercials are momentum, or positive feedback, traders and commercials on average contrarians. Over the most recent five-year period, the positions of index traders and swap dealers show low sensitivity to contemporaneous commodity returns relative to the average sensitivity of all non-commercial traders. Moreover we find no evidence of a positive feedback from index investor positions to commodity returns. This does not lend support to the view that index investors have been the primary driver of commodity price variation over the past years.

Commodity futures markets remain under-researched relative to many other areas of finance, taking equity markets as an example. In addition, our review indicates that some findings reported in the earlier literature may have been sample specific. On this basis, we conclude that there are many good open questions for academic researchers to answer in this field. Commodity futures markets are unique because in principle there exist great data. Large traders have frequent reporting requirements to exchanges and the CFTC, which implies that there exists a central data repository about individual market participants that is unique to commodities markets and more comprehensive than most other financial markets we know of. Given that both policy makers and academics share an interest in the three sets of questions we formulated in the introduction of this review, it would seem logical to unlock this data vault—perhaps not the most recent, but certainly some of the more distant historical data. On occasion, the CFTC has allowed some of this data to be used in coauthored papers with CFTC staff, but a broader dissemination could mobilize the "free" resource of academic research. If policy makers, regulators, and academia can make progress on answering these questions, it would lead to a better understanding of the markets in which the raw materials for industrial production and natural resources to feed the world are traded.

DISCLOSURE STATEMENT

K.G.R. is Director of Research and partner in Summer Haven, a commodity management company.

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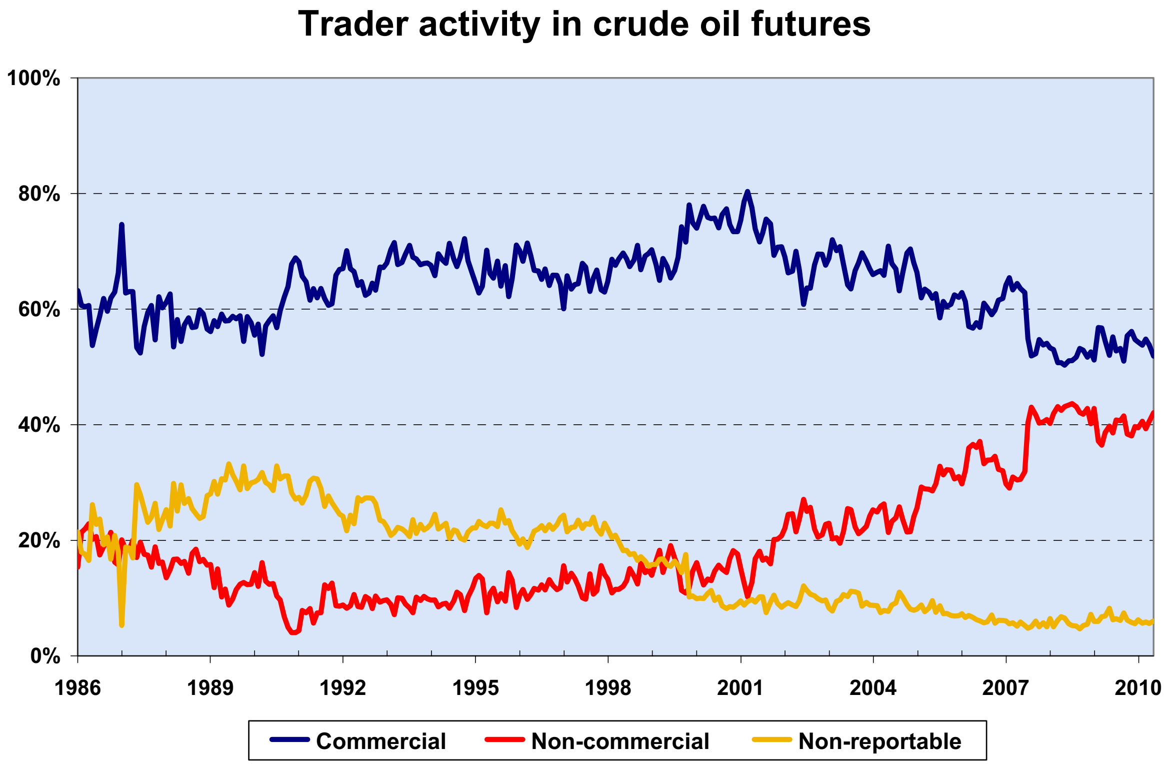

Figure 1

Trader activity in crude oil futures. Share of trader activity is calculated as $Activity_t = \dfrac{Long_t + Short_t}{2 \times OpenInterest_t}$ for commercials, non-commercials, and non-reportables (small traders), respectively. Note that the three shares sum up to 100% at any time. The sample is from the CoT data from 1986 to 2010 with a monthly frequency.

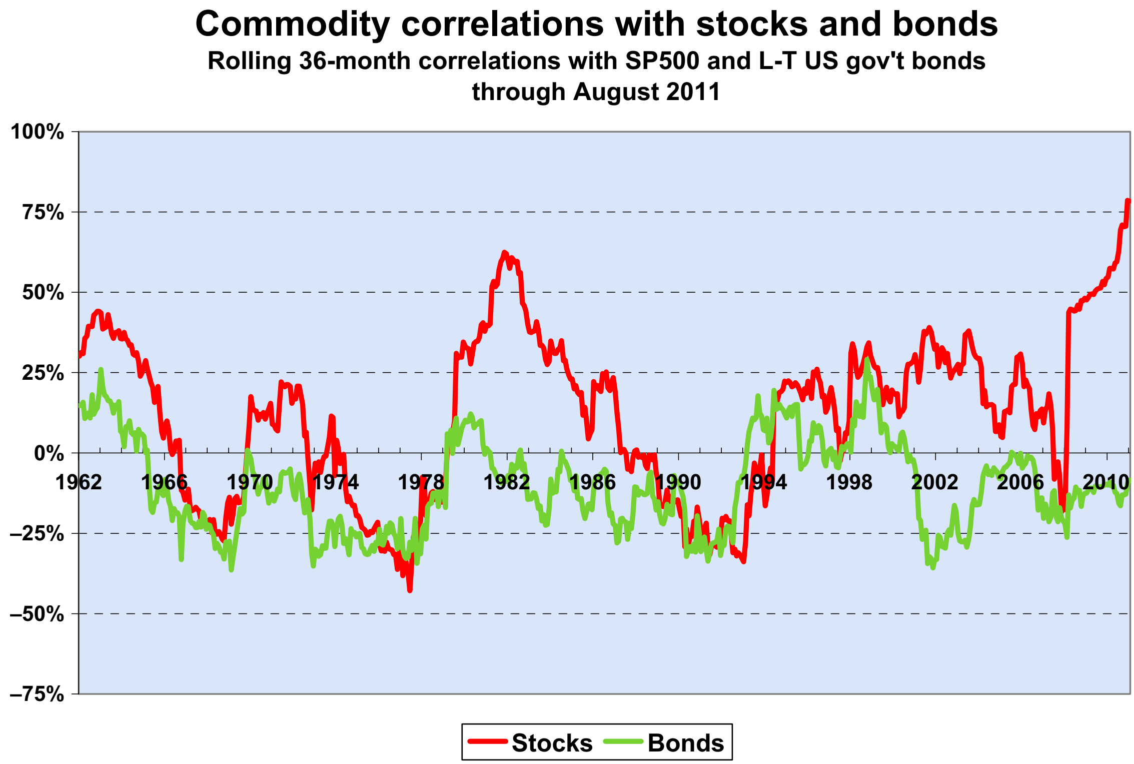

Figure 2

The rolling correlation between an equally weighted commodity index and stocks (SP500 index) and bonds (long-term US government bond). The rolling window is 36 months.

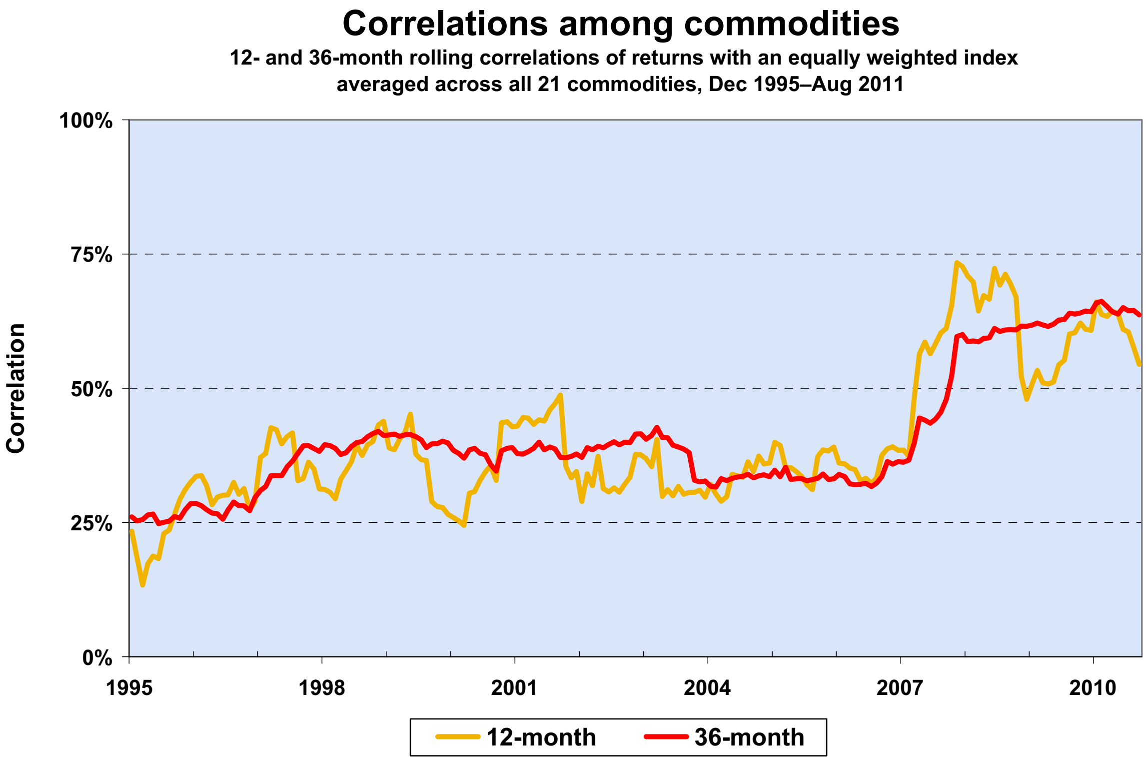

Figure 3

The rolling correlation of monthly returns with an equally weighted index averaged across 21 commodities.

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Contents

Errata

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