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Financialization and speculators risk premia in commodity futures markets

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ABSTRACT

J.M. Keynes coined the term *normal backwardation*, a situation where a futures price for a particular expiry month is less than the expected spot price for that month. He argued hedgers pay speculators a risk premium, giving rise to normal backwardation. We study the behavior of commodity futures before and since financialization of the markets, which started about 20 years ago. We find the poor returns to managed futures in recent years are likely due to the impact of financialization and the associated outside money suppressing the futures risk premium.

"Investments that track broad stock indexes have become the favorite of many investors and analysts for long-term returns that are hard to beat. But index tracking has not done so well in the commodities market." The Wall Street Journal, April 10, 2017.

1. Introduction

The existence and size of a *risk premium* in futures markets has been controversial since the famous Telser-Cootner debate in the late 1950s and early 1960s (see Cootner (1960) and Telser (1958)). Based on the belief that trading profits on the long side could be earned from such a risk premium, about 40 years after the Telser-Cootner debate, the American International Group (AIG) established the AIG commodity index – an index of commodity futures prices – in the late 1990s. The AIG index was established to attract outside investors to commodity futures, as investing in the AIG index was a relatively easy way for an investor to add commodities to a portfolio. The work by Gorton and Rouwenhorst (2006) supported AIG's aim to attract investors to futures markets as Gorton and Rouwenhorst argued that commodity futures offer the same return and Sharpe ratio as U.S. equities. The underlying explanation was the existence of a risk premium in commodity futures. However this view was not without controversy, as Erb and Harvey (2006) concluded that average commodity futures returns are not equity-like, instead they are zero. Later, Erb and Harvey (2016) argued that portfolios of commodity futures do not have equity-like returns either.

Index speculation in commodities took off in the early 2000s, so much so that in 2008 the U.S. Senate held committee hearings on the role of index speculators influencing crude oil prices, because the price of oil spiked above $100 a barrel.[1] The impact of the rising presence of noncommercial players on commodity prices has been dubbed the *financialization of commodity markets*. Many of the "outside" investors hold commodities through commodity futures indexes such as the Goldman Sachs commodity index (GSCI), the Dow Jones index (DJ-UBS) and the S&P commodity index (SPCI). They also invest in over-the-counter (OTC) swaps and exchange-traded-funds (ETFs) linked to commodity indexes. Index speculators are thought to be one of the largest participants in several commodity futures markets today, and nearly all of them are based on passive, long-only, commodity futures positions (Adams et al. (2020), Henderson, Pearson, and Wang (2015), and Stoll and Whaley (2010)). Pension and hedge funds have joined this group of large commodity speculators.

Commodity index investments were positive and profitable for a number of years from 2000 until 2010, according to the Barclay commodity trading adviser – *CTA Benchmark Index*. The CTA Benchmark Index peaked around the same time as assets under management in commodity futures peaked (approximately 2011). After this peak there was a degradation in futures returns earned by this class of traders. Could this be due to increased competition for the same source of alpha[2]–a case of more funds using the same approach in the same

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[1] Adams, Collot, and Kartsakli (2020) citing (Haase, Zimmermann, & Zimmermann, 2016) pointed out that the latter examined 100 published papers on the topic of financialization in commodity markets, concluding that as the number of papers finding a positive effect of speculation and the ones finding a negative effect were about the same, the overall picture was rather mixed. Natoli (2021) supports this conclusion as he finds that studies of the market impacts of financialization are mixed.

[2] The excess return of an asset relative to the return associated with the asset's beta is the asset's alpha.

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markets? Cheng and Xiong (2014) found that financialization impacted risk sharing in commodity markets. In addition, they argued that more work is needed to measure whether and how financialization has affected commodity markets. This is precisely the goal in this paper. We are not providing a novel methodology but instead apply an accepted and traditional methodology to two different time periods, before and after financialization.

The question we address in this paper is whether *financialization of futures* has impacted futures market risk premia.[3] Previous studies by Hamilton and Wu (2015) and Main, Irwin, Sanders, and Smith (2018) have addressed a similar question. Hamilton and Wu (2015) found that commodity index-fund investing had no measurable effect on commodity futures prices. Similarly, Main et al. (2018) showed that the average unconditional return to individual commodity futures markets was approximately equal to zero before and since financialization of the markets. However, neither of these studies used a portfolio framework, which is a major drawback because most investors assess the risk and return of any single asset in the context of their portfolio.[4] In addition, this previous work failed to control for changing speculative positions, the importance of which was recognized by Carter, Rausser, and Schmitz (1983)–hereafter CRS and Cootner (1960). In this paper we use a portfolio model and we control for weekly changes in speculative positions. As in Etula (2013), we use a modified capital asset pricing model. We find that the recent poor returns to managed futures trading coincided with a suppressed risk premium.

The structure of the paper is as follows: we start by providing a background on the financialization of commodity futures, which is followed by a literature review (Section 3) on *normal backwardation* since Keynes and its developments. The next section presents the methodology of the paper. Section 5 presents our empirical analysis and Section 6 concludes.

2. Background

The *financialization* of commodity futures refers to the fact that managed money (or institutional funds) investments in commodity futures grew rapidly — i.e., the emergence of commodities as an asset class. Assets under management in commodities grew from less than $50 Billion in the early 2000s to over $300 Billion by 2012. A well accepted measure of the returns to these managed funds is the Barclay CTA Index. This index represents the benchmark performance of hundreds commodity trading advisers[5] and its performance has been rather lackluster since about 2011, see Fig. 1. The index in Fig. 1 shows strong performance from 2000 to the spring or summer of 2009. Subsequently the index more or less flattened out until 2019, the end of our sample in this paper. What explains this flattening of returns?

Fig. 2 provides an annual breakdown of the average performance of managed futures funds, from 2000 to 2019. The funds earned positive returns on average from 2000 through 2008. From 2000 to 2008 the annual average return was 6.7%. Average returns then declined and from 2009 through 2019 the annual average return was only 0.8%, with negative annual returns more frequent than positive annual returns.

Further confirmation that futures have not been generating equity like excess returns is shown in Table 1, which reports 1987–2019 returns for the S&P equity index, the Bloomberg Commodity Index (BCOM), and the 10 year US Treasury yield. Bloomberg's BCOM is calculated as an excess return and it reflects commodity futures price movements. BCOM experienced an annual average return of 5.4% from 1987–2006 and then the performance declined to −1.85% from 2006–2019. The S&P return averaged 10.42% from 1987–2006 and 9.98% from 2006–2019. Even U.S. Treasuries outperformed the BCOM for both time periods shown in Table 1.

Table 1
Alpha decay in commodity futures.
Source: Bloomberg Terminal.

Average yearly returns			
	S&P 500	BCOM index	10-year US Treas. yield
1987–2006	10.42%	5.4%	6.07%
2006–2019	9.98%	−1.85%	2.42%

Table 2
Average weekly trader positions: 2006–2019.
Source: CFTC Supplemental Index Report.

Commodity	Average Net Position (Long - Short): Number of contracts			
	Large speculator	Large hedger	Small trader	Index trader
Wheat	−50,610	−91,930	−14,423	156,963
Corn	46,790	−324,240	−77,324	354,775
Soybeans	34,597	−135,625	−38,051	139,080
Cotton	27,022	−103,222	5,363	70,836
Live cattle	42,667	−124,719	−27,588	109,641
Sugar	19,885	−261,385	15,823	225,676

Traders are classified as large speculators or large hedgers if they hold positions above specific reporting levels set by CFTC regulations. Small traders positions are below this threshold. Reporting levels are found in CFTC Regulation 15.03(b). Index traders includes positions of managed funds, pension funds, and other investors that are generally seeking exposure to a broad index of commodity prices as an asset class in an unleveraged and passively-managed manner. In addition index traders may include swap dealers hedging of over-the-counter transactions involving commodity indices. The index traders category is therefore typically made up of traders with long-only futures positions replicating an index.

For 13 agricultural commodity futures markets, the Commodity Futures Trading Commission (CFTC) publishes weekly data on the relative importance of index trading in a supplemental commodity index report.[6] Six of these thirteen markets make up a portion of the 11 markets analyzed in this paper. The six are SRW wheat, corn, soybeans, cotton, live cattle and sugar. The index trader position data for these six markets are summarized in Table 2, along with average net positions (long–short) for three other CFTC trader categories: large speculators, large hedgers, and small traders. It is important to note that with the exception of live cattle and sugar, the index traders were the dominant group of traders over the 2006–2019 time period.

In order to illustrate the relative stability of index traders' positions compared to large speculators and hedgers, the CFTC weekly data for corn are shown in Fig. 3.[7] The left-hand vertical axes in Fig. 3 reports

[3] An earlier and shorter version of this paper was published in a workshop proceedings book, see Carter and Revoredo-Giha (2022). The proceedings paper studied only five commodity futures contracts (corn, cotton, live cattle, soybeans and wheat), whereas this paper examines eleven commodity futures contracts.

[4] The CAPM framework allows us to use a portfolio approach and Samuelson (1970) provides a defense of this type of mean–variance analysis.

[5] http://bitly.ws/6HVK.

[6] The CFTC explains that: "Index Traders are drawn from the noncommercial and commercial categories. The noncommercial category includes positions of managed funds, pension funds, and other investors that are generally seeking exposure to a broad index of commodity prices as an asset class in an unleveraged and passively-managed manner. The commercial category includes positions for entities whose trading predominantly reflects hedging of over-the-counter transactions involving commodity indices — for example, a swap dealer holding long futures positions to hedge a short commodity index exposure opposite institutional traders, such as pension funds," see https://www.cftc.gov/MarketReports/CommitmentsofTraders/ExplanatoryNotes/index.htm. The 13 markets included in the CFTC supplemental index report include: CBOT SRW wheat, CBOT HRW wheat, CBOT corn, CBOT soybeans, CBOT soybean oil, CBOT soybean meal, ICE cotton, CME lean hogs, CME live cattle, CME feeder cattle, ICE cocoa, ICE sugar No. 11, and ICE coffee.

[7] The CFTC data for the other markets are not shown graphically due to space considerations but their net trader position patterns are consistent with the corn market.

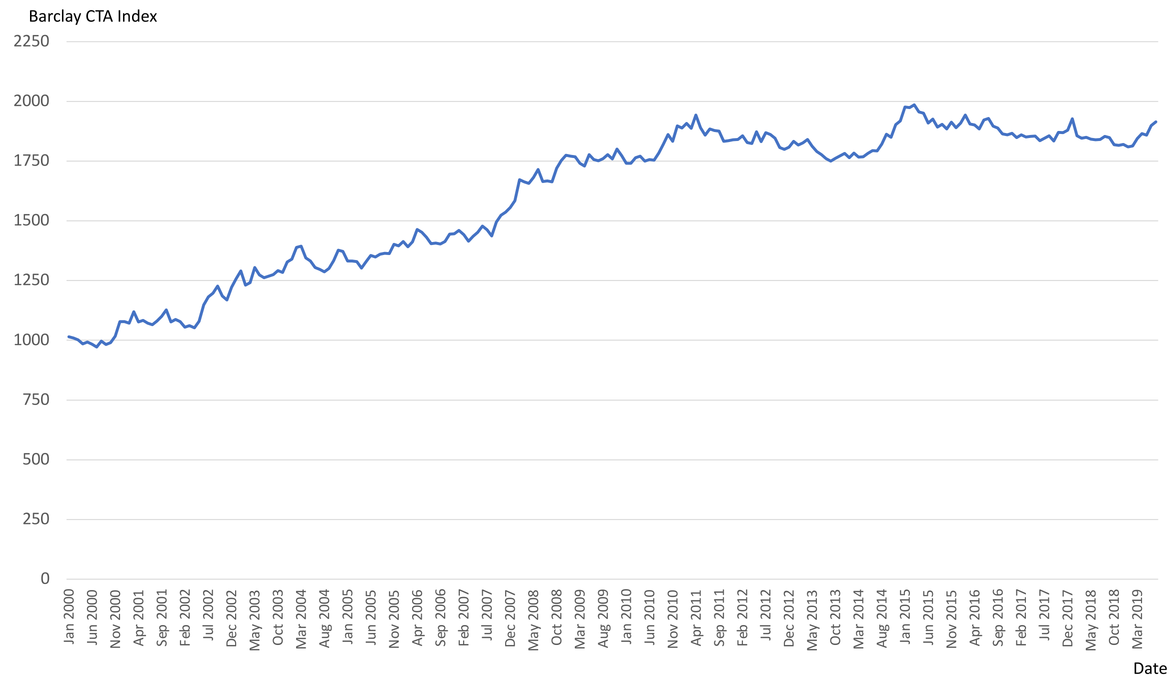

Fig. 1. Barclay CTA Index.
Source: BarclayHedge.

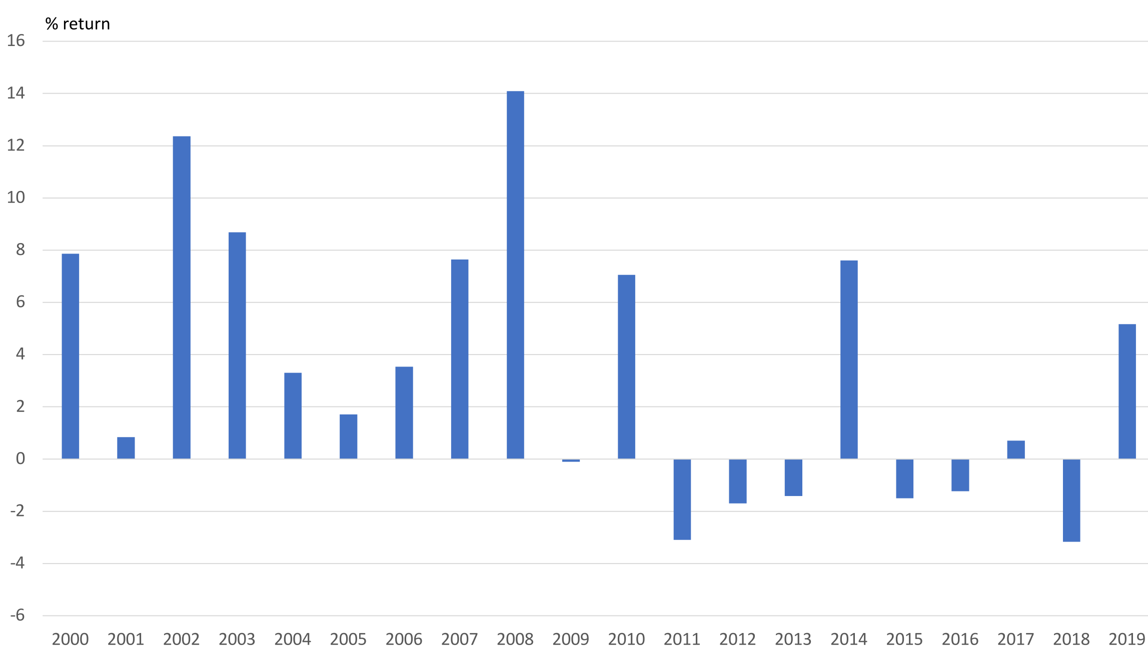

Fig. 2. Managed futures performance.
Source: Barclay CTA Index.

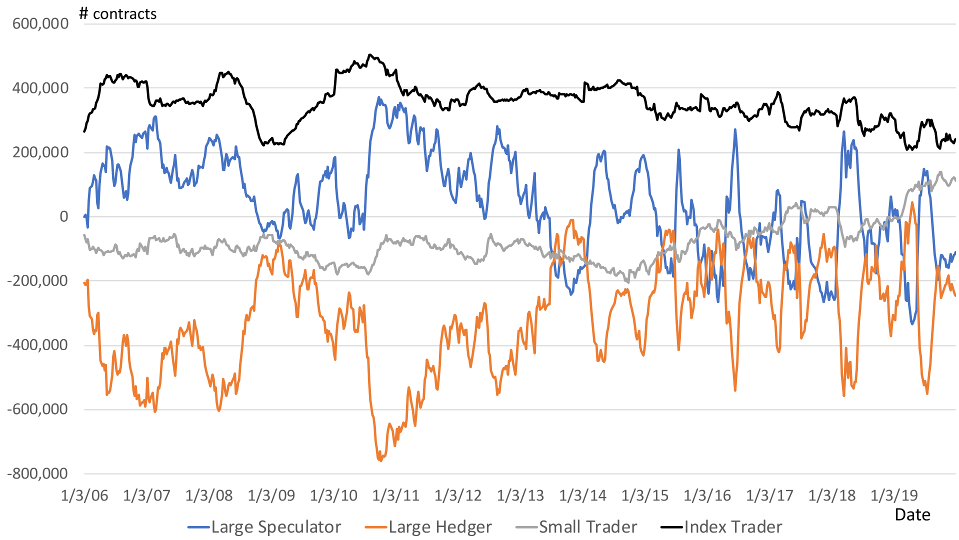

Fig. 3. Index traders large share of the market: CBT Corn 2006–2019.
Source: Commodity Futures Trading Commission, COT Reports.

the net futures positions (long minus short) for four classes of traders reported in Table 2. It is clear from Fig. 3 that index traders are the largest participants in the corn market on average. Unlike other classes of traders, the overall number of contracts held by index traders from week to week does not vary much, which means it is not correlated with the price. In contrast to index traders, there is considerable variation in the large speculative positions and they switch from being net long to net short (crossing the 0 horizontal line). Large hedger positions also range widely.

3. Literature review and conceptual framework

An essay in the Manchester Guardian Commercial in 1923 by Keynes (1923a) initiated the concept of the *theory of normal backwardation.*[8] In his view futures prices are unreliable estimates of the cash or spot price prevailing on the date of expiry of the futures contract. He believed it "normal" for the futures price to be a downward biased estimate of the forthcoming spot price. This theory in effect, argues that speculators sell "insurance" to hedgers and that the market is "normally" inefficient because the futures price is not an unbiased estimate of the subsequent spot price.[9]

Cootner (1960) argued that Keynes' hypothesis implies futures prices should not necessarily rise until after the peak of net short hedging has passed. That is, he interpreted the theory to mean seasonal trends in futures prices should be taken as an indication of a risk premium. Cootner (1960) and Telser (1958) both tested their interpretation of the theory of normal backwardation and obtained conflicting results, even though they used the same data. Cootner found evidence to support the theory of normal backwardation, whilst Telser's conclusions were contrary. However, the problem was essentially assumed away to Telser. He assumed speculators require no remuneration to play the futures market and then went on to conclude they earn no remuneration in a competitive market.

Several other early writers have also tested the validity of the theory of normal backwardation. For a succinct summary of their findings, see Rockwell (1967). Dusak (1973) tested for the existence of a risk premium within the context of the capital asset pricing model (CAPM) and her results suggested that wheat, corn, and soybeans futures contracts are not risky assets whether they are held independently or as part of a larger portfolio of assets.

Conceptually, the equilibrium futures price in relation to the expected spot price at expiry can be characterized by examining the net positions of hedgers and speculators. Hedgers are interested in entering into futures contracts in order to eliminate price risk. If commercial hedgers are typically net short, this means that at any given futures price, hedgers as a group want to sell more contracts than they want to buy as illustrated by the line WX in the left quadrant in Fig. 4. This figure is based on Stoll (1979). The higher the futures price the more contracts they want to sell, and hence WX is downward sloping. Speculators have no interest in entering into futures contracts as a way to reduce risk, instead they enter into futures contracts with the goal of profiting from expected price movements. When the futures price is equal to the expected spot price at expiry, E, speculators as a group will be neither short nor long as there is no potential profit since the expected price change in the futures contract is zero. When the futures price is below the expected spot price at expiry, (the right-hand portion of the line YZ in Fig. 4) speculators will be net long as they anticipate earning a profit from the expected increase in the futures price. Similarly, when the futures price is above the spot price "expected" at expiry, speculators as a group will want to be net short. This is shown by the top portion of the line YZ in Fig. 4.

The futures market will clear only when the total number of short contacts equals the number of long contracts. This market clearing condition along with the net short position of hedgers leads to the futures price equilibrium, B, at a price below the expected spot price (E) at expiry. In Fig. 4, we can see that the equilibrium futures price is at point B and the volume of contracts represented by the net hedgers position, A, equals the speculators net long position, C. This is why, in the view of John Keynes, futures prices are unreliable estimates of the cash price prevailing on the date of expiration of the futures contract. Conceptually, it is our hypothesis that financialization of the markets flattened the YZ line in Fig. 4, which would serve to reduce the risk premium.

CRS (1983) built on Cootner (1960), Dusak (1973), Houthakker (1957), and Telser (1958), and found risk premiums in the futures market. CRS measured returns in a portfolio context, as in the equity

[8] See Cristiano and Naldi (2014) for an interesting analysis of Keynes's own personal speculation in the cotton market as it relates to the theory of *normal backwardation.*

[9] As an aside note, it is not surprising that the insurance explanation behind backwardation appealed to Keynes as he was a director of the Provincial Insurance Company from 1923 until his death. It is also interesting that although he was well aware of the operations of different commodity markets as evidenced by Keynes (1923b), the only empirical information presented in Keynes (1923a) is a calculation based on cotton futures markets.

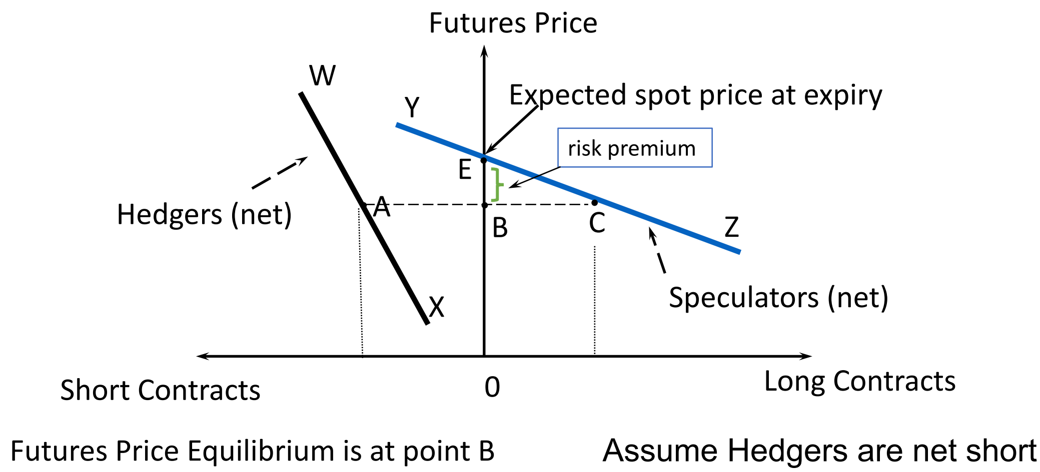

Fig. 4. Theory of normal backwardation.
Source: Hans Stoll, 1979.

risk premium literature that focuses on portfolios of stocks instead of individual securities. With this framework, futures returns depend on movement with the market — systematic risk (β) and idiosyncratic risk (α).

CRS found commodities in which hedgers were net short had positive excess returns on average and commodities in which hedgers were net long had negative excess returns on average — supporting (Cootner, 1960) that speculative pressure matters. CRS estimated non-market and systematic risk as time-varying parameters to evaluate seasonal changes in investors' positions and they modified Dusak's choice of the investor's portfolio.

CRS not only found evidence of systematic risk, but more importantly, they found evidence of *non-systematic risk* that varied seasonally. Marcus (1984) criticized CRS for over-weighting commodities in the well-diversified portfolio and showed that with a reduced weighting the hypothesis of zero systematic risk cannot be rejected. This critique is essentially a restatement of the Dusak result, and it assumes that a portfolio comprised of only equities is optimal. However, importantly the CRS finding of seasonality of non-market risk is independent from the debate over how much weight to give commodities in the investor's portfolio. Their finding of time-varying non-market risk encouraged subsequent work to apply more general non-static models of the pricing of futures contracts. For instance Fama and French (1987) also tested for a time-varying risk premium in futures prices. Bessembinder (1992), Chang (1985) and De Roon, Nijman, and Veld (2000) confirmed futures risk premia are related to market risk and hedging pressure. Erb and Harvey (2006), and Gorton, Hayashi, and Rouwenhorst (2012) further linked the commodity futures risk premium to backwardation in commodity futures and the theory of commodity storage.

Bhardwaj, Gorton, and Rouwenhorst (2016), and Gorton and Rouwenhorst (2006) studied monthly returns to commodity futures as an asset class. Their data set went back as far as the 1950s. They conclude that commodity futures have offered the same return and as publicly traded U.S. stocks, adjusted for the risk free return equities. Furthermore they found commodity futures returns are negatively correlated with stock returns and bond returns. The negative correlation arises from commodity futures different behavior over a business cycle because commodity futures are positively correlated with inflation. Implicit in this finding is the implication that speculators in commodity futures receive a return for providing price insurance to hedgers.

Bhardwaj, Janardanan, and Rouwenhorst (2019)-BJR found that futures prices have on average been set at a discount to future spot prices by about 5% (1871–2018 data). Of the contracts that survived longer than 50 years, 91% earned a positive risk premium. BJR found that of the 230 contracts in their sample, 58% earn a positive lifetime "buy-and-hold" risk premium when they rolled expiring contracts forward over time, and the median geometric average premium across commodities was 1.5%.

Tang and Xiong (2012) found the price behavior of index commodities has become different from those of nonindex commodities — with index commodities becoming more correlated with crude oil and equities. The intuition is that institutions that entered these commodity markets have linked them together, as well linked them to the stock market, through cross-holdings in their portfolios. In a study of 12 agricultural commodity futures, Hamilton and Wu (2015) found commodity index-fund investing had no measurable effect on commodity futures prices (using 1990–2014 data). Henderson et al. (2015) analyzed the effect of hedging over-the-counter (OTC) commodity linked notes (CLNs). The CLNs have a payoff linked to the price of a single commodity, commodity futures contract, commodity index, or basket of commodity futures. Investor flows into and out of CLNs are passed to and withdrawn from the futures markets via issuers' trades to hedge their CLN liabilities. Although, their flows are not based on information about futures price movements, their finding were consistent with the hypothesis that non-information-based financial investments have significant impacts on commodity prices. Main et al. (2018) found the average unconditional return to 19 individual agricultural and energy futures markets was approximately equal to zero before and since financialization (using 1961–2014 data). Controlling for the importance of liquidity provision in the commodities market, Kang, Rouwenhorst, and Tang (2020) find an empirical relationship between hedging pressure and expected futures risk premiums. However, as mentioned above, these papers treat commodities as individual assets instead of being part of a balanced portfolio that includes equities and other commodities. Using a portfolio approach, the purpose of this paper is to explore whether financialization affected the systematic and idiosyncratic risks associated with futures contracts.

4. Methodology

As explained above, CRS provided theoretical and empirical evidence to support the notion that the nonmarket rate of return is a stochastic variable that is a function of net hedging pressure. This generalizes the Keynesian theory of normal backwardation to allow for variable traders' positions. For completeness and to clarify the model, we provide the derivation of the estimation model. The starting point of the model is Dusak's empirical equation for an individual asset j based on the CAPM:

$$R_{jt} = \alpha + \beta x_{jt} + \epsilon_{jt} \quad (1)$$

where: R_{jt} is the asset return for futures contract j during period t,[10] x_{jt} is the market index minus the risk-free interest rate, α is the pooled non-market risk (averaged across all contracts for a specific commodity), β is the asset's pooled systematic risk, and ϵ_{jt} is the error term, assumed to be with mean 0 and variance equal to σ_{ϵ}^2 and uncorrelated with x_{jt}.

The reason why the CRS model is used as the basis of this paper is twofold: First, it should be noted that despite the criticisms found in the literature regarding the CAPM, Berk and Van Binsbergen (2016) tested a set of candidate models to establish the model that is closest to the asset pricing model that investors use. They compared the CAPM against reduced form factor models and dynamic equilibrium models. They found that CAPM was closest to the model that investors use to make capital allocation decisions. Moreover, the CAPM does a better job of explaining returns than no model at all, indicating that investors do price risk. A very similar result was obtained by Barber, Huang, and Odean (2016). Second, we note that the model in the CRS paper is an improved version of the CAPM model, which considers the parameters of the CAPM model to be stochastic and affected by net speculative positions.

There are no *a priori* reasons why α and β are deterministic, therefore, we assume that both terms are stochastic and dependent of the net market position of large speculators, Z_t. Eq. (1) becomes Eq. (2), where * indicates that the coefficients are stochastic.

$$R_{jt} = \alpha^* + \beta^* x_{jt} + \epsilon_{jt} \tag{2}$$

The coefficients α^* and β^* are defined as in Eqs. (3) and (4).

$$\alpha^* = \alpha + \delta Z_t + e_{jt} \tag{3}$$

$$\beta^* = \beta + \gamma Z_t + \upsilon_{jt} \tag{4}$$

where e_{jt} and υ_{jt} are error terms. The x_{jt} variable represent first differences of the natural logarithms of the market index (the S&P and DJ&C indices weighted equally) minus the ninety-day Treasury Bill rate converted to a weekly interest rate.[11]

Note that $\alpha^* = \alpha + \delta Z_t$ is the expected value of the non-market component of a futures contracts' excess return, and $\beta^* = \beta + \gamma Z_t$ is the expected value of the systematic component of a futures contracts' excess return. Thus, the total return to holding a futures contract is made up of two components. The first is the excess return and the second is the systematic risk based on the asset's covariance with the market index. Hedging pressure can influence both of these components of return. Inserting Eqs. (3) and (4) into (1) gives our empirical model shown as Eq. (5).

$$R_{jt} = \alpha + \delta Z_t + \beta x_{jt} + \gamma Z_t x_{jt} + \mu_{jt} \tag{5}$$

where $\mu_{jt} = \epsilon_{jt} + x_{jt}\upsilon_{jt} + e_{jt}$. Assuming that $E(e_t, \mu_t) = 0$, $E(\upsilon_t, \mu_t) = 0$, $\text{var}(e_t) = \sigma_e^2$, $\text{var}(\upsilon_t) = \sigma_\upsilon^2$, and $\text{cov}(e_t, \upsilon_t)$, the variance of μ_t is given by (6):

$$var(\mu_{jt}) = \sigma_\epsilon^2 + x_{jt}^2 \sigma_\upsilon{}^2 + \sigma_e^2 + 2x_{jt}\sigma_{e\upsilon} \tag{6}$$

Our data set consists of weekly observations of 11 commodity futures contracts over the period from January 1986 to July 2019. Each futures contract with a specific delivery month over this time period was included in our data. For instance, corn futures have five different delivery months (March, May, July, September and December). Our data set consists of each of the March corn contracts over the 1986 to 2019 time period, each of the May corn futures contracts, and so on.

We define Z_t = (non-commercial longs)/(non-commercial longs + non-commercial shorts), sourced from Commodity Futures Trading Commission: Commitment of Traders (COT) weekly reports: January 1986–July 2019. When $Z_t = 0.5$ speculators are neither long nor short on net; when $Z_t > 0.5$ speculators are net long; and when $Z_t < 0.5$ speculators are net short. Therefore, Z_t represents the percentage of reporting speculators that were net long, and lies in the interval between zero and one.

Figs. 5 and 6 show the Z_t index plotted against crude oil and wheat futures prices, respectively. To conserve space, the relationship between Z_t and the commodity price is only shown for these two representative contracts.[12] Interestingly the data reported in Figs. 5 and 6 show the Z_t index for crude oil and wheat was more variable before financialization compared to after. In the case of crude oil the Z_t index also trended upward with financialization.

As pointed out in CRS the error term of Eq. (1) is a function of the errors from the nonmarket α^* and systematic β^* components of the futures contracts (i.e., they are heteroskedastic) and therefore the equation is estimated using generalized least squares.

5. Analysis

Summary statistics for the weekly returns for all futures contracts studies are presented in Table 3. The number of observations (N) is reported in the second column. Column three reports the average returns over the entire time period studied and column four reports the one period return autocorrelation (ρ). Columns five and six report the average Z values, and the average x (i.e., market index) minus the riskless interest rate.

The unconditional mean weekly returns for copper, live cattle, soybeans and crude oil are positive and statistically significant from zero. Alternatively the average returns for corn, natural gas, and wheat are negative and statistically significant. Returns for the other four markets (cotton, gold, silver, and sugar) are not statistically different from zero.

As in De Roon et al. (2000), the last two columns of Table 3 present the estimated slope coefficient of two simple regressions of weekly returns on the market index (the θ) and on the Z_t (the ϕ).[13] About one-half of the markets have a significant θ, indicating these commodity markets exhibit evidence of systematic risk. Furthermore, from Table 3 it is interesting that each market has a statistically significant ϕ. This suggests there is a potential statistical relationship between futures returns and the net position of speculators.

Table 4 presents the results from the generalized least squares estimation of Eq. (5). As in Hamilton and Wu (2014), and Main et al. (2018) we estimate the same model over two different time periods. In Table 4 we report the regression results separately for the periods *before* (1986–2006) and *after* (2007–2019) the financialization period. The Davidson and MacKinnon (1989) test was carried out to explore the potential exogeneity of the regressors with respect to the error term.[14] All the tests failed to reject the null hypothesis of exogeneity.

Looking at Table 4, for both the *before* and *after* periods, we find that silver is the only commodity without a statistically significant systematic risk coefficient (β) in either of the two time periods. If a commodity has no systematic risk then any returns above zero will be due to idiosyncratic (or nonsystematic) risk only (i.e., excess returns).

[10] R_{jt} is interpreted as net of the risk-free rate. In other words, it is interpreted as the risk premium on the spot commodity, i.e., $R_{jt} - R_f$, where R_f is the risk-free interest rate.

[11] We tested the robustness of the results to different combinations of weights for the S&P and DJ&C indices, by computing the correlation of different weights. If we consider the series used for the estimation (50/50) the correlations with (90/10) is 0.9924 and with (75/25) is 0.9960. We therefore conclude that the results are robust to the choice of weights.

[12] Figs. 5 and 6 show data from 1993 as that is when the CFTC shifted from bi-weekly to weekly COT reports.

[13] The t-values in Table 3 are based on heteroskedasticity-consistent standard errors.

[14] Minten and Barrett (2008) also used the Davidson and MacKinnon (1989) approach to test for endogeneity.

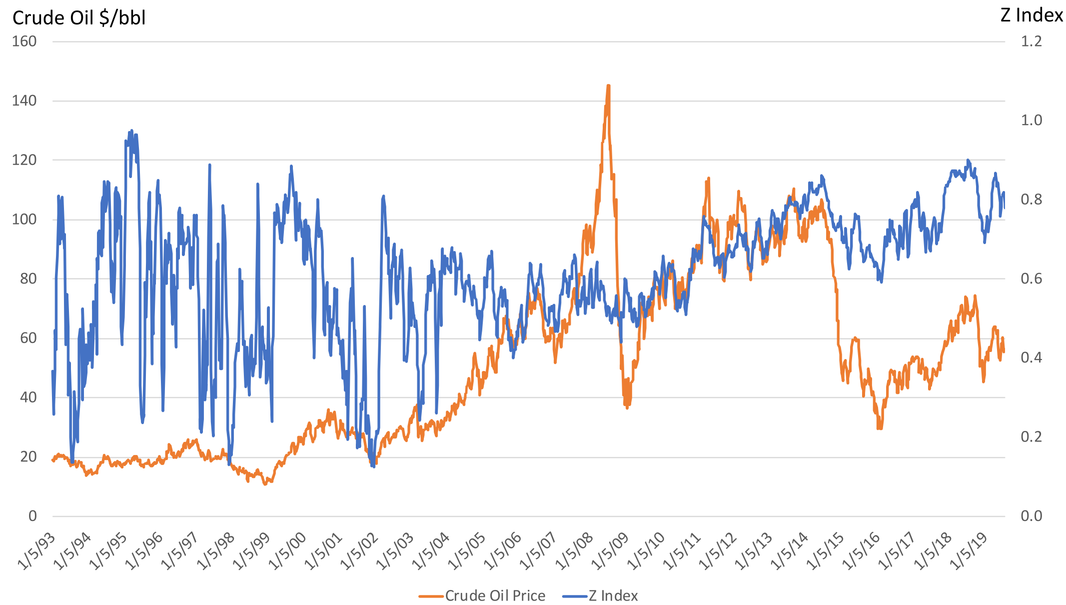

Fig. 5. Crude oil futures and Z Index.
Source: barchart.com and CFTC.

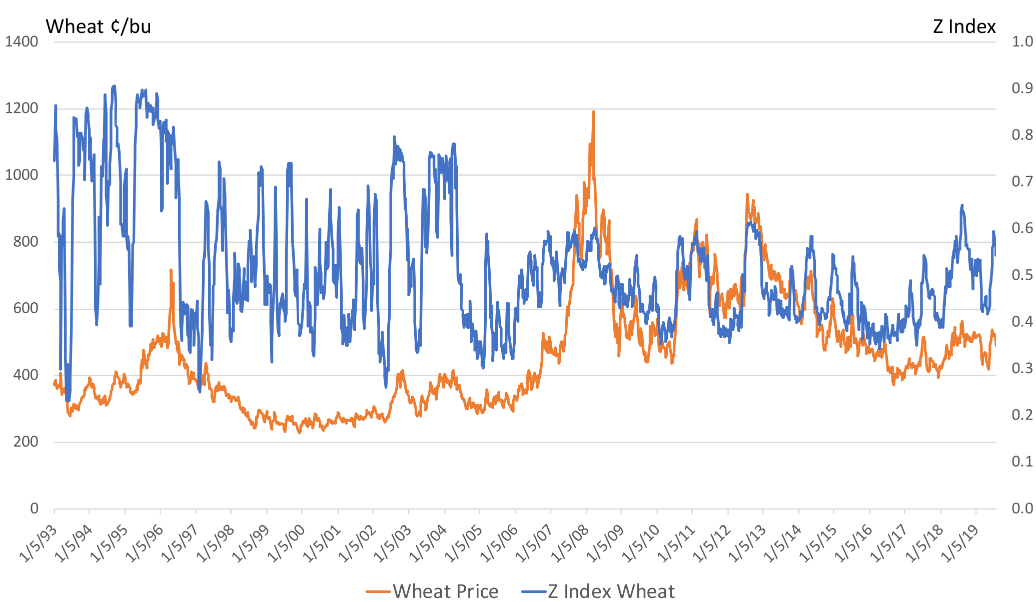

Fig. 6. CBOT wheat futures & Z Index.
Source: barchart.com and CFTC.

Across the various commodities, there is no clear pattern as to whether or not systematic risk is lower or higher after financialization.

The γ estimates in Table 4 suggest that for commodities characterized by systematic risk, the degree of systematic risk may be impacted by the Z value. Across all commodities studied the β and γ statistically significant coefficients have opposite signs. Since the net long position of speculators increases with Z, this finding suggests that an increase in speculative buying will tend to reduce the systematic risk, *ceteris paribus*. In other words, increased financialization has tended to reduce the systematic risk component of futures returns.

The nonmarket rate of returns measure (α) and its systematic change associated with net speculative positions (δ), go directly to the question of whether or not there is a Keynesian risk premium. We find the estimated α and δ values are almost all significantly different from zero and the δ values tend to be roughly twice as large as the α values and they tend to have the opposite sign (see Table 4). It is also noteworthy that the estimated α and δ values are different in the before/after time periods.

These α and δ results provide an interesting interpretation of the Cootner hypothesis. Recall that the value of $\alpha^* = \alpha + \delta Z_t$, represents the expected value of the nonmarket component of a futures contract's return, i.e., the *risk premium*. When Z_t is equal to 0.5, the net position of speculators is neither long nor short; and the results in Table 4 suggest that the nonmarket returns are near zero. When $Z_t > 0.5$, speculators are net long and the rate of return is greater than the amount predicted by the market model. Similarly, when $Z_t < 0.5$, speculators are net short, and there are negative returns in excess of the market return. Therefore our findings provide support for the Cootner hypothesis of the existence of a degree of normal backwardation in the commodity futures market, given an appropriate interpretation of the net position of speculators.

Table 3
Summary statistics: Commodity returns.

Commodity		Returns		Z	x		Bivariate model	
	N	Avg.	ρ^2	Avg.	Avg.	ρ(x, Z)[3]	θ^4	ϕ^5
Copper	19,483	0.0014*	−0.0653	0.55*	−0.05*	−0.05	−0.0058*	0.013*
Corn	8,810	−0.0009*	0.2308	0.63*	−0.06*	−0.03	0.0016	0.014*
Cotton	8,732	−0.0002	0.2202	0.56*	−0.06*	0.08	0.0003	0.014*
Natural gas	16,970	−0.0012*	−0.0965	0.46*	−0.05*	−0.12	−0.0001	0.017*
Gold	11,086	0.0003	−0.0035	0.59*	−0.06*	0.25	0.0048*	0.007*
Live cattle	10,485	0.0006*	0.1804	0.63*	−0.06*	0.05	−0.0052*	0.010*
Silver	10,491	−0.0001	0.0446	0.73*	−0.06*	0.06	0.0043	0.011*
Soybeans	12,335	0.0004*	0.2109	0.64*	−0.06*	0.05	0.0030*	0.012*
Sugar	6,866	0.0001	0.1120	0.67*	−0.06*	−0.04	−0.0159*	0.013*
Wheat	8,812	−0.0008*	0.2223	0.54*	−0.06*	−0.11	−0.0029	0.015*
Crude oil	18,135	0.0007*	−0.0462	0.57*	−0.05*	0.16	−0.0224*	0.006*

Notes
1. One lag autocorrelation of returns.
2. Correlation between x and Z.
3. Slope of a regression of the futures returns on the x variable.
4. Slope of a regression of the futures returns on the Z variable.
*Stands for statistically different than zero at 95% significance.

Table 4
Regression results.

	α	β	δ	γ
Copper 86–06	−0.0058*	0.015*	0.010*	−0.018
Copper 07–19	−0.0093*	0.032*	0.013*	−0.089
Corn 86–06	−0.0062*	0.026*	0.010*	−0.032*
Corn 07–19	−0.0030*	0.039*	0.002*	−0.069*
Cotton 86–06	−0.0055*	0.027*	0.012*	−0.0360
Cotton 07–19	−0.0102*	0.052*	0.014*	−0.060*
Natural Gas 86–06	−0.0024*	0.0300*	0.009*	−0.032*
Natural Gas 07–19	−0.0205*	−0.155*	0.052*	0.4530*
Gold 86–06	−0.0058*	−0.0031	0.0114*	−0.0244
Gold 07–19	−0.0093*	0.0660*	0.0134*	−0.1099*
Live Cattle 86–06	−0.0054*	−0.006*	0.011*	0.0080
Live Cattle 07–19	−0.0121*	−0.022*	0.022*	0.0450*
Silver 86–06	−0.0082*	−0.0103	0.0143*	0.0444
Silver 07–19	−0.0147*	0.0190	0.0206*	−0.0182
Soybeans 86–06	−0.0005	0.040*	0.005*	−0.035*
Soybeans 07–19	−0.0156*	−0.007	0.024*	0.0120
Sugar 86–06	−0.0048*	0.0064	0.0077*	−0.0142
Sugar 07–19	−0.0204*	−0.1000*	0.0263*	0.1052*
Wheat 86–06	−0.0052*	0.015*	0.010*	−0.018
Wheat 07–19	−0.0104*	0.032*	0.013*	−0.089
Crude Oil 86–06	−0.0066*	−0.0074	0.0188*	0.0151
Crude Oil 07–19	0.0049*	0.2203*	−0.0066*	−0.313*

*Note: Denotes statistical significance at the 95% level.

Table 5
Annualized excess futures returns before & since 2007.

Commodity	Average			
	Z Before	Z Since	Return Before	Return Since
Copper	0.60	0.48	21.8%	−2.0%
Corn	0.62	0.65	−0.2%	−8.7%
Cotton	0.50	0.67	2.4%	−5.6%
Natural gas	0.53	0.37	12.5%	−5.4%
Gold	0.49	0.76	1.8%	−0.9%
Live cattle	0.62	0.65	6.2%	9.4%
Silver	0.73	0.72	11.6%	0.6%
Soybeans	0.62	0.67	12.5%	3.3%
Sugar	0.68	0.66	2.5%	−16.7%
Wheat	0.58	0.47	0.3%	−16.4%
Crude oil	0.51	0.66	15.3%	2.7%
Mean	0.59	0.61	**7.5%**	**0.7%**

Note: Expected value of the non-market component of a futures contracts' excess return, $\alpha^* = \alpha_j + \delta_j \tilde{Z}_t$.

Figs. 7 to 9 present different graphical views of the estimated α and δ coefficients from Eq. (5). As shown in Table 4, the estimated α and δ coefficients in all cases are statistically different from zero, with the exception of the soybeans α in the before period. With one exception, all of the commodities have statistically significant values of α that are negative and statistically significant values of δ that are positive.

Fig. 7 shows the before and after α coefficients, and Fig. 8 shows the before and after δ coefficients. The 45-degree line in these two figures indicates no change in the parameters across the two time periods. Fig. 7 shows that all the commodities, except crude oil, are characterized by negative values of α in both periods. Most of the commodities (except for corn and crude oil) show a decrease in the value of α (i.e., the coefficient became more negative). In the case of corn, the value α increased after financialization, although it remained negative. For crude oil the α value increased and became positive. However, both the α and δ crude oil coefficients switched signs after financialization, preserving the inverse relationship between these two coefficients.

The values of δ in Fig. 8 mimic what we observe for the case of α in Fig. 7 but in a reverse way. All of the commodities show an increase in the value of δ, except for corn and crude oil.

Fig. 9 presents α and δ pairs for the two sub periods. The Figure shows a clear change in the distribution of the coefficients. However it is important to note that the α and δ relationship is preserved in the after period, it is just shifted. After 2007, the pairs of coefficients moved in the north-west direction, indicating that they all became larger in absolute value, with the exception of corn and crude oil. The net effect of the shift is that the values of $\alpha^* = \alpha + \delta Z_t$ were reduced.

Table 5 reports estimates of the annualized non-market component of excess futures returns before and since 2007. The table shows a significant decrease in the average non-market returns to speculators after 2006 from 7.5% to 0.7%. For instance, copper returns declined from 21.8% to −2.0%. At the same time, crude oil returns declined from 15.3% to 2.7%. Live cattle was the only commodity to experience an increase in returns, from 6.2% to 9.4%. These result provides evidence supporting the view that the scale of financialization was large enough to reduce the historical risk premiums in commodity futures markets when considering several commodity markets. The lower risk premiums serve to benefit futures market hedgers.

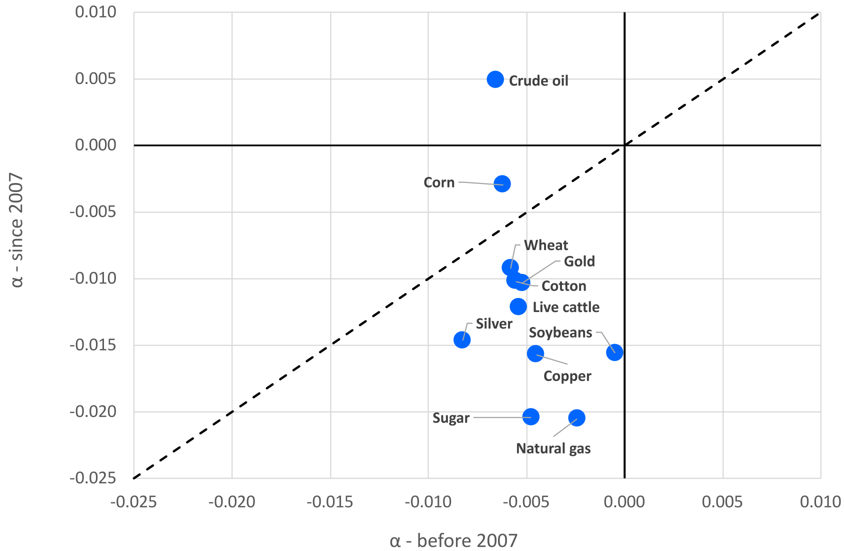

Fig. 7. Alpha-Alpha relationship.

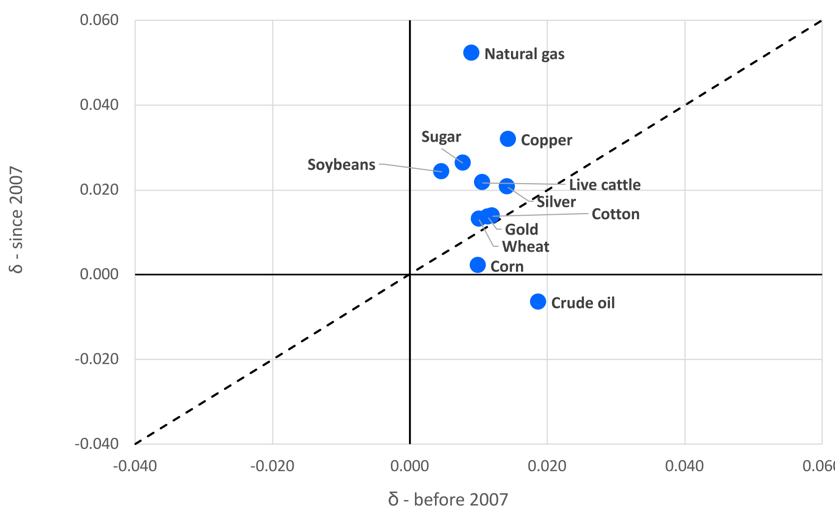

Fig. 8. Delta-Delta relationship.

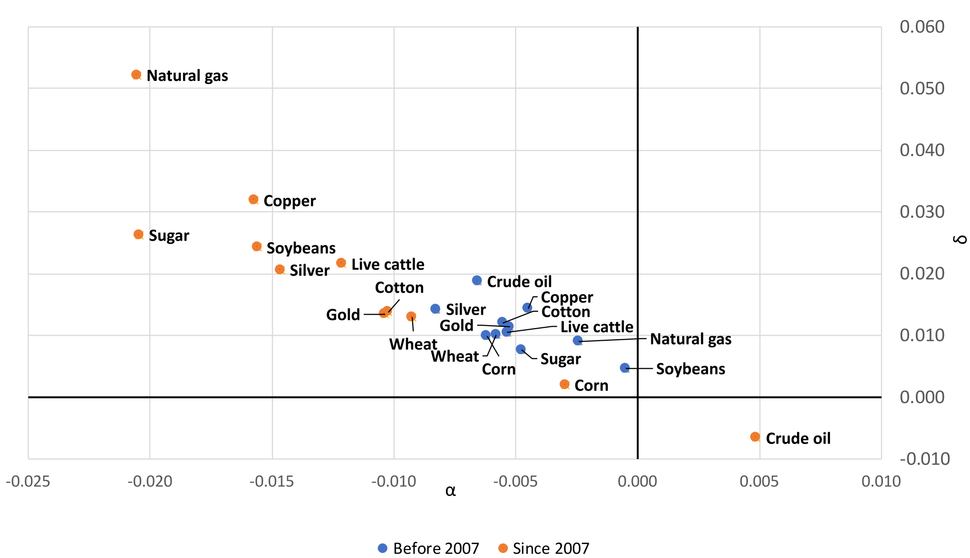

Fig. 9. Alpha-Delta-before/since.

6. Conclusion

The popularization of commodities as an investment is commonly referred to as the *financialization* of commodity futures markets. In the early 2000s, investors were attracted to commodity futures as a new asset class. The investors were informed that commodities provided stock like returns, with the added advantage of a low correlation with stocks and bonds. Hundreds of billions of dollars then flowed into the commodities market. Large institutional investors generally gained long exposure to commodities through direct holdings of futures contracts as well as the use of over-the-counter derivatives and swaps. The returns to this asset class initially performed well, but then peaked in about 2011. Since then, the investment benefits have not turned out as promised. For instance, $10,000 invested on August 2010 in one of the larger commodity index funds – the United States Commodity Index Fund (USCI) – was worth less than $8000 in January 2020.

There has been discussion in the literature whether the scale of financialization was large enough to reduce the historical risk premiums (due to normal backwardation) in commodity futures markets. Our results for eleven commodities provides evidence supporting the view that risk premia declined after 2007, with increased financialization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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