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Financialization and the returns to commodity investments

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ABSTRACT

Commodity futures investment grew rapidly after their popularity exploded—along with commodity prices—in the mid-2000s. Numerous individuals and institutions embraced alternative investments for their purported diversification benefits and equity-like returns. We investigate whether the "financialization" of commodity futures markets reduced the risk premiums available to long-only investors in commodities. While energy futures markets generally exhibit a decline in risk premiums after 2004, premiums in all but one non-energy futures market actually increased over the same time period. Overall, the average unconditional return to individual commodity futures markets is approximately equal to zero before and after financialization.

1. Introduction

Several influential studies published in the last 15 years (e.g., Gorton and Rouwenhorst, 2006) concluded that long-only commodity futures investments generate equity-like returns.[1] This undoubtedly contributed to the rise of commodity futures from relative obscurity to a common feature in today's investing landscape. Blue-ribbon investment companies now view commodities as a potentially valuable alternative investment that should be considered in any serious discussion about the portfolio mix for investors. These investments include commodity index funds, commodity-linked notes, and Exchange Traded Funds (ETFs), all of which track broad commodity indices as well as those focused on particular market segments or individual commodities. Large institutional investors generally gain long exposure to commodities through direct holdings of futures contracts as well as the use of over-the-counter derivatives and swaps.

The popularization of commodities as an investment is commonly referred to as the "financialization" of commodity futures markets (e.g., Tang and Xiong, 2012). The magnitude of the financialization wave since the mid-2000s certainly was impressive in its scale. For example, the U.S. Commodity Futures Trading Commission (CFTC) estimates that commodity index investments in U.S. and non-U.S. futures markets totaled \$144.4 billion as of December 31, 2014, a very large figure by historical standards.[2] There has been much discussion whether the scale of financialization was large enough to reduce the historical risk premiums in commodity futures markets.

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[1] Earlier studies also found evidence of positive returns to commodity futures portfolios (e.g., Bodie and Rosansky, 1980; Fama and French, 1987; Greer, 2000).

[2] *Index Investment Data* report for December 31, 2014: http://www.cftc.gov/ucm/groups/public/@marketreports/documents/file/indexinvestment1214.pdf.

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The traditional Keynesian theory of normal backwardation predicts that long speculators in commodity futures earn a risk premium from short hedgers in the form of an embedded downward bias in futures prices before maturity. Theoretical models developed by Acharya et al. (2013), Etula (2013), Brunetti and Reiffen (2014), Hamilton and Wu (2015), and Basak and Pavlova (2016) demonstrate how buying pressure from commodity investors can exert downward pressure on risk premiums, or equivalently, upward pressure on commodity futures prices before expiration. Hamilton and Wu (2014) report empirical evidence in the crude oil futures market of a decline in risk premiums when comparing 1990–2004 with 2005–2011. The timing of the change in premiums observed by Hamilton and Wu is consistent with the start of the financialization wave of commodity investments around 2004 (e.g., Tang and Xiong, 2012). To the best of our knowledge, this is the only evidence to date of a reduction in risk premiums consistent with the prediction of theoretical models.

The purpose of this paper is to provide a comprehensive analysis of the impact of financialization on risk premiums available to long-only investors in commodity futures markets. We first use the cost-of-carry model for storable commodity prices to show how long returns are driven by risk premiums. We next use daily futures prices for 19 commodity futures markets over January 1961–December 2014 to determine whether financialization pressures drove risk premiums downward in recent years. While energy futures markets generally exhibit a decline in risk premiums after 2004, premiums in all but one non-energy futures market actually increased over the same time period. Overall, the average unconditional return to individual commodity futures markets is approximately equal to zero before and after financialization.

1.1. *Risk premiums and the cost-of-carry model*

We focus on the underlying dynamics of commodity futures prices at the individual market level. The "cost-of-carry" model is a well-developed theoretical framework for pricing storable commodities (e.g., Pindyck, 2001). We use the same version of cost-of-carry model as in Bessembinder et al. (2016) to analyze the expected behavior of returns in commodity futures markets.[3] To begin, let P_t represent the spot price at date *t*, $F_t(m)$ represent the futures price at date *t* for delivery at $t + m$, and C_t is the per period cost-of-carry which includes interest and other storage costs. The basic no-arbitrage cost-of-carry relationship between spot and futures prices can be expressed as follows,

$$F_t(m) = P_t e^{C_t m}. \tag{1}$$

Using (1), the market-implied cost-of-carry per period can be expressed in terms of the relative price of a distant futures contract (delivery date $t + n$) and a nearby futures contract (delivery date $t + m$),

$$C_t = \frac{ln\left[\frac{F_t(n)}{F_t(m)}\right]}{(n - m)} \tag{2}$$

where C_t consists of forgone interest (r_t), physical storage costs (c_t), and the convenience yield (y_t) associated with having stocks on hand, such that $C_t = r_t + c_t - y_t$. As noted earlier, C_t normally is dominated by interest and physical storage costs (r_t+$c_t > y_t$) in which case the futures market is in a normal carry or contango ($F_t(n) > F_t(m)$ and $C_t > 0$). Other times, the convenience of having stocks on-hand dominates such that (r_t+c_t y_t) in which case the futures market is inverted ($F_t(n) < F_t(m)$ and $C_t < 0$). In all cases, the cost-of-carrying inventory is revealed by the term structure of the futures market.[4]

The return on the spot commodity net of storage costs can be expressed as

$$U_{t+1} = ln\left[\frac{P_{t+1}}{P_t e^{C_t}}\right] = \pi + \varepsilon_{t+1}. \tag{3}$$

Bessembinder et al. (2016) call U_{t+1} the *ex post* premium. It has two components: (i) the *ex ante* risk premium (π), which is the return that holders of the commodity expect to earn as compensation for risk, and (ii) the *ex post* price shock (ε_{t+1}), which includes unforeseen supply and demand shocks. The forces of arbitrage imply that *ex post* price shocks should average zero, and therefore, the *ex post* premium is, on average, determined by the risk premium.[5] For example, if traders expect demand for the commodity to increase in the future, then they will hold some of the commodity off the market to store in anticipation of higher future prices. This action will cause current prices to rise and eliminate any excess returns from storage.

Equations (1)–(3) can be used to express the continuously compounded returns to holding spot and futures positions,

[3] The Bessembinder et al. (2016) version of the cost-of-carry model is found in the appendix to their paper.

[4] There is an important exception to this result. Garcia et al. (2015) show that the futures term structure provides a downward-biased measure of the cost-of-carrying inventory when the market price of physical storage exceeds the maximum storage rate allowed by the delivery terms of the futures market. This situation actually occurred frequently over 2006–2010 for grain futures markets, and Garcia et al. show how this explains the much-discussed episodes of non-convergence that plagued the markets during this time period.

[5] Formally, this statement applies to the mean of the exponential rather than the level of U_t. In a rational expectations equilibrium, the expected price next period equals the current price plus the price of storage and the *ex ante* risk premium, i.e., $E(P_{t+1}) = P_t e^{\pi + C_t}$, which implies $E(e^{U_{t+1}}) = e^{\pi}$ and, from Jensen's inequality, $E(U_{t+1}) < \pi$.

$$ln\left[\frac{P_{t+1}}{P_t}\right] = U_{t+1} + C_t \tag{4}$$

$$ln\left[\frac{F_{t+1}(m-1)}{F_t(m)}\right] = U_{t+1} + (m-1)\Delta C_{t+1} \tag{5}$$

where $\Delta C_{t+1} = C_{t+1} - C_t$. The gross return to the holder of the cash or spot commodity in (4) is the sum of the *ex post* premium, U_{t+1}, and the market-implied cost-of-carrying the inventory, C_t. From (5), the return to a long futures position is the sum of the *ex post* premium, U_{t+1}, and the 1-period *change* in the cost-of-carrying the inventory, ΔC_{t+1}.

Equations (4) and (5) yield four important predictions regarding returns in storable commodity markets. First, if there is a risk premium ($\pi \neq 0$), it appears in both the spot and futures returns. Different risk premiums in spot and futures prices would be a violation of no-arbitrage conditions. Second, if there is no risk premium ($\pi = 0$) and carrying costs are static ($\Delta C_t = 0$), then cash prices will change by exactly those carrying costs (C_t) and futures returns are determined entirely by *ex post* price shocks. Carrying costs are incorporated in the period *t* futures price, $F_t(m)$, so they are not a component of the return from period *t* to *t*+1.

Third, the futures returns in (5) are not determined by the carry term structure of the futures markets or the *level* of C_t, as previously argued by Burton and Karsh (2009), Sanders and Irwin (2012), Bhardwaj et al. (2015), and Bessembinder et al. (2016).[6] In other words, the futures return is not a function of whether the futures market is in contango ($C_t > 0$) or backwardation ($C_t < 0$). This result does not preclude the possibility that C_t may serve as a signal for a time-varying risk premium (Gorton et al., 2013), but it does rule out a direct one-to-one connection between the level of C_t and futures returns, which is often assumed by investment practitioners.

Fourth, the return on a long futures position is affected by the *change* in the cost-of-carrying the inventory, ΔC_t. An increase in carrying costs ($\Delta C_t > 0$)—or a market moving into a greater contango—will generate positive futures returns and a decrease in carrying costs ($\Delta C_t < 0$)—or a market moving into an inverted structure—will generate negative futures returns. This result is somewhat counterintuitive, but it is important to highlight that random shocks and risk premiums occur in both spot and futures prices.[7] So, for a given spot price, an increase in carry costs ($\Delta C_t > 0$) necessitates a higher futures price (or positive futures returns). Conversely, for a given spot price, a decrease in carry costs ($\Delta C_t < 0$) results in a lower futures price (or negative futures returns).

1.2. *Financialization and risk premiums*

To investigate whether financialization pressures have driven risk premiums downward since the mid-2000s, we use daily futures data for a cross-section of 19 storable commodity futures markets over January 1961 through December 2014. If financialization pressures drove risk premiums in recent years, this effect should be evident across the spectrum of commodity futures markets. The commodities include New York Mercantile Exchange (NYMEX) energy and metals markets (WTI crude oil, RBOB gasoline, heating oil, natural gas, copper, gold, and silver), Intercontinental Exchange (ICE) softs markets (cocoa, coffee, sugar, and cotton), Chicago Board of Trade (CBOT) grain markets (corn, wheat, soybeans, soybean meal, soybean oil, oats, and rough rice), and the Kansas City Board of Trade (KCBT) hard red winter wheat market. We do not include any livestock markets in our sample because these are non-storable commodity futures markets and the cost-of-carry model does not strictly apply. See Main (2013) for an interesting discussion of applying the cost-of-carry framework to livestock futures markets, with the computed "storage cost" interpreted as a cyclical component of futures returns.

We initially consider only the January 1990–December 2014 sample period in order to compare results with those of Hamilton and Wu (2014). The second half of our sample differs slightly from that considered by Hamilton and Wu; their sample ends in June 2011 and ours ends in December 2014. Data for each of the commodity futures markets is available for the full 1990–2014 sample, except natural gas, which starts in 1991.[8] We partition our data set using the same breakpoint as Hamilton and Wu (2014): 1990–2004 and 2005–2014. The analysis is also repeated using deferred futures contracts (at least six months to maturity) to test the sensitivity of findings to the location of positions along the commodity term structure.

We compute annualized (implied) spot price changes, futures returns and the components of returns using the following procedure:

1. Estimate the daily cost-of-carry as $C_t = \frac{1}{(n-m)} ln\left[\frac{F_t(n)}{F_t(m)}\right]$, where $F_t(n)$ is the relative price of the second-from-maturity futures contract (delivery date $t+n$), $F_t(m)$ is the nearby futures contract (delivery date $t+m$), and $n > m$.
2. Estimate the daily implied spot price by discounting the nearby futures price as $P_t = \frac{F_t(m)}{e^{C_t m}}$. Implied spot prices are estimated in order to provide a consistent measurement of spot prices across all commodities. Two problems are paramount with respect to the use of observed spot prices. First, spot prices should correspond to the geographic delivery areas and delivery terms for each commodity

[6] While equation (5) demonstrates that futures returns are not determined by the market structure, C_t, this does not falsify the standard decomposition where futures returns equal the spot return plus the roll return or carry (e.g., Moskowitz et al., 2012). The common decomposition is an accounting identity that must be true under no arbitrage conditions (futures return = spot price change + carrying costs).

[7] The result is counterintuitive because a market that moves to an inverse is usually associated with low inventories and high prices and a market in contango is typically characterized by abundant stocks and low prices.

[8] The old NYMEX unleaded gasoline and the new RBOB contract were merged to create one series. We switched from the unleaded to the RBOB gasoline contract beginning in January 2006.

Table 1
Annualized *Ex Post* spot risk premiums for 19 commodity futures markets, nearby futures contracts, January 1990–December 2014.

Market	1990–2014		1990–2004		2005–2014		Difference	
	Average	t-stat.	Average	t-stat.	Average	t-stat.	Average	t-stat.
WTI Crude Oil	3.7%	0.47	9.5%	0.88	−5.0%	−0.44	−14.5%	−0.92
Heating Oil	3.0%	0.40	5.2%	0.50	−0.4%	−0.04	−5.6%	−0.38
RBOB (Gasoline)	7.3%	0.84	10.9%	0.97	1.8%	0.13	−9.1%	−0.52
Natural Gas	−8.4%	−0.67	5.5%	0.32	−29.2%	−1.62	−34.7%	−1.40
Gold	1.3%	0.40	−2.4%	−0.70	6.9%	1.08	9.3%	1.28
Silver	0.3%	0.06	−1.8%	−0.30	3.6%	0.31	5.4%	0.41
Copper	4.2%	0.78	3.3%	0.54	5.6%	0.57	2.3%	0.20
Corn	−4.5%	−0.84	−7.9%	−1.41	0.7%	0.07	8.6%	0.72
CBOT Wheat	−2.7%	−0.44	−4.8%	−0.70	0.5%	0.04	5.3%	0.40
KCBT Wheat	1.0%	0.18	−1.7%	−0.28	5.1%	0.50	6.8%	0.58
Soybeans	2.5%	0.50	−1.4%	−0.23	8.5%	0.97	9.9%	0.93
Soybean Meal	6.0%	1.08	0.4%	0.07	14.6%	1.46	14.2%	1.19
Soybean Oil	−1.4%	−0.29	−2.7%	−0.48	0.8%	0.10	3.5%	0.36
Rough Rice	−3.3%	−0.60	−6.3%	−0.84	1.2%	0.15	7.5%	0.69
Oats	−1.8%	−0.26	−5.1%	−0.59	3.2%	0.28	8.3%	0.58
Cotton	−3.8%	−0.62	−6.8%	−0.98	0.8%	0.07	7.6%	0.57
Cocoa	1.3%	0.21	−2.0%	−0.23	6.2%	0.66	8.1%	0.65
Coffee	−4.7%	−0.59	−6.5%	−0.57	−2.0%	−0.20	4.5%	0.29
Sugar	−6.1%	−0.75	−2.8%	−0.27	−10.7%	−0.83	−7.9%	−0.48
All	−0.4%	−0.12	−0.8%	−0.24	0.2%	0.04	1.0%	0.15

Notes: All entries are daily annualized returns (log price changes). Natural gas futures data start in 1991. The *t*-statistic is for a two-tailed t-test that the mean equals zero.

futures market. Such price quotations are often not readily available. Second, even if delivery area spot prices are available the spot market may be illiquid, and therefore, not provide an accurate representation of commercial transactions.

3. Estimate the daily (implied) spot price change as $ln\left[\frac{P_{t+1}}{P_t}\right]$.
4. Estimate the daily nearby futures return as $ln\left[\frac{F_{t+1}(m-1)}{F_t(m)}\right]$.
5. Estimate the daily *ex post* risk premium as $ln\left[\frac{P_{t+1}}{P_t e^C}\right]$ Market forces are assumed to force the average *ex post* price shock (ε_{t+1}) to be zero.

Note that in all computations futures contracts are rolled to the next contract 21 days before first delivery day. Daily averages are annualized by multiplying by 250. Finally, the daily *ex post* risk premium that we compute is technically considered to be an "excess" return because it does not include the interest (treasury bill) return associated with a fully collateralized long-only commodity investment.

Table 1 shows the results for nearby futures and, consistent with Hamilton and Wu (2014), energy markets in general exhibit a marked decline in the *ex post* spot premium for the post-2004 sub-sample. Most notably, WTI crude oil dropped from an average premium of 9.5% per year over 1990–2004 to −5.0% per year over 2005–2014. Differences in the sub-sample averages for energy ranged from −5.6% (heating oil) to −34.7% (natural gas). None of the differences are statistically significant at the 5% level. The contrast between the results for energy and non-energy markets in Table 1 is striking. Specifically, the average *ex post* spot premium increased in 14 of the 15 non-energy markets when 2005–2014 is compared with 1990–2004. The positive differences in the sub-sample averages ranged from 2.3% (copper) to 14.2% (soybean oil). Despite undergoing a similar financialization process to the energy markets, the metal, grain, and soft commodity markets do not show a consistent pattern of declining risk premiums. Furthermore, the average estimated risk premium across all 19 markets is −0.8% per year in the first sub-sample and increases to +0.2% per year in the later sub-sample. [9] Although U_{t+1} provides a noisy estimate of the market risk premium (π), there is little evidence that risk premiums across commodity markets declined in a systematic fashion from 2005 forward.[10] Either financialization pressures were restricted to energy markets or other factors account for the contrasting patterns in estimated risk premiums across energy and non-energy markets. The average estimated risk premium across the 19 markets and 25 years of data is a miniscule −0.4% per year.

Table 2 shows the results for deferred futures and energy markets and we again find a marked decline in the *ex post* spot premium for the post-2004 sub-sample, with WTI crude oil dropping from an average premium of 9.4% per year over 1990–2004 to 1.3% per year

[9] The average estimated risk premium of 0.2% for 2005–2014 should not be directly compared to returns in other recent studies covering roughly the same sample period (e.g., Bhardwaj et al., 2015, Erb and Harvey, 2016). The reason is that we do not include interest earnings, our sample of commodity futures markets is not the same, and we do not rebalance portfolio weights through time.

[10] Two examples highlight the noise in the estimates of *ex post* spot premiums reported in Table 1: i) the average premium for RBOB (gasoline) over 1990–2004 is 10.9% with a t-statistic of only 0.97, and ii) the average premium for soybean meal over 2005–2014 is 14.6% with a t-statistic of only 1.46. The noise associated with highly volatile daily spot price changes and futures returns may cause statistical tests to have relatively low power. For this reason, we focus on the size of the point estimates and patterns in the point estimates when interpreting the empirical results of this study.

Table 2
Annualized *Ex Post* spot risk premiums for 19 commodity futures markets, deferred futures contracts, January 1990–December 2014.

Market	1990–2014		1990–2004		2005–2014		Difference	
	Average	t-stat.	Average	t-stat.	Average	t-stat.	Average	t-stat.
WTI Crude Oil	6.2%	0.96	9.4%	1.15	1.3%	0.12	−8.1%	−0.61
Heating Oil	6.3%	0.73	7.8%	0.78	4.1%	0.26	−3.7%	−0.20
RBOB (Gasoline)	8.4%	0.56	20.8%	1.16	−10.0%	−0.40	−30.8%	−0.99
Natural Gas	1.7%	0.07	11.3%	0.40	−12.9%	−0.36	−24.2%	−0.53
Gold	1.4%	0.42	−2.3%	−0.67	7.0%	1.09	9.3%	1.28
Silver	1.2%	0.19	−1.2%	−0.20	5.1%	0.39	6.3%	0.44
Copper	4.9%	0.90	3.6%	0.58	7.0%	0.69	3.5%	0.29
Corn	−2.3%	−0.31	−5.5%	−0.64	2.5%	0.18	7.9%	0.49
CBOT Wheat	−1.6%	−0.18	−1.1%	−0.10	−2.4%	−0.16	−1.3%	−0.07
KCBT Wheat	1.4%	0.15	0.1%	0.01	3.3%	0.20	3.2%	0.16
Soybeans	2.4%	0.34	−2.3%	−0.28	9.5%	0.82	11.8%	0.82
Soybean Meal	6.2%	0.64	−1.2%	−0.09	17.7%	1.11	18.9%	0.93
Soybean Oil	2.0%	0.34	1.4%	0.19	2.8%	0.32	1.4%	0.12
Rough Rice	6.2%	0.54	3.7%	0.22	9.5%	0.62	5.8%	0.26
Oats	0.4%	0.03	−2.9%	−0.19	5.3%	0.29	8.2%	0.35
Cotton	1.5%	0.01	0.2%	0.02	3.4%	0.01	3.2%	0.01
Cocoa	2.0%	0.32	−1.6%	−0.20	7.3%	0.80	8.9%	0.72
Coffee	−3.2%	0.40	−6.4%	−0.57	1.6%	0.15	7.9%	0.52
Sugar	3.8%	0.42	5.3%	0.48	1.5%	0.10	−3.8%	−0.20
All	1.5%	0.10	1.2%	0.05	2.1%	0.11	0.9%	0.03

Notes: All entries are daily annualized returns (log price changes). Natural gas futures data start in 1991. The *t*-statistic is for a two-tailed t-test that the mean equals zero.

over 2005–2014. The average *ex post* spot premium increased in 12 of the 15 non-energy markets for 2005–2014 compared to 1990–2004. The average estimated risk premium across all 19 markets is 1.2% per year in the first sub-sample and increases to 2.1% per year in the later sub-sample. This increase in average risk premiums is significant when using deferred futures. Once gain there is little evidence that risk premiums across all commodity markets declined in a systematic fashion from 2005 forward.

For a longer-term perspective on the potential impact of financialization, we also computed average daily *ex post* spot premiums by decade for 1961–2009 using the 19 commodity futures markets. We follow Sanders and Irwin (2012) and present estimates only for complete decades. For example, a market that started trading in 1978 does not show any data in the 1970's but shows a complete return history for the 1980's. The data are arranged in this manner to keep the markets within each decade consistent and complete. We present the estimation results for nearby futures over 1961–2009 in Table 3. Comparing estimates for the 1990s and 2000s provides an alternative breakpoint to that considered by Hamilton and Wu (2014). The change in breakpoint substantially alters the results, as energy markets in general exhibit a marked *increase* in the *ex post* spot premium for the 2000s. Premiums increased in three of the four energy futures markets based on the full data for the two decades, and most notably, the average premium in WTI crude oil rose from 5.6% per year in the 1990s to 11.9% per year in the 2000s. These results demonstrate that conclusions about financialization pressures in energy futures markets are sensitive to relatively small changes in the sample breakpoint (2000 vs. 2004). In contrast, the average *ex*

Table 3
Annualized *Ex Post* spot risk premiums for 19 commodity futures markets by decade, nearby futures contracts, January 1961–December 2014.

	1960s	1970s	1980s	1990s	2000s	Average	
						1960–2014	t-stat.
WTI Crude Oil				5.6%	11.9%	3.6%	0.52
Heating Oil			5.3%	−1.8%	12.4%	3.4%	0.56
RBOB (Gasoline)				5.6%	14.5%	7.6%	1.00
Natural Gas				2.0%	−7.3%	−8.4%	−0.67
Gold			−9.5%	−5.9%	9.2%	0.3%	0.09
Silver		20.4%	−24.4%	−2.7%	6.2%	−0.5%	−0.12
Copper		0.2%	−0.8%	2.5%	11.4%	5.7%	1.55
Corn	−4.7%	5.0%	−6.3%	−6.7%	−3.6%	−3.1%	−0.98
CBOT Wheat	−4.0%	11.8%	−1.5%	−5.7%	1.5%	−0.1%	−0.02
KCBT Wheat		0.3%	0.0%	−2.9%	5.2%	0.7%	0.17
Soybeans	3.9%	11.0%	−5.8%	−4.1%	8.0%	2.8%	0.81
Soybean Meal	6.7%	10.4%	−3.4%	−2.8%	10.1%	5.2%	1.31
Soybean Oil	3.8%	20.2%	−6.5%	−5.0%	6.6%	2.6%	0.72
Rough Rice				−6.6%	3.0%	−1.2%	−0.23
Oats	−5.6%	6.9%	−3.4%	−13.2%	6.9%	−1.2%	−0.28
Cotton	−3.3%	13.4%	4.0%	−1.9%	−8.7%	0.8%	0.23
Cocoa	−32.7%	22.2%	−15.8%	−8.3%	13.2%	1.8%	0.38
Coffee			−5.3%	0.8%	−11.9%	−0.4%	−0.07
Sugar		8.6%	−28.2%	−3.7%	1.0%	−9.4%	−1.42

Notes: All entries are daily annualized returns (log price changes). Natural gas futures data start in 1991. The *t*-statistic is for a two-tailed t-test that the mean equals zero.

Table 4
Annualized *Ex Post* spot risk premiums for 19 commodity futures markets by decade, deferred futures contracts, January 1961–December 2014.

	1960s	1970s	1980s	1990s	2000s	Average	
						1960–2014	t-stat.
WTI Crude Oil				4.5%	17.2%	4.5%	0.76
Heating Oil			−7.7%	2.3%	16.4%	3.0%	0.39
RBOB (Gasoline)				21.9%	10.1%	8.3%	0.62
Natural Gas				7.9%	5.6%	1.7%	0.07
Gold			−9.7%	−5.9%	9.3%	0.3%	0.10
Silver		20.5%	−24.3%	−2.2%	8.1%	0.1%	0.02
Copper		−0.7%	−3.6%	1.1%	14.5%	4.2%	0.86
Corn	10.4%	6.5%	−5.3%	−4.8%	−0.1%	0.9%	0.20
CBOT Wheat	−7.5%	6.6%	−1.1%	−2.7%	2.4%	−1.1%	−0.17
KCBT Wheat		0.2%	−5.4%	−1.1%	5.7%	−0.4%	−0.05
Soybeans	3.1%	10.7%	−3.5%	−6.1%	8.6%	2.9%	0.54
Soybean Meal	23.6%	11.1%	−1.3%	−4.3%	10.8%	8.3%	0.07
Soybean Oil	4.9%	17.5%	−4.0%	−3.6%	12.6%	4.2%	0.72
Rough Rice			23.0%	4.4%	13.6%	8.1%	0.75
Oats	6.1%	6.1%	−2.4%	−12.6%	12.2%	1.4%	0.19
Cotton	3.4%	18.1%	2.2%	−3.5%	5.4%	4.8%	0.08
Cocoa	6.6%	16.6%	−16.7%	−7.3%	13.4%	0.8%	0.18
Coffee			−5.2%	0.1%	−8.3%	−0.7%	−0.11
Sugar		18.7%	−7.2%	4.0%	11.0%	−1.0%	−0.13

Notes: All entries are daily annualized returns (log price changes). Natural gas futures data start in 1991. The *t*-statistic is for a two-tailed t-test that the mean equals zero.

post spot premium increased in 13 of the 15 non-energy markets comparing the 1990s with the 2000s, similar to our previous findings. Overall, the comparisons for the two decades consistently show a pattern of increasing risk premiums across the energy, metal, grain, and soft commodity futures markets, the opposite of that predicted by financialization pressures.

The results in Table 3 span five decades and so should reveal any longer-term patterns in *ex post* spot risk premiums. Grain futures markets have the longest samples for the most markets, but it is difficult to discern a pattern across decades in grain risk premiums. For example, corn average premiums by decade from the 1960s through the 2000s are −4.7%, 5.0%, −6.3%, −6.7%, and −3.6% per year. The most that can be said about premiums over time is that they are extraordinarily high in the 1970s (positive for all 10 markets) but otherwise near zero on average.

In the final column of Table 3, we report the average *ex post* spot risk premiums by market using all available observations over 1961–2014. There is an exceedingly wide range in the average premiums across markets, especially in light of the long samples of high frequency data used to estimate the premiums. The low is −9.4% per year for sugar and the high is 7.6% per year for RBOB gasoline. It is also noteworthy that 11 of the 19 markets have positive average premiums and 8 have negative average premiums. None of the average premiums are statistically at the 5% level. While it is difficult to directly compare these results to other studies due to varying samples and methods, they are generally in agreement with those from previous well-known studies such as Kolb (1992) and Fama and French (1987) who fail to find consistent evidence of positive risk premiums across a broad cross-section of futures markets.

The estimation results for deferred futures over 1960–2009 are presented in Table 4. Similar patterns are found to that observed with nearby futures contracts. Three of the four energy markets exhibit a marked *increase* in the *ex post* spot premium for the 2000s compared to the 1990s, with WTI crude oil increasing from 4.5% to 17.2%. The average *ex post* spot premium increased in 14 of the 15 non-energy markets comparing the 1990s with the 2000s. It is interesting to note the tendency for average estimated risk premiums over 1960–2009 to be higher in 11 of 19 markets for deferred contracts. The overall average across all 19 markets for the full sample is 2.7% for deferred contracts versus 0.5% for nearby contracts. It is not clear whether the returns for deferred contracts can actually be earned by investors given the much diminished liquidity and trading volume in these contracts.

Overall, our findings indicate that the average unconditional return to individual commodity futures markets is approximately equal to zero both before and after financialization. There is a directional tendency of the point estimates for returns to increase after the mid-2000s. However, none of the point estimates is statistically significant. In terms of our earlier theoretical model, the results imply that the *ex post* premium, $\boldsymbol{U}_{t+1} = \boldsymbol{\pi} + \boldsymbol{\varepsilon}_{t+1}$, for these commodity futures markets consists solely of unforeseen supply and demand price shocks ($\boldsymbol{\varepsilon}_{t+1}$) because the *ex ante* risk premium (π) is zero. This is an especially interesting result due to the theoretical logic of large-scale commodity investment driving down risk premiums (e.g., Acharya et al., 2013; Etula, 2013; Brunetti and Reiffen, 2014; Hamilton and Wu, 2015; Basak and Pavlova, 2016). Despite the size of the financialization wave that hit commodity futures markets starting in the mid-2000s the average level of unconditional risk premiums—zero—was largely unaffected.

2. Summary and conclusions

The purpose of this paper is to investigate whether the rise of long-only commodity investments —popularly known as "financialization"—reduced the very risk premiums such investments were designed to earn. We first use the cost-of-carry model for storable commodity prices to show theoretically that long-only returns in commodity futures markets are driven by risk premiums. As Bhardwaj et al. (2015, p.2) state, "The source of value to an investor in commodity futures is the risk premium received for bearing future spot price risk." We next use daily futures prices for a broad cross-section of 19 commodity futures markets over January 1961–December

2014 to determine whether financialization pressures have driven risk premiums since the mid-2000s. While energy futures markets generally exhibit a decline in risk premiums after 2004, premiums in all but one non-energy futures market actually *increase* over the same time period. So, we find little evidence that risk premiums across markets declined in a systematic fashion consistent with downward pressure brought about by the process of financialization. None of these findings are sensitive to the use of nearby versus deferred futures contracts.

Our results show an exceedingly wide range in the estimates of average premiums across markets, especially in light of the long samples of high frequency data used to estimate the premiums. Over 1961–2014, the low is −9.4% per year for sugar and the high is 7.6% per year for RBOB gasoline. We find that over this period 11 of the 19 markets have positive average premiums and 8 have negative average premiums. None of the average premiums are statistically different from zero.

Overall, our findings indicate that the average unconditional return to individual commodity futures markets is approximately equal to zero both before and after financialization. This implies that long-only returns in commodity futures markets are largely driven by idiosyncratic random fluctuations in supply and demand. It also implies that, despite the size of the financialization wave that hit commodity futures markets starting in the mid-2000s, the average level of unconditional risk premiums—zero—was largely unaffected.

It is important to emphasize that our findings do not imply that all commodity investment is without merit. There is some evidence that risk premiums may be available by simultaneously going long low-storage-cost commodities and short high-storage cost commodities. However, picking up premiums based on the level of storage costs requires following a trading strategy that has an uncertain foundation. There is also some evidence of time-varying risk premiums that are conditional on momentum and other factors (e.g., Szymankowska et al., 2014). Finally, some researchers note that returns to portfolios of commodity futures may be positive even when returns to individual futures markets are zero—the so-called "turning water into wine" benefits of diversification. Willenbrock (2011) shows this can indeed be the case, but it depends on whether the portfolio is rebalanced or not. There is clearly room for further research on commodity investment strategies.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jcomm.2018.05.004.

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