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Yale ICF Working Paper No. 15-18

Facts and Fantasies about Commodity Futures Ten Years Later

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Abstract

Gorton and Rouwenhorst (2006) examined commodity futures returns over the period July 1959 to December 2004 based on an equally-weighted index. They found that fully collateralized commodity futures had historically offered the same return and Sharpe ratio as U.S. equities, but were negatively correlated with the return on stocks and bonds. Reviewing these results ten years later, we find that our conclusions largely hold up out-of-sample. The in- and out-of-sample average commodity risk premiums are not significantly different, nor is the cross-sectional relationship between average returns and the basis. Correlations among commodities and commodity correlations with other assets experienced a temporary increase during the financial crisis which is in line with historical experience of variation of these correlations over the business cycle.

* The paper has benefited from comments by seminar participants at the 2015 Bloomberg Global Commodity Investment Roundtable, the 2015 FTSE World Investment Forum, and from Rajkumar Janardanan, Kurt Nelson, Ashraf Rizvi, and Matthew Schwab.

1. Introduction

Commodity futures play an important role in the global economy, allowing companies to insure the future value of their outputs or inputs. This future price risk is shifted to investors who receive compensation for bearing it. Gorton and Rouwenhorst [GR] (2006) examined commodity futures returns over the period July 1959 to December 2004 based on an equally-weighted (EW) index. This is the longest data set of commodity futures. They found that a portfolio of fully collateralized commodity futures offered the same average return and Sharpe ratio as U.S. equities, and, depending on the investment horizon, had low or negative correlation with equity returns and bond returns. Distinct from stocks and bonds, commodities have a positive correlation with inflation. Since the writing of that paper, ten years' worth of new data has accumulated, which presents an opportunity to examine whether the basic results reported in the original paper have changed. The out-of sample period includes the global economic expansion led by the industrialization of China, a housing boom and bust in the United States, the largest financial crisis since the Great Depression, followed by a monetary policy stimulus response which has driven interest rates towards zero. It is against this rich background that collateralized commodity futures gradually gained acceptance as an asset class. The decade has also seen an increased interest by academics in questions concerning the behavior of commodity prices, and the effect of changes in the composition of participants in commodity futures markets (see Rouwenhorst and Tang (2012) and Cheng and Xiong (2014) for recent surveys).

While acknowledging that ten years of data is not always sufficient to draw definitive conclusions, we find that most of our original findings hold up out-of-sample. Between 2005 and 2014, the average risk premium of the EW index was 3.67% per annum, which is somewhat lower but not significantly different from the in-sample average of 5.23% during the 1959-2004 period. The out-of-sample ten year risk premium is close to the median of the distribution of all possible ten year blocks for the period July 1959 to December 2004, with 49% of the decades showing a risk premium lower than 3.67% and 51% yielding a higher risk premium. The finding of a positive risk premium is consistent with the fundamental economic function of futures markets.

The correlation among commodities and the co-movement of commodities with other asset classes has varied during the out-of-sample period, and increased substantially during the financial crisis. Experience from previous episodes of economic turmoil shows that these correlation increases tend to be temporary in nature, and it appears that they have since returned close to their long-term sample averages. Correlations between commodities and inflation have been positive in the past decade, albeit in a low inflation environment. Finally, the futures basis, an indicator of scarcity of physical inventories, has been reliably correlated with the cross-section of futures risk premiums.

Exchange traded futures markets have experienced substantial growth during the out-of sample period. Despite the temporary contraction during the financial crisis, the open interest for the average commodity has more than doubled since 2004. At the same time, the composition of market participation has stayed relatively stable.

The remainder of the paper is organized as follows. Section 2 contains an update of the equally-weighted commodity index of the 2006 paper, and compares the risk premium over the past decade to its long-term average since 1959. Section 3 examines the cross-section of commodity risk

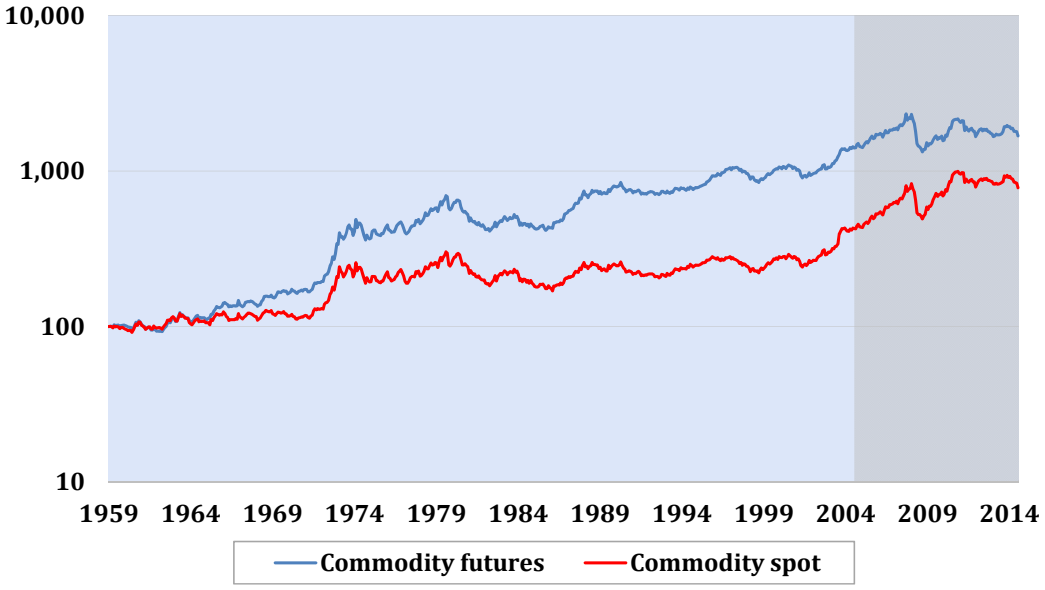
premiums to the basis. In section 4 we examine the correlations among commodities and the correlation of commodities with stocks, bonds and inflation. The fifth section analyzes the growth of commodity markets since 2004. Section 6 concludes.

2. Historical Returns and the Risk Premium on Commodity Futures

2.1 Commodity spot returns versus futures returns

The source of value to an investor in commodity futures is the risk premium received for bearing future spot price risk. Consequently, providers of insurance in the futures market are concerned with deviations from the *expected future* spot price, and futures prices embed these expectations (see Black (1976)). Futures prices can increase during a period when spot prices decline if the spot price declines are anticipated. Unexpected fluctuations in spot prices affect spot and futures prices alike. Spot prices are different from futures prices for these reasons.

Figure 1: Inflation-Adjusted Commodity Futures and Commodity Spot Returns July 1959 – Dec 2014



The upper line in Figure 1 shows the inflation-adjusted total return index of an equally-weighted portfolio of collateralized commodity futures that is monthly rebalanced.[1] The bottom time-series represents the corresponding index of spot prices. Both series are normalized to 100 in 1959/7 and are presented on a log scale. The shaded area represents the out of sample period 2005/1 – 2014/12. The advantage of a log scale is that is facilitates a direct comparison of the slopes across time and indices to measure return differentials. For example the narrowing of the distance between the lines in the out-of sample period illustrates that spot returns have exceed futures returns over the past decade.

[1] The construction of commodity futures returns and the EW index is detailed in Gorton and Rouwenhorst (2006).

To put the recent decade into perspective we examine the performance of the equally-weighted spot and futures indices in prior decades back to 1959. Table 1 shows the returns to commodity futures and the equally-weighted spot return for different sub-periods.

In the most recent decade:

- Inflation-adjusted collateralized commodity futures returns have been relatively low, and spot price growth relatively high.
- Spot returns have exceeded collateralized futures returns.

Table 1: Commodity Futures and Spot Returns for Selected Periods

	Nominal		**Inflation-Adjusted**	
	Futures	Spot	Futures	Spot
1/2005 to 12/2014	5.09%	9.42%	2.93%	7.26%
1/1995 to 12/2004	8.55%	8.20%	6.13%	5.78%
1/1985 to 12/1994	9.69%	6.66%	6.15%	3.13%
1/1975 to 12/1984	9.01%	7.08%	1.91%	-0.02%
1/1965 to 12/1974	19.23%	13.18%	14.10%	8.07%
7/1959 to 12/1964	3.88%	2.98%	2.62%	1.71%

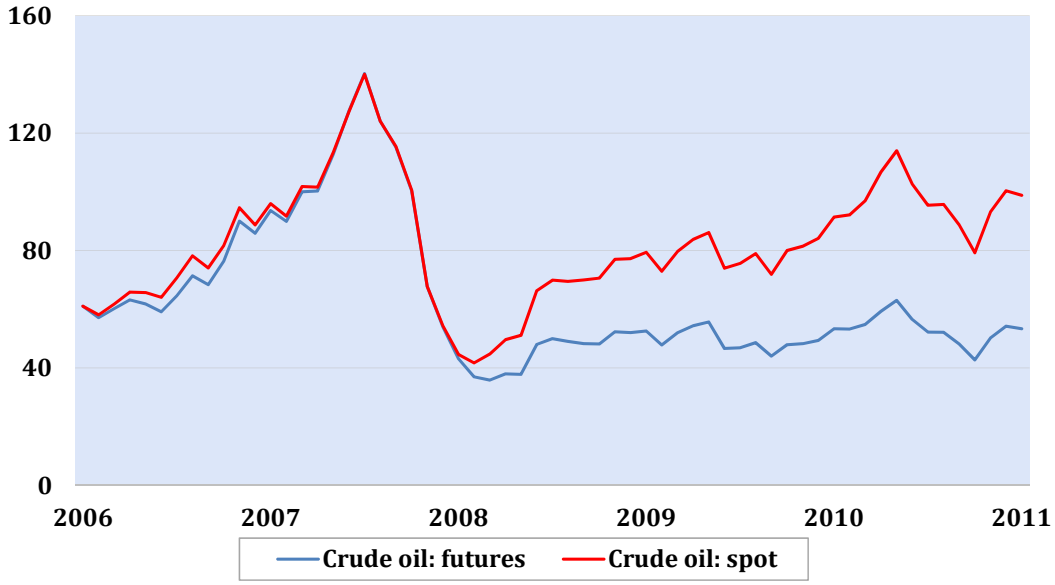
Note: The table gives the (arithmetic) average annual return on an equally-weighted portfolio of collateralized commodity futures that is monthly rebalanced, as well as the corresponding index of spot prices. The monthly average return is annualized by multiplying by 12.

The high average spot returns relative to futures returns over the past decade suggests that high spot price growth was partially anticipated by investors markets when setting futures prices. This is consistent with a widespread belief in the markets of growing demand for commodities in Asia, especially before the financial crisis.

Note that the comparison does not imply that holders of physical commodities fared better than futures investors. Unlike the collateralized futures return, the spot price return does not correspond to a feasible investment strategy in physical commodities, which requires calculating spot returns net of the cost of carry (e.g. storage costs, insurance, etc.). Figure 2 plots the front month futures price of crude oil (a proxy for the spot price) against the total return (including collateral) on rolling oil futures during the period 2006-2011 which includes the financial crisis. The figure illustrates the dramatic rise and decline of the price of WTI crude oil during this period. A second striking feature of the graph is that spot and rolling futures tracked closely from 2006 to 2008, but diverged subsequently. A common way to describe this shift is that "the roll yield turned negative" in 2008, or that "the oil market moved into contango". While both statements are true, they are not always helpful to investors in trying to understand why their futures investment in oil did not seem to benefit from the spot price appreciation of oil since 2008. A different perspective is provided by the realization that the spot price appreciation is not a feasible investment return, because the holder of physical oil would have incurred storage costs which are not subtracted in figure 2. A fair comparison of collateralized futures to spot returns net of carrying cost would indeed show that both tracked

closely following 2008. This same comparison would illustrate that investors in oil futures did much better than spot investors on a net basis between 2006 and 2008.

Figure 2: WTI: spot price versus collateralized futures 2006-2011



Note: Futures – collateralized front investable futures. Spot – future contract that is closest to maturity.

2.2 The Influence of Rebalancing

Conclusions about the performance of an (commodity) index are sensitive to the methodology of index construction. Periodic changes of index weights by rebalancing will cause the return to a rebalanced index to deviate from a buy-and-hold index that does not rebalance. As pointed out in GR (2006), outperformance can be positive or negative depending on whether the "trading strategy" embedded in the rebalancing rule is profitable or not. Moreover, rebalancing can affect a spot index different from a futures index due to differences in the time-series properties of spot and futures prices. For example, commodity spot prices often exhibit predictable mean reversion due to seasonality (heating season, crop cycles, etc.) that is anticipated by futures investors and therefore not a feature of futures prices.

Table 2 shows the average annualized returns for the full sample between 1959 and 2014, broken down by in-sample (1959-2004) and out-of-sample (2005-2014) periods. The table compares average spot and futures returns of the monthly rebalanced EW index to indices that are rebalanced annually or not rebalanced (i.e. buy-and-hold).

In addition to our discussion of Table 1, we note that:

- Average futures returns have been lower in the out-of-sample period compared to the period prior to 2004. This could be due to a lower risk premium, lower collateral (T-bill) returns, or both.
- Monthly rebalancing lowers the performance of our futures index relative to permutations of the index that are not (or less frequently) rebalanced.

- Unlike futures indices, the performance of spot indices is greatly enhanced by more frequent rebalancing
- The opposite impact of rebalancing on average returns is consistent with short-term momentum in futures returns and predictable mean-reversion of commodity spot prices.

Table 2: Average Annualized Returns

In-Sample 1959/7 - 2004/12				
		Rebalancing		
Return % p.a.	Index	Monthly	Annual	Buy and Hold
Arithmetic	Futures	10.69%	11.97%	11.46%
	Spot	8.08%	7.26%	4.48%
	Inflation	4.14%		
Geometric	Futures	10.45%	11.77%	10.81%
	Spot	7.59%	6.65%	3.53%
	Inflation	4.21%		
Full Sample 1959/7 - 2014/12				
Arithmetic	Futures	9.68%	10.81%	10.60%
	Spot	8.32%	7.43%	4.78%
	Inflation	3.78%		
Geometric	Futures	9.25%	10.41%	9.56%
	Spot	7.75%	6.75%	3.72%
	Inflation	3.83%		
Out-of-Sample 2005/1 - 2014/12				
Arithmetic	Futures	5.09%	5.53%	6.38%
	Spot	9.42%	8.23%	6.44%
	Inflation	2.12%		
Geometric	Futures	3.98%	4.42%	4.93%
	Spot	8.49%	7.17%	5.03%
	Inflation	2.12%		

2.3 Risk Premium of Commodities versus Stocks and Bonds

Figure 3 plots the inflation-adjusted performance of the equally-weighted commodity index against U.S. Stocks (S&P 500 Total Return) and Bonds (Long-term US Government Bonds Total Return). As before, the shaded portion of the figure contains the out-of sample portion of the performance.

Table 3 compares the performance of commodities to stocks and bonds, by summarizing their risk premiums (excess returns over T-bills) and the Sharpe ratios, broken down by the same sub-periods as in Table 2.

Figure 3: Inflation-Adjusted Performance of Stocks, Bonds, and Commodity Futures, July 1959-December 2014

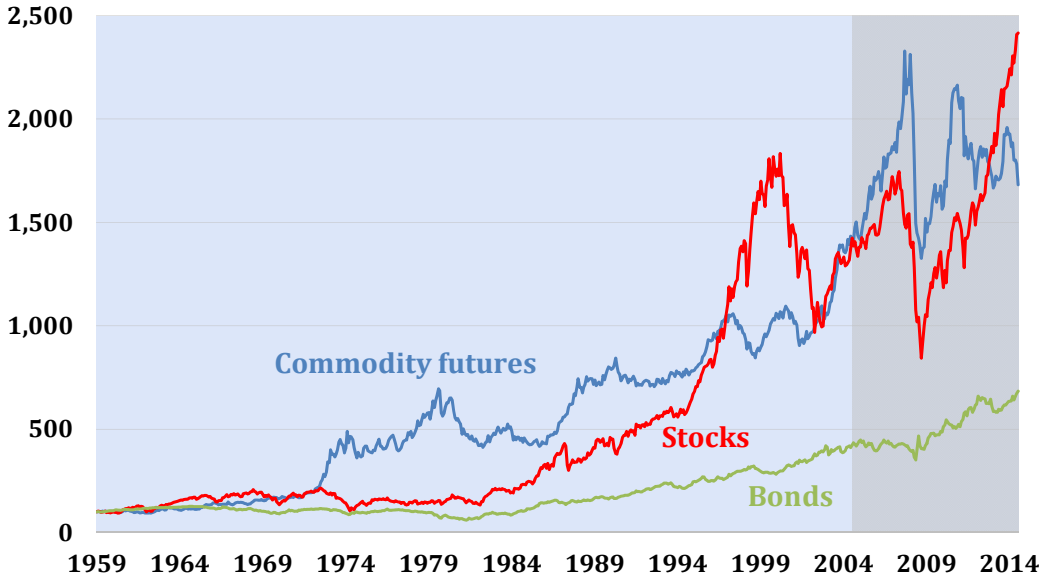


Table 3: Risk Premiums for Annualized Monthly Returns

In-Sample 1959/7 - 2004/12			
	Commodity Futures	Stocks	Bonds
Risk Premium (*t*-stat)	5.23% (2.92)	5.65% (2.57)	2.22% (1.77)
Standard deviation	12.10%	14.85%	8.47%
Sharpe Ratio	0.43	0.38	0.26
% Returns > 0	55%	57%	54%
Full Sample 1959/7 - 2014/12			
	Commodity Futures	Stocks	Bonds
Risk Premium (*t*-stat)	4.95% (2.90)	5.91% (2.97)	2.93% (2.43)
Standard deviation	12.71%	14.81%	8.97%
Sharpe Ratio	0.39	0.40	0.33
% Returns > 0	55%	58%	55%
Out-of-Sample 2005/1 - 2014/12			
	Commodity Futures	Stocks	Bonds
Risk Premium (*t*-stat)	3.67% (0.76)	7.09% (1.52)	6.17% (1.78)
Standard deviation	15.23%	14.71%	10.96%
Sharpe Ratio	0.24	0.48	0.56
% Returns > 0	58%	63%	58%
In-Sample vs Out-of-Sample Difference in Mean Test			
	Commodity Futures	Stocks	Bonds
t-statistics	-0.35	0.28	1.2
In-Sample vs Out-of-Sample Difference in Standard deviation			
	Commodity Futures	Stocks	Bonds
F-test (p-value)	0.63 (0.00)	1.02 (0.80)	0.60 (0.00)

Subject to the important caveat that 10 years of data is generally insufficient to make definitive statements about the statistical significance of risk premiums, we note that:

- Risk premiums to stocks, bonds and commodities have all been positive during the past decade. In a statistical sense, excess returns on bonds have deviated the most from their average historical risk premium (*t*-stat = 1.2), followed by commodities (*t*-stat = -0.35) and stocks (*t*-stat = 0.28).
- The lower out-of-sample average return for commodity futures was in large part due to lower collateral returns over the past decade. The average historical risk premium of 3.67% was about 1.5% lower than its historical mean over the 1959-2004 period.
- In a statistical sense the out-of-sample risk premiums on all asset classes (stocks bonds, and commodities) have been insignificantly different from their historical in-sample averages (and also from zero from that matter).
- All markets have experienced an increase in volatility (standard deviation of returns), with the increase significant in a statistical sense for Commodities and Bonds.

3. The Behavior of the Basis: Link to the Fundamentals of Scarcity

The *basis* refers to the difference between the current spot price and the futures price.[2] It is also sometimes called *backwardation* or the *roll yield.* The basis (and backwardation) can be observed on a trader's futures screen, and is distinct from *normal backwardation* which refers to difference between the futures price and the *expected* future spot price (i.e. the expected risk premium, which is unobservable).

Several papers have linked the basis (backwardation) to the risk premium (normal backwardation).[3] One suggested logic behind the relationship is that the basis is a measure of the scarcity of a commodity. Scarcity leads to price volatility, which is the risk that is transferred (insured) through commodity futures markets. When physical inventories of a commodity are high, and the risk of a shortage or stock-out is low, futures prices will trade at a premium to spot prices (contango). However, with the threat of a shortage, the spot commodity price will be bid up relative to the futures price to secure supply by those who use the commodity as an input in the productive process. If this convenience premium becomes large enough, and exceeds the full cost of storage, the futures curve will become inverted (backwardation). Scarcity is the exception rather than the rule, as can be seen in figure 4, which plots the percentage of backwardated commodities in the equally-weighted index since 1959.

The figure illustrates that:

- In the majority of months since 1959 the median commodity has been in contango. For this reason, an upward sloping futures curve is considered a "normal curve."

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[2] Basis is calculated as the slope of the futures curve. If F^1 is the futures price of the front contract, and F^2 is the futures price of the next contract, the basis is calculated as $[(F^1-F^2)/F^1] \times 365/(T^2-T^1)$, where T^1 and T^2 refer to the time (in days) to expiration of the two contracts.

[3] See, for example, Fama and French (1987), Erb and Harvey (2006). This literature is surveyed by Rouwenhorst and Tang (2012).

- Predominance of contango does not preclude a positive risk premium, i.e. *normal backwardation*.
- The proportion of commodities in backwardation dropped from an average of 37% per month to 26% post 2004 in part due to a decline during the financial crisis.

Figure 4: Fraction of Commodities in Backwardation
(Lifetime average: 35%, Pre 2004: 37%, post 2004: 26%)

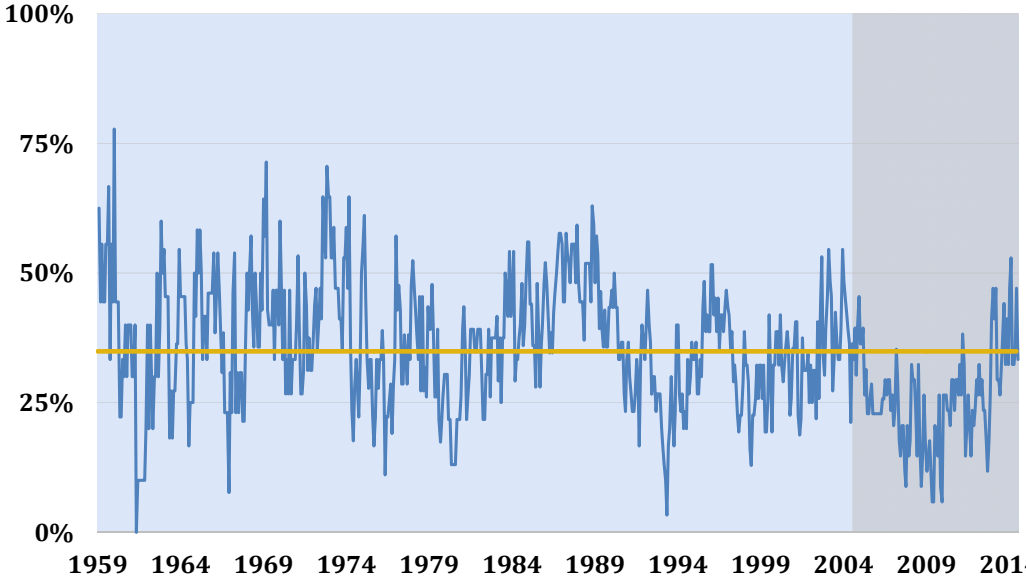
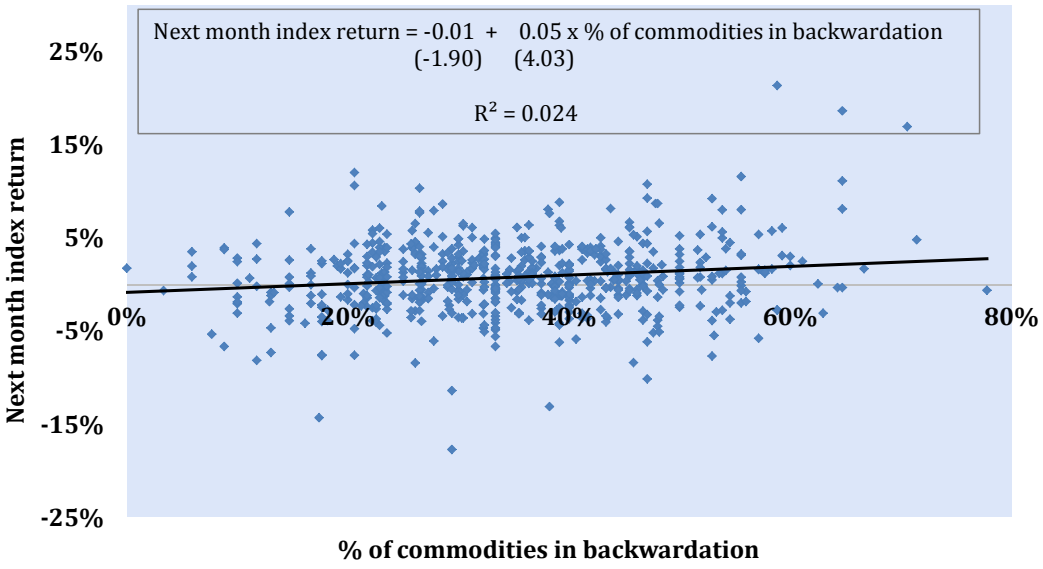


Figure 5: Fraction of Commodities in Backwardation versus Next Month Index Return



The predictability of the risk premium by the basis is more robust in the cross-section of futures returns than in the time-series. Figure 5 shows that using the percentage of commodities as a market timing signal for the market is relatively weak.

By contrast, cross-sectional predictability is stronger: if variation in the basis reflects differences in required risk premiums, then a trading strategy that selects commodities according to the size of its basis would make positive profits in expectation.[4] At the end of each month, index commodities are ranked according to their basis and divided into two portfolios, each containing half of the commodities in the equally weighted index. Table 4 shows the in- and out-of-sample results from the original paper.

The table suggests that the link between fundamentals and expected returns has been stable over time:

- Out-of-sample performance of the high versus low basis strategy has been very similar to the in-sample performance, and the spread continues to be wide (about 10% per annum).
- The hit ratio (% months with positive returns) is stable at just below 60%.

Table 4: Performance of High- and Low-Basis Portfolios:
Annualized Return Deviations from the Equally Weighted Index

In-Sample 1959/7 - 2004/12			
	High-Basis Portfolio - Index	Low-Basis Portfolio - Index	High - Low
Average Returns (*t*-stat)	4.27% (4.11)	-4.93% (-4.87)	9.2% (4.60)
Standard deviation	7.00%	6.81%	13.48%
Sharpe Ratio	0.61	-0.72	0.68
% Returns > 0	57%	39%	59%
Full Sample 1959/7 - 2014/12			
	High-Basis Portfolio - Index	Low-Basis Portfolio - Index	High - Low
Average Returns (*t*-stat)	4.34% (4.82)	-5.08% (-5.79)	9.42% (5.43)
Standard deviation	6.69%	6.53%	12.92%
Sharpe Ratio	0.65	-0.78	0.73
% Returns > 0	57%	40%	59%
Out-of-Sample 2005/1 - 2014/12			
	High-Basis Portfolio - Index	Low-Basis Portfolio - Index	High - Low
Average Returns (*t*-stat)	4.62% (2.89)	-5.79% (-3.60)	10.41% (3.28)
Standard deviation	5.05%	5.08%	10.02%
Sharpe Ratio	0.91	-1.14	1.04
% Returns > 0	59%	42%	59%
In-Sample vs Out-of-Sample Difference in Mean Test			
	High-Basis Portfolio - Index	Low-Basis Portfolio - Index	High - Low
t-Statistics	0.15	-0.38	0.27
In Sample vs Out-of-Sample Difference in Standard Deviation			
	High-Basis Portfolio - Index	Low-Basis Portfolio - Index	High - Low
F-test (p-value)	1.92 (0.00)	1.80 (0.00)	1.81 (0.00)

[4] See Gorton, Hayashi and Rouwenhorst (2013) for more details.

4. Correlations of Commodities with Stocks, Bonds, and Inflation

4.1 Commodities and Inflation

In the original GR study, an equally-weighted commodity futures index exhibited positive inflation correlations while stocks and bonds had low to negative correlations with inflation. These correlations were more pronounced at longer horizons. Over the past decade inflation has been very low, and the out-of-sample data provide little information about the behavior of asset classes in an inflationary environment. Table 5 provides a recap of these results and an update through 2014, with the exception of the 5-year correlation with is not precisely estimated for the out-of-sample period.

Table 5: Correlations of Assets with Inflation

In-Sample 1959/7 - 2004/12			
	Stocks	Bonds	Commodity Futures
Monthly	-0.14	-0.11	0.02
Quarterly	-0.19	-0.21	0.14
One Year	-0.19	-0.32	0.29
Five Year	-0.25	-0.22	0.45
Full Sample 1959/7 - 2014/12			
	Stocks	Bonds	Commodity Futures
Monthly	-0.08	-0.18	0.09
Quarterly	-0.08	-0.23	0.24
One Year	-0.13	-0.29	0.33
Five Year	-0.10	-0.20	0.47
Out-of-Sample 2005/1 - 2014/12			
	Stocks	Bonds	Commodity Futures
Monthly	0.07	-0.38	0.25
Quarterly	0.29	-0.33	0.49
One Year	0.19	-0.27	0.65

Note: Correlations are based on overlapping monthly returns data.

The table shows that the out-of-sample correlations with inflation have been somewhat higher for both commodities and equities during the out-of-sample period, albeit in a decade of a low inflation environment.

4.2 Commodities and Diversification

Unlike the inflation correlations, the correlation of commodities with equities has deviated from its historical average during the out-of-sample period. The summary statistics are in Table 6:

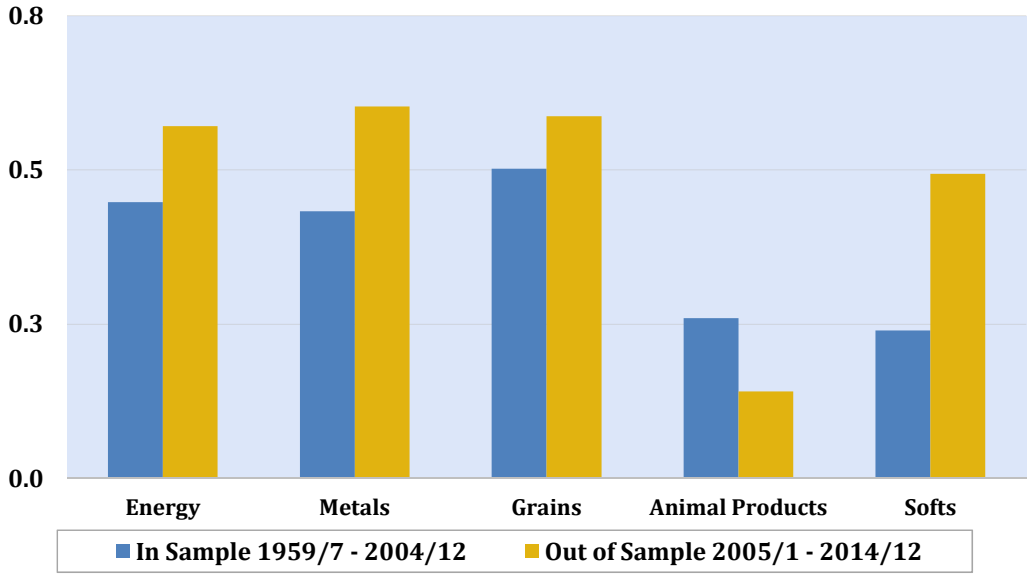
- Commodity-equity correlations that were negative during the period up to 2004 turned positive and above 0.5 during the 2005-2014 period
- By contrast the correlation between commodities and bonds has been more stable, and the additional decade of data had little effect on the estimated correlation.

Table 6: Correlations of Commodity Futures Returns with Stocks and Bonds

In-Sample 1959/7 - 2004/12		
	Stocks	Bonds
Monthly	0.05	-0.14
Quarterly	-0.06	-0.27
One Year	-0.10	-0.30
Five Year	-0.42	-0.25
Full Sample 1959/7 - 2014/12		
	Stocks	Bonds
Monthly	0.15	-0.09
Quarterly	0.09	-0.21
One Year	0.04	-0.25
Five Year	-0.26	-0.25
Out-of-Sample 2005/1 - 2014/12		
	Stocks	Bonds
Monthly	0.52	0.05
Quarterly	0.57	-0.04
One Year	0.60	-0.01

Note: Correlations are based on overlapping monthly returns data.

Figure 6: Average Correlation of Commodities with the Equally Weighted Index by Sector



Note: See table A1 for the classification of commodities into different sectors.

Some observers have linked the increase of the stock-commodity correlation to the "financialization"[5] of commodity futures markets. While this term has not been precisely defined, it attributes changes in the behavior of commodity prices to the increased participation of financial investors in commodity futures markets. Financialization, it is argued, has also contributed to an

[5] For example, see Tang and Xiong (2012). This literature is surveyed by Cheng and Xiong (2014).

increase in correlations among commodities (i.e. corn versus natural gas). If the average pairwise correlation among individual commodities were to go up, a portfolio of commodities would benefit less from natural diversification.

Figure 6 summarizes the average correlation of individual commodity returns with our equally-weighted index. With the exception of the Animal Products sector, out of sample correlations have exceeded the correlations prior to 2005. Soft commodities have experienced the largest increase among all sectors.

In the next section we examine the average pairwise commodity correlations, which appear to be at the heart of the financialization debate.

5. Investor Interest in Commodity Futures Markets

The increased interest of financial investors and the volatility of commodity prices over the past decade have fueled the debate on the influence of speculative capital on commodity futures prices.[6] The category of index investors (investors taking a long exposure to commodity futures via an index of futures) has received special scrutiny by policy makers.[7] The extent to which such financialization has influenced prices has been debated.

In principle, there are several ways in which speculative capital could influence the properties of returns:

1. *Risk premium*: to the extent that index investment represents a new source of (long) futures market participation, this increase in the supply of price insurance can lower the price paid by hedgers to obtain protection. To the extent that index investments are merely a new mechanism for financial intermediaries to lay off their producer hedging book in the futures market, index investment would simply displace the hedging by these intermediaries with little effect on the price of insurance. Because non-index speculative investment in commodity futures can be either long or short, its effect on the risk premium is ambiguous.

2. *Return correlations*: As in other asset markets, large investment flows can put pressure on prices.[8] If financial investors would become the marginal investor in commodities markets and trade simultaneously in various markets (through baskets, or index trades) their sentiment could increase the co-movement of prices relative to fundamentals.

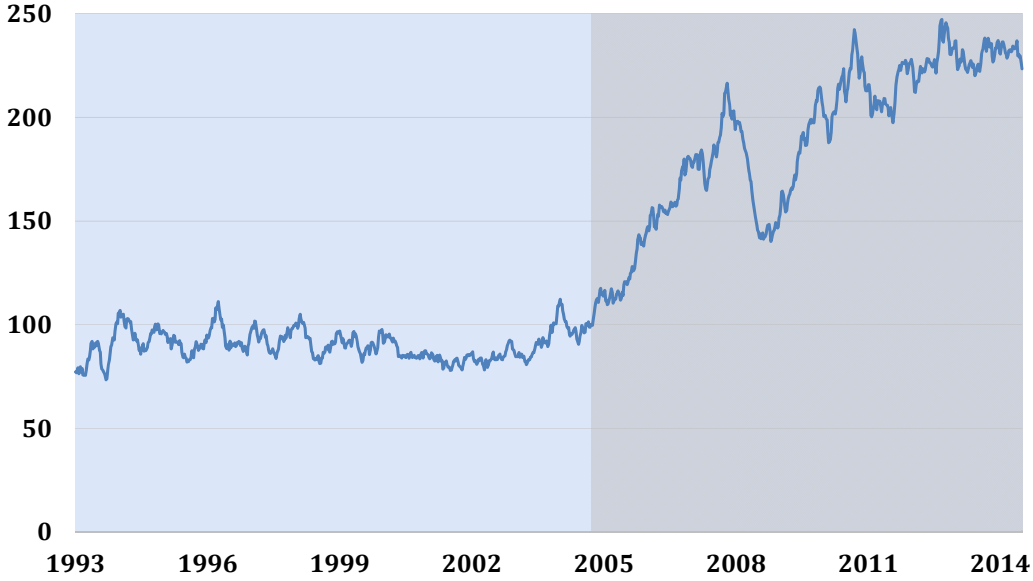
5.1 Investor flows

Inflow of investment capital by institutional investors, money managers, and other speculators has to be evaluated against changes in the size of the overall market. The analysis is complicated by a

[6] See the references in Chen and Xiong (2014).
[7] See, for example, the *Staff Report on Commodity Swap Dealers & Index Traders with Commission Recommendations* (2008), Commodity Futures Trading Commission: http://www.cftc.gov/PressRoom/PressReleases/pr5542-08 .
[8] See Wurgler (2011) who discusses this in the context of U.S. equity markets. Hau, Massa and Peress (2010) show the effects of changes in the MSCI Global Equity Index.

paucity of data. First, a large fraction of commodity trading takes place over-the-counter. The Bank for International Settlements conducts a bi-annual survey of the overall size of the OTC derivatives market, but does not provide details of positions by participants. Position data information about futures is available to the exchanges and regulators, and the weekly CFTC report on positions provides a snapshot at a very high level of aggregation.

Figure 7: EW Index of Open Interest (# of contracts, Dec 28, 2004 = 100)



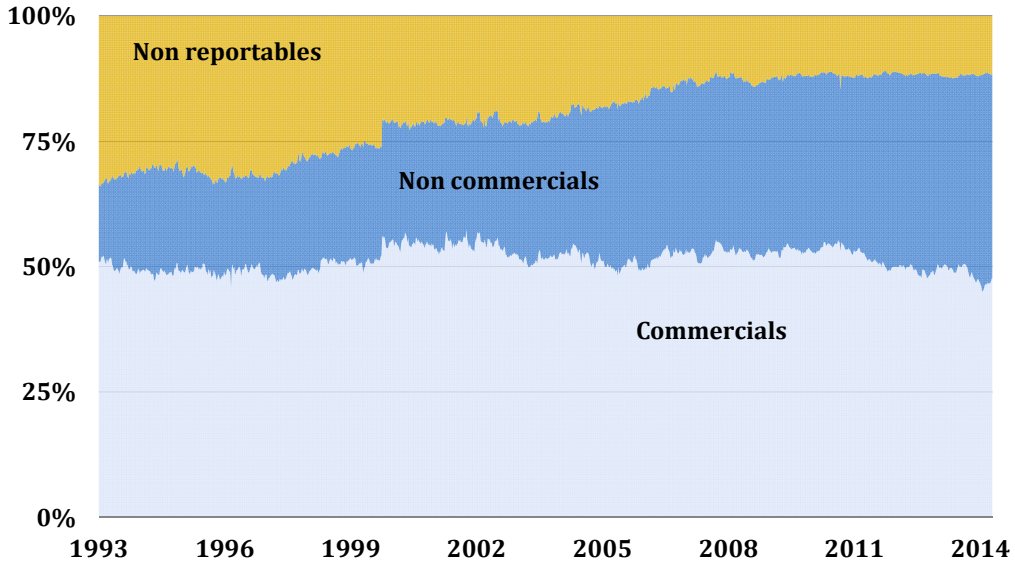
Note: The figure is based on weekly futures open interest as reported in CFTC's commitment of traders report for 27 commodities in our dataset. The commodities covered are: Heating Oil, Crude Oil, Gasoline, Natural Gas, Copper, Silver, Gold, Platinum, Palladium, Wheat, Corn, Soybean, Soybean Oil, Soybean Meal, Oats, Rough Rice, Pork Bellies, Live Cattle, Lean Hogs, Feeder Cattle, Milk, Cotton, Orange Juice, Lumber, Cocoa, Coffee, and Sugar. For each commodity we create an index of open interest, standardized such that December 28, 2004 = 100. The plotted index is the average index level across all 27 futures markets.

Figure 7 gives the growth of open interest, averaged across all futures markets for which the CFTC reports data.[9] It illustrates the growth in overall futures market participation during the out-of sample period. Despite the temporary contraction during the financial crises, the open interest for the average commodity has more than doubled since 2004.

Figure A1 in the appendix shows the breakdown of the futures open interest by commodity. It dramatically illustrates that growth in open interest occurred in almost every commodity futures market, with the notable exceptions being Pork bellies and Orange Juice. What does speculative participation look like as a fraction of open interest? A breakdown of the positions according to the CFTC's Commitment of Traders report is given in Figure 8.

[9] For each commodity we create an index of open interest, standardized such that 2004/12 = 100. The figure gives the average index level across all available futures markets.

Figure 8: Commercials (hedgers), Non-Commercials (speculators) and Non Reportable as a % of Total Open Interest



Note: The figure is based on weekly CFTC's commitment of traders report for 27 commodities in our dataset, see notes to figure 7. CFTC reports long and short positions for commercials (hedgers), non-commercials (speculators) and non-reportable. The report provides spread positions of non-commercials. Total open interest is the sum of long (short) positions across the three categories of traders and the spread positions of non-commercials. For each commodity and category we calculate the total gross positions (long plus short and twice the spread positions) as a ratio of twice the open interest. The figure plots average share for each of the three categories across the 27 commodities.

The CFTC does not classify market participants as speculators or hedgers, but instead groups participants according to their participation in physical markets (commercials versus non-commercials).[10] Subject to caveats regarding misclassification of positions, the figure indicates that commercial activity has been a stable proportion of open interest over time. The same picture also emerges from more recent classification of positions that separates out swap dealers from the commercial category in Figure 9.

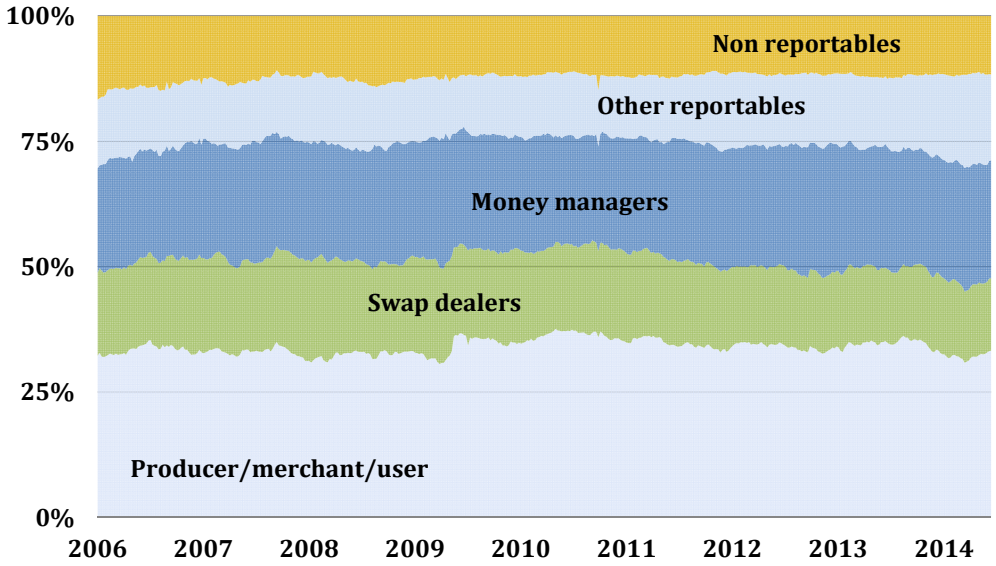
The patterns that emerge from this data are:

- Open interest has more than doubled for the average commodity since 2004. The drop in open interest of 50% during the financial crisis has been temporary. It has reversed.
- The composition of the open interest has remained remarkably stable throughout the out-of-sample period.

There is little evidence that one or more categories of futures market participants have grown disproportionally relative to the market such as to shift the distribution of interests in the market.

[10] Bona fide hedging activity would be classified as a commercial position, as would swap dealers laying off their OTC book in the futures markets would also be included in the category. If the futures hedges were for a commodity index swap, it would be recorded as a long commercial position which is speculative in nature. This is a commonly mentioned drawback of the CFTC's Commitment of Traders report.

Figure 9: Users, Swap Dealers, Money Managers, Other Reportable and Non Reportable as a % of Total Open Interest



Note: The figure is based on weekly CFTC's disaggregated commitment of traders report for same 27 commodities in figures 7 and 8. The CFTC reports long and short positions for producer/merchant /processor/user, swap dealers, money managers, and other reportables. It also provides spread positions of swap dealers, money managers, and other reportables. Total open interest is the sum of long (short) positions across the four categories and non-reportables and the spread positions. For each commodity and category we calculate the total gross positions (long plus short and twice the spread positions) as a ratio of twice the open interest. The figure plots average share for each of the categories across the 27 commodities.

5.2 Behavior of Prices and Correlations

In the previous sections we showed that in many respects futures markets behaved similarly during the past 10 years as in the prior history. The risk premium has been comparable to its long-term historical average, and, despite the more than doubling of the market, the composition of the market participants has been stable. But what has been distinct during the 2005-2014 period has been the average co-movement among stocks and commodities, and to a lesser degree commodities with each other. The question is whether this marks a permanent change – perhaps due to financialization – or whether the change is temporary, similar to the drop in open interest during the crisis. Figure 10 shows the year-by-year average correlation of commodities with equities.

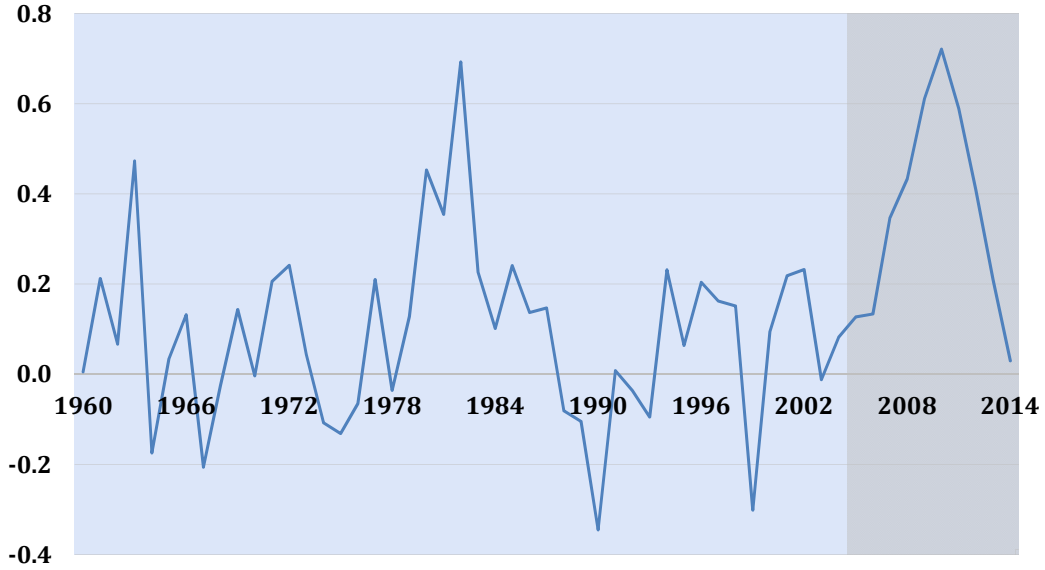
The figure shows that:

- The correlation between equities and commodities spiked during the crisis 2009-2011, but has since fallen back to a level close to zero.
- There have been earlier spikes in the correlation of similar magnitudes as the recent spike, most notably in the early 1980s and 1960s.

The fact that the spike in the correlation has been temporary, and that the composition of participants has been relatively stable (Figure 9), seems inconsistent with the financialization interpretation of the correlations.

Figure 10: Stock Commodity Correlation

Average Commodity Returns and S&P 500 Index Return 52 Week Correlation

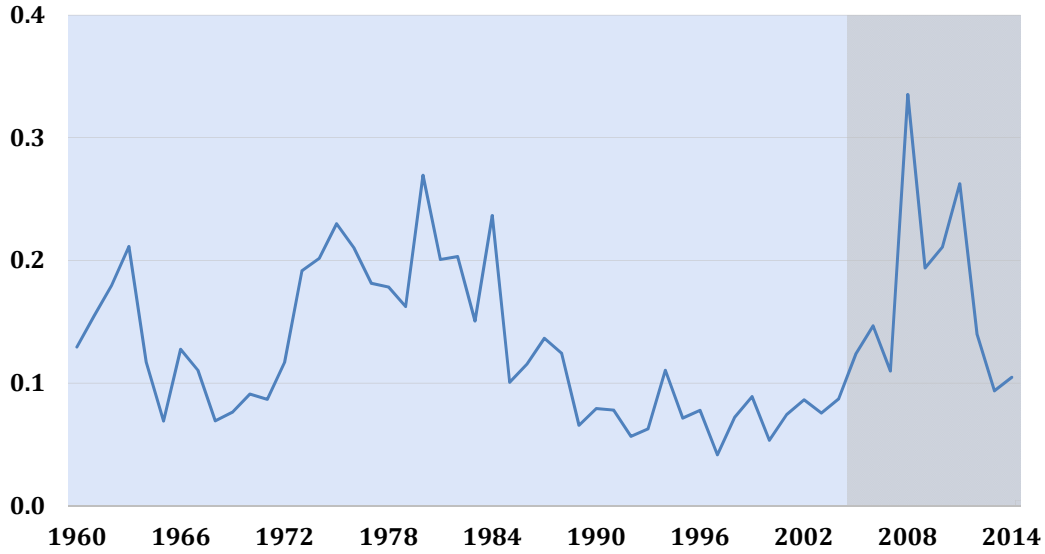


Note: Correlations are calculated using weekly data. For each year the figure plots the correlation between commodity and equity returns calculated based on 52 weekly return observations.

Figure 11 shows a similar transitory increase in the commodity co-movement.

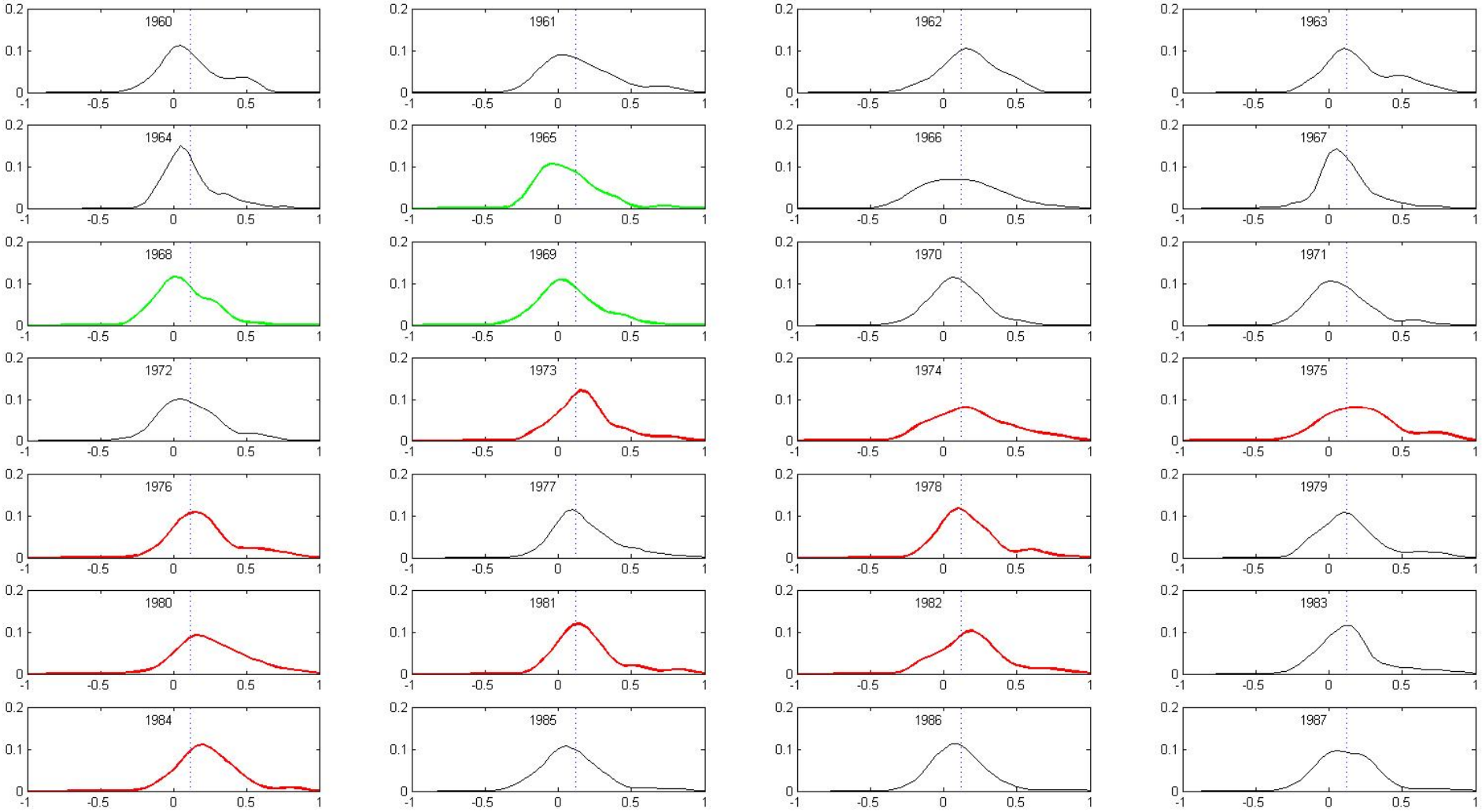
- The average pairwise correlation among commodities spiked in 2008, albeit from a relatively low level if taken in the context of the 55 year history. The increase has since reversed.
- Earlier spikes in the pairwise correlations between commodities occurred in the 1980s and 1960s.

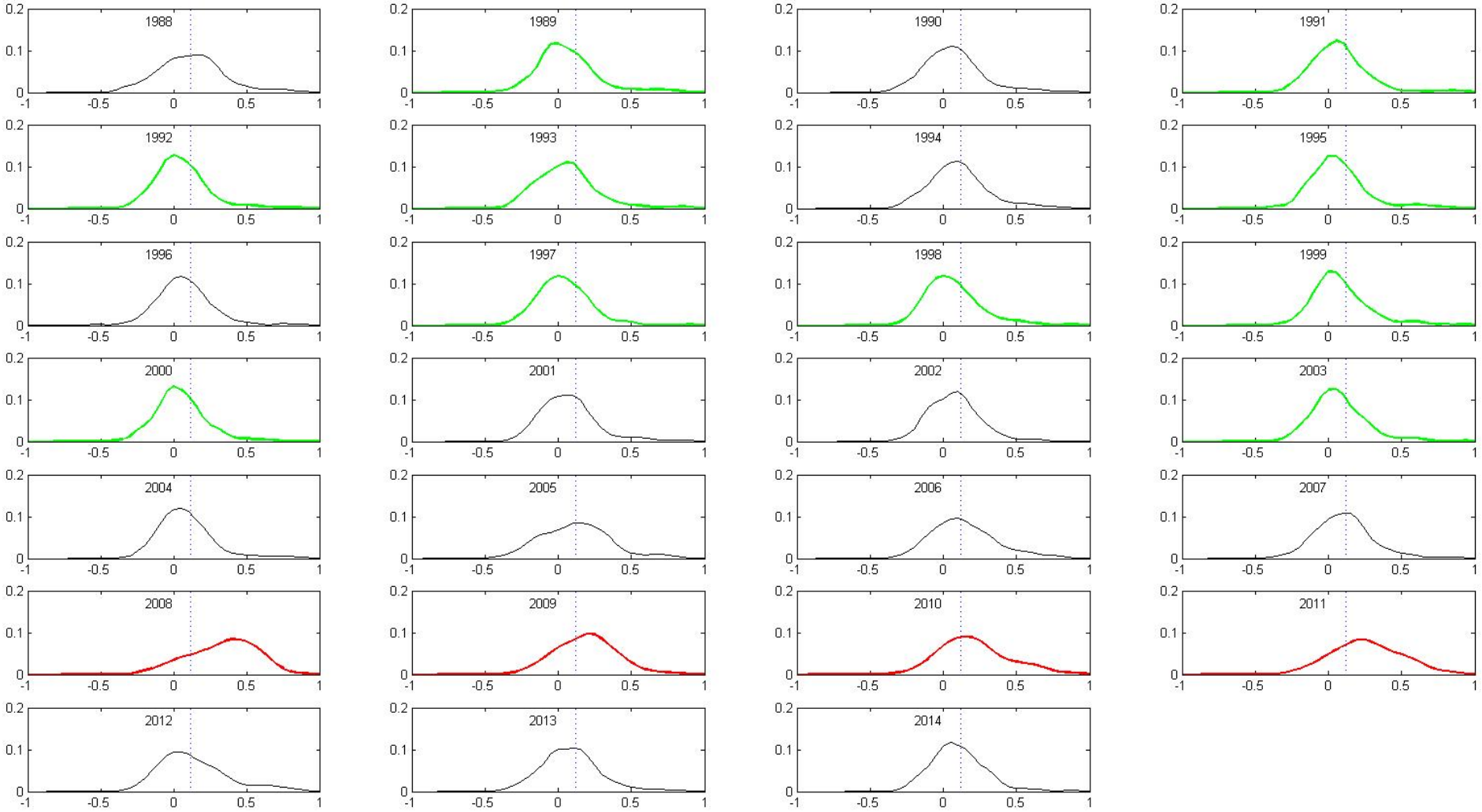
Figure 11: Average Intra Commodity 52 Week Correlation



Note: We construct the weekly commodity level future excess returns. For every year the figure plots the average pairwise correlation between all possible commodity pairs over one year period.

Figure 12: Distribution of 52 Week Intra Commodity Correlation, 1960-2014





Note: Vertical line shows the median intra commodity correlation (0.117) for the 52 week correlation plotted in figure 10. Subplots in red: 13 years with most mass to the right of median, Green: 13 years with least mass to the right of median.

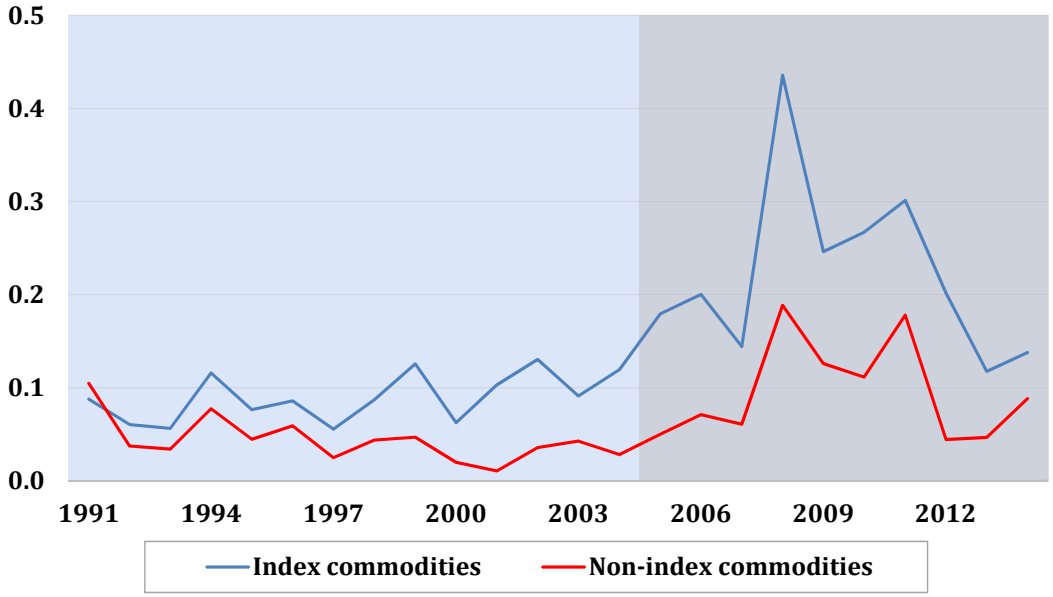
Figure 12 provides further detail by presenting the distribution of pairwise correlations by calendar year. Calendar years are further sorted into quartiles according to the fraction of their probability mass lies to the right of the median of 0.117. Years of lowest weight are colored in green, and the top quartile is colored red. The figure shows that:

- In addition to the 2008-2011 period which include the crisis, the 1973-1984 stands out as a period of high intra-commodity correlations (9 of 13 years are in the top quartile).
- The 2004–2007 period experienced inflow of institutional investor money into commodities, but does not stand out as a period with high intra-commodity correlations.

Yet another perspective is to ask whether the rise in correlations was limited to commodities that were part of a major commodity index. Figure 13 compares the average pairwise correlations of index versus non-index commodities, where "index" is defined as belonging to either the Bloomberg Commodity Index (BCOM) or the Standard and Poor's Goldman Sachs Commodity Index (SPGSCI) indices in the year 2014. This comparison would be of interest for the question whether index investment was responsible the rise in correlations.

- The intra-commodity correlations are marginally higher for index commodities than non-index commodities, although no correction has been made for the different sector composition of the two groups
- The figure shows that non-index commodities similarly experienced an increase and subsequent decrease in correlations in recent years, albeit somewhat less pronounced than index commodities.
- Both correlations among index and non-index commodities has fallen in recent years

Figure 13: Intra Commodity Correlation, Index and Non-Index Commodities



Note: Index commodities are those commodities in our dataset that are common with either the BCOM commodity index or the SP GSCI commodity Index. In 2014 nine commodities in our dataset are not in either of the public indices: Oats, Port Bellies, Orange Juice, Lumber, Platinum, Palladium, Rough Rice, Propane and

Tin. Over the years Milk, Butter, Coal and Electricity were added to our set of non-index commodities. We start the figure in 1991 when Goldman Sachs first published the GSCI, BCOM was launched later in the decade.

Marginally higher correlations among index commodities is consistent with a form of financialization that is also observed in other asset classes. Wurgler (2011) discusses this in relation to the S&P 500. He points out, for example, that when a new company is added to the S&P Index "it begins to move more closely with its 499 new neighbors and less closely with the rest of the market" (p. 5).[11]

Financialization is harder to reconcile with time-series variation of correlations, as it suggests a permanent regime shift for commodity futures markets that is not easily reversed.[12] We can ask whether the pairwise correlations of commodity futures returns are significantly out of the ordinary.

5.3 Commodity correlations and the Business Cycle

The variation of the average pairwise commodity correlations shown in Figure 11 is hard to rationalize with "financialization." Although one could attempt to imagine a scenario under which markets cyclically became "de-financialized" and then "financialized", it seems reasonable to explore what alternative explanation may be offered for the rise in correlations that could also account for its subsequent decline. We examine whether the average pairwise commodity correlations and the average stocks and commodities' correlations primarily represent business cycle movements.

Are risk premiums earned for macroeconomic risks? If this is the case to any significant extent then the risk premiums for different commodities should move together. "Business cycles" occur when there is a high pairwise correlation among a number of important macroeconomic variables (see, e.g., Sargent (1987)). The problem is that there are hundreds of macroeconomic series, making analysis difficult via, say, a vector-autoregression. For this reason, economists tend to focus on an index or factor structure. The simplest way to do this is to simply select series that capture the factor structure of the macroeconomic variables. One variable that is often used to do this is the default spread, the difference between Baa and AAA corporate yields. Chen (1991), for example, shows that the default premium tracks the health of the economy as measured by the recent growth rate of GNP and consumption.[13]

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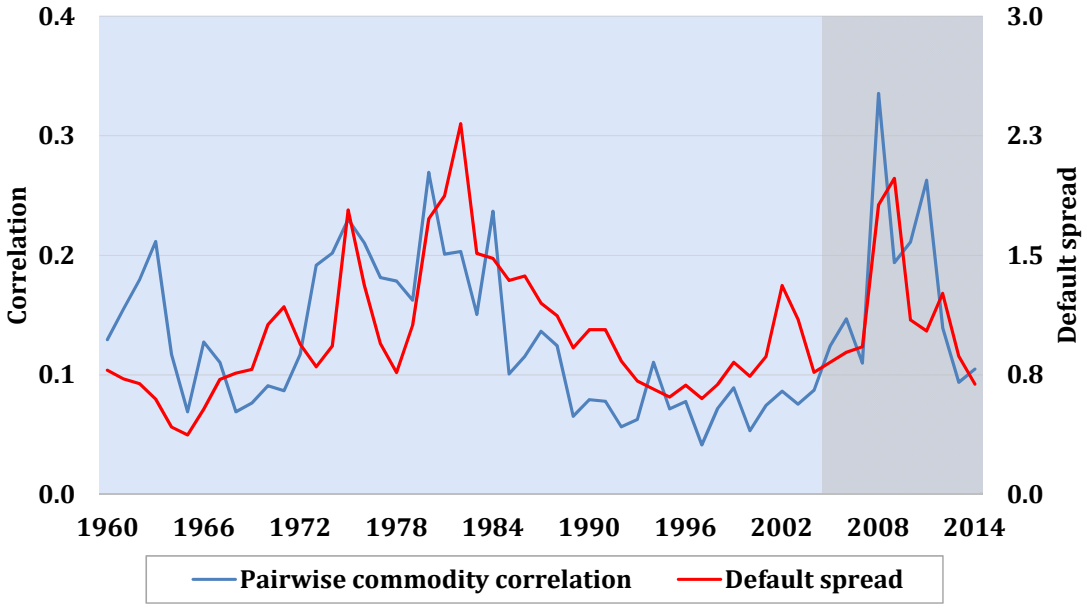
[11] Also, see Barberis, Shleifer and Wurgler (2005), and Vijh (1994). And, Sullivan and Xiong (2012) show that average pairwise correlation for price and volume changes for all stocks (on NYSE, Amex and NASDAQ) increased from October 1983 to April 2010, but there are two distinct regimes: a relatively flat regime of 1980-1996 and a positive sloped period of 1997-2010. In fact, there is a very large literature on this. Some examples include Hau, Massa and Peress (2010) show this for the MSCI Global Equity Index. Greenwood (2008) and Greenwood and Sosner (2001) examine the Nikkei 225 index.

[12] Kupiec (1991) examines the increase in the inter-market correlations for 15 OECD countries, arguing that there was a regime shift associated with the founding of the Euro zone.

[13] The importance of this variable is in line with other more recent research. Gilchrist and Zakrajšek (2012) study the predictive power of credit spreads for business cycle fluctuations. Phillippon (2009) also shows the predictive content of corporate bond spreads for the real economy. Others haves studied predicting asset returns with default spreads. Chen, Roll and Ross (1986), Keim and Stambaugh (1986), Fama and French (1989) and other researchers have documented the ability of the ex-ante default premium in the bond market (and the dividend yield in the stock market) to forecast realized asset returns due to risk premiums that vary with the business cycle.

Figure 14: Average Default Spread and Commodity Co-movement



Note: Default spread is defined as the annual average of the difference of Moody's Seasoned Baa Corporate Bond Yield (BAA), and Moody's Seasoned Aaa Corporate Bond Yield (AAA) monthly observation, Source: Board of Governors of the Federal Reserve System.

Bailey and Chan (1993) use the default spread to explain co-movement of the futures basis of individual commodities. Figure 14 plots the average pairwise commodity correlation against the average annual default spread, a measure of expected (downside) risk in the overall economy. The correlation between the two series is 0.56, which suggests an alternative explanation for the rise of commodity correlation.

Figure 14 has an intuitive message:

- Intra-commodity correlations have a strong business cycle component. Not only does the perceived downside risk explain the rise of the commodity correlation during the period of "financialization", it also explains the subsequent decline in correlations.
- The default spread seems to track temporary fluctuations in correlations in prior decades in a way that financialization does not.

To briefly examine this further, Table 7 shows the correlations of several macroeconomic time-series with the Intra-Commodity correlations and the Stock-Commodity correlation.[14] The table shows that both the intra-commodity and the stock-commodity correlations move substantially with business cycle indicators – the default spread and the annual unemployment rate in particular.

[14] These variables are not detrended.

Table 7: Commodity Correlations and Business Cycle Variables

Correlation of annual data		
	Intra Commodity Correlation	Stock Commodity Correlation
Default Spread	0.56	0.45
Treasury Spread: 10 Year - 3 Month	0.05	0.22
Average Unemployment Rate	0.50	0.52
Shiller PE	-0.52	-0.12
IP YoY change	-0.24	-0.10
Housing Start Annual Average (Thousands of Units)	-0.26	-0.34
Conference Board Coincident Composite	-0.25	-0.20

Note: Treasury Spread is defined as the annual average of difference of 10-Year Treasury Constant Maturity Rate, Monthly, Not Seasonally Adjusted; and 3-Month Treasury Bill: Secondary Market Rate, Monthly, Not Seasonally Adjusted, Source: Board of Governors of the Federal Reserve System. Average Unemployment Rate is defined as the annual average of Civilian Unemployment Rate, Monthly, Not Seasonally Adjusted, Source: US. Bureau of Labor Statistics. Shiller PE is defined as the annual average of Price earnings ratio based on average inflation-adjusted earnings from the previous 10 years; also known as the Cyclically-Adjusted PE Ratio (CAPE Ratio). Source: http://www.econ.yale.edu/~shiller/. IP YoY change is defined as the year over year change in the industrial production index, Source: Board of Governors of the Federal Reserve System.

6. Conclusion

GR (2006) made the point that most research on commodity futures has been done "with the use of short data series applying to small numbers of commodities" (p. 47). This statement still characterizes much of recent research. GR (2006) constructed a data set covering July 1959 through December 2004. The length and breadth of the series was important for reaching conclusions. For that reason we update the research in this paper.

In the original study we found that commodities had historically offered a risk premium similar to equities, and at the same time would provide diversification to a traditional portfolio of stocks and bonds. What set commodities apart from these traditional assets was their positive correlation with inflation. Here we provide 10 years of additional data. Although a decade is sometimes too short to draw firm conclusions, our-of-sample period is rich because it includes a global economic expansion led by the industrialization of China, a housing boom and bust in the United States, the largest financial crisis since the Great Depression, followed by a monetary policy stimulus response which has driven interest rates around the world towards zero.

Commodity markets have continued to grow during this period, although the composition of traders has been remarkably stable over time.

Many of the basic conclusions of the original study continue to hold. The average risk premium to commodity futures was 3.7% per annum. The risk premium has been comparable to its long-term historical average, and, despite the more than doubling of the market, the composition of the market participants has been stable.

The longer time series history of commodity markets shows that the rise in correlations occurs in periods of heightened financial risk/turmoil associated with macroeconomic activity. This feature is shared by many asset classes.[15] Commodity correlations have spiked during the financial crisis, in a way that resembles other episodes of increased risk in history. The fundamental relationship between return and risk (as measured by carry) has been similar across the in-sample and out of sample period.

There are many areas for future research. We indicate three.

First, how does the growth of commodity futures markets affect the required risk premium for transferring price risk? Our preliminary analysis of the CFTC data in this paper suggests that futures markets for the "average" commodity have grown proportionally, attracting at the same time both new hedgers as well as new speculators. Does this mean there was a latent demand for hedging, limited by speculative participation? If growth in open interest had been entirely fueled by increased speculation, the new supply of insurance capital would likely reduce the cost of insurance. Was the growth of futures markets paralleled by growth in the OTC markets? Or is the futures growth replacing OTC activity? For example, as banks reduce their appetite for hedging future commodity price risks for clients over-the-counter because of Dodd-Frank and other regulations, this hedging demand may end up at futures exchanges (Etula (2013)).

A second area of research concerns the impact of "speculation" on market prices. The economic function of a futures market is to transfer price risk. Those shedding risk are often considered hedgers and those assuming the risk are usually called "speculators." Since the beginning of organized futures markets in the 1870s in the U.S, there has been controversy about the influence of speculators on the level and volatility of prices. The work of Working (1953, 1960), Gray (1960, 1967), and Hieronymus (1971) has been influential in framing relevant questions in this area. What is the effect of futures transactions other than those intended to accommodate the demands by hedgers? The debate is complicated by the fact that we lack a proper definition of hedgers and speculators. As noted by Hart and Kreps (1986): "Despite the many attempts [define speculation] in the literature, a satisfactory general definition is still not available (and probably never will be. . .)" (p. 928). For example while transactions by commercial traders (under the CFTC trader classification) are typically considered hedging activity, some of their trading is likely speculative in nature.

Both of these research areas could tremendously benefit from access to data that is collected but not widely available to academic investigators. Unlike other financial markets, futures markets are unique in that exchanges (CME, ICE) and regulators (CFTC) have access to holdings data of all participants, and provide a near complete transaction history.

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[15] For example, King and Wadhawani (1990) test for an increase in stock market correlations between the United States, the United Kingdom and Japan following the U.S. market crash of 1987. They find a significant increase in cross-market correlations. Campbell, Lettau, Malkiel and Xu (2001) show that the average pairwise correlations of individual stocks on the NYSE and NASDAQ are trending downwards, due to an increase in idiosyncratic volatility, the correlations increase in recessions. Aggregate market volatility is countercyclical.

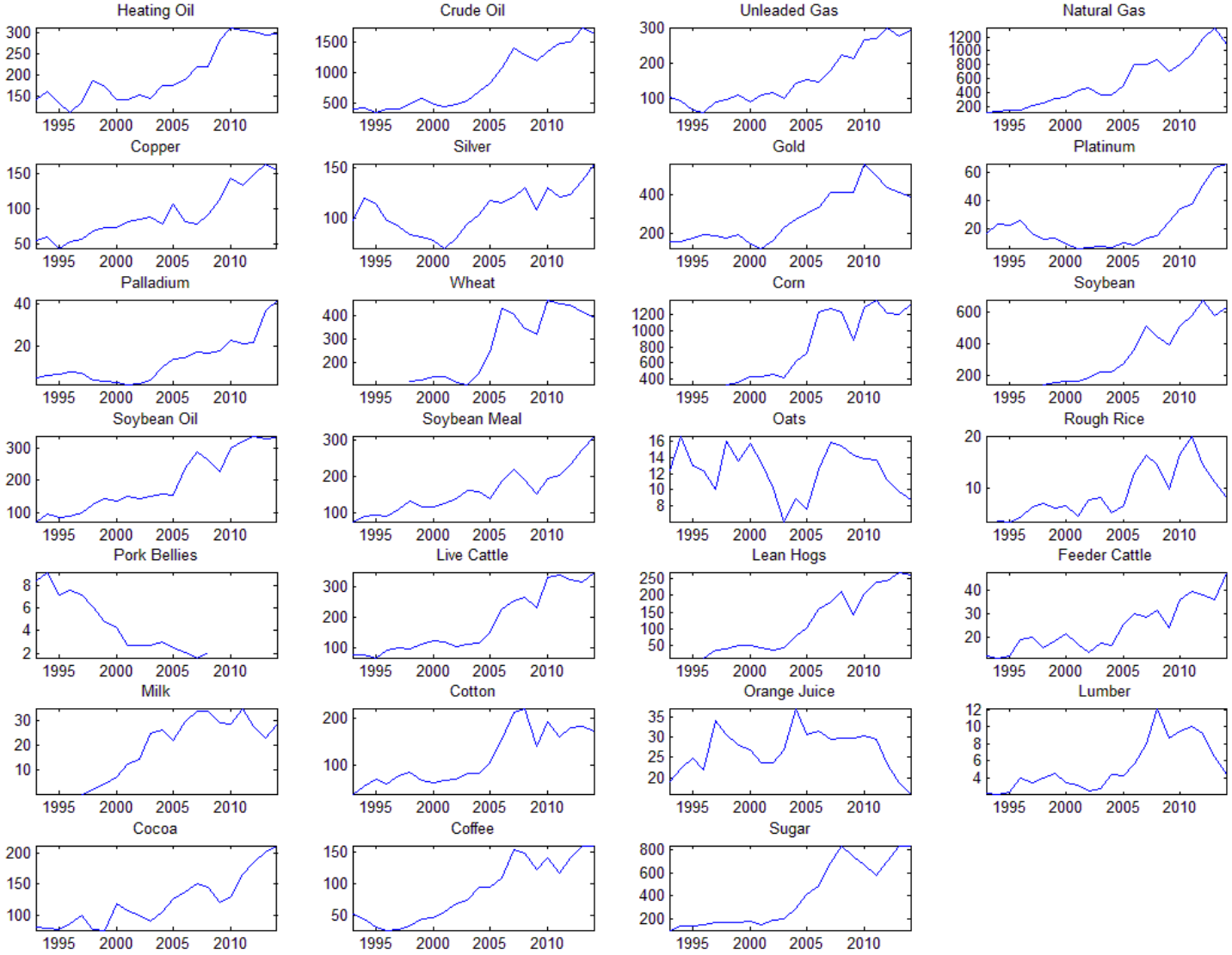
Finally, why do some commodity futures contracts succeed, while others do not? Commodity exchanges are increasingly for-profit enterprises which in part will need to compete by answering this question. Gray (1966) identifies three reasons why a contract might fail (see also Black (1986), and Till (2014)). First, the contract may be poorly designed. Second, parties with market power might boycott a futures contract, and use the over-the-counter forward market instead. Third, there may be a failure to attract speculators. This is a practical question of security design as well as an issue of where the latent demand for insurance lies.

Table A1: List of commodities in the equally weighted Index

	Name	Quotes start	Index inclusion date	Sector
1	Heating Oil	11/14/1978	11/30/1978	Energy
2	Crude Oil	3/30/1983	3/31/1983	Energy
3	Unleaded Gas	12/3/1984	12/31/1984	Energy
4	Propane*	8/21/1987	8/31/1987	Energy
5	Natural Gas	4/4/1990	4/30/1990	Energy
6	Coal	7/12/01	7/31/01	Energy
7	Electricity	4/11/03	4/30/03	Energy
8	Copper	7/1/1959	7/1/1959	Metals
9	Silver	6/12/1963	6/30/1963	Metals
10	Platinum	3/4/1968	3/31/1968	Metals
11	Gold	12/31/1974	12/31/1974	Metals
12	Palladium	1/3/1977	1/31/1977	Metals
13	Zinc	1/3/1977	1/31/1977	Metals
14	Lead	2/1/1977	2/28/1977	Metals
15	Nickel	4/23/1979	4/30/1979	Metals
16	Aluminum	6/1/1987	6/30/1987	Metals
17	Tin	7/3/1989	7/31/1989	Metals
18	Wheat	7/1/1959	7/1/1959	Grains and Oilseeds
19	Corn	7/1/1959	7/1/1959	Grains and Oilseeds
20	Soybeans	7/1/1959	7/1/1959	Grains and Oilseeds
21	Soybean Oil	7/1/1959	7/1/1959	Grains and Oilseeds
22	Soybean Meal	7/1/1959	7/1/1959	Grains and Oilseeds
23	Oats	7/1/1959	7/1/1959	Grains and Oilseeds
24	Rough Rice	8/20/1986	8/31/1986	Grains and Oilseeds
25	Pork Bellies*	9/18/1961	9/30/1961	Animal Products
26	Live Cattle	11/30/1964	11/30/1964	Animal Products
27	Lean Hogs	2/28/1966	2/28/1966	Animal Products
28	Feeder Cattle	11/30/1971	11/30/1971	Animal Products
29	Milk	1/11/1996	1/31/1996	Animal Products
30	Butter	9/5/1996	9/30/1996	Animal Products
31	Cotton	7/1/1959	7/1/1959	Softs
32	Cocoa	7/1/1959	7/1/1959	Softs
33	Sugar	1/4/1961	1/31/1961	Softs
34	Orange Juice	2/1/1967	2/28/1967	Softs
35	Lumber	10/1/1969	10/31/1969	Softs
36	Coffee	8/16/1972	8/31/1972	Softs

* Propane and Pork Bellies futures were delisted. The last month of returns for Propane is September, 2009; while that for Pork Bellies is July, 2011.

Figure A1: Average annual open interest, '000 of Contracts



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