Risk Premia in Commodity Futures Markets – An Out-of-Sample Test

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The authors of the comprehensive paper document the properties of the first diversified commodity futures index introduced by the Dow Jones & Company in 1933 and use its live track record to study the properties of the asset class in an experimental setting that does not suffer from backfill, selection, or survivorship biases. Despite the setbacks posed by contract failure and trading suspensions of several index constituents, the index appreciated by 3.7% per year between 1933 and 1998, while an investment in collateralized front-month futures returned 4.5% in excess of the risk-free rate. The authors quantify the impact of trading suspensions and contract failure on estimates of the risk premium.

Do Commodities Futures Contain a Risk Premium?

The existence of a risk premium in commodity futures markets continues to be the focus of debate among academics and practitioners. Theoretical arguments have been made both in favor of and in opposition to such an idea. For the detractors, commodity futures contracts are in zero net supply. Each seller of a futures contract has a buyer, so there is no reason to believe that the risk premium consistently goes either way.

Famed financial economist Kenneth French presented this view against a positive commodity risk premium in no uncertain terms:[1]

"*The claims that, going forward, commodity funds (i) will have the same Sharpe ratio as the stock market, (ii) will be negatively correlated with the returns on stocks and bonds, and (iii) will be a good hedge against inflation can't all be true. Who would want the other side of this trade*?"

Proponents of a positive commodity risk premium go back at least to John Maynard Keynes. Decades prior to Modern Portfolio Theory, Keynes hypothesized that futures contracts are set at a discount relative to expected futures prices to compensate speculators for taking on price risk (Keynes, 1930). In a similar vein, Working (1933) and Kaldor (1939) develop the Theory of Storage, which posits a positive risk premium as a function of convenience yield.

Early empirical studies yielded mixed results. In a review paper, Gray and Rutledge (1971) question the existence of a risk premium. In contrast, Bessembinder (1992) documents a link between commercial hedging demand for futures contracts and positive risk premia. Gorton and Rouwenhorst (2006), using a much larger set of commodities, find strong evidence of a risk premium at the commodity index level of a comparable magnitude to the equity premium, although Erb and Harvey (2006) ascribe that premium to the periodic rebalancing of the index.

More recent empirical analysis offers more persuasive support for the existence of commodity risk premia. Using significantly enlarged data sets that start in the 19th century, Levine *et al*. (2018) and Bhardwaj *et al*. (2019) document that commodities have a positive risk premium going back 150 years.

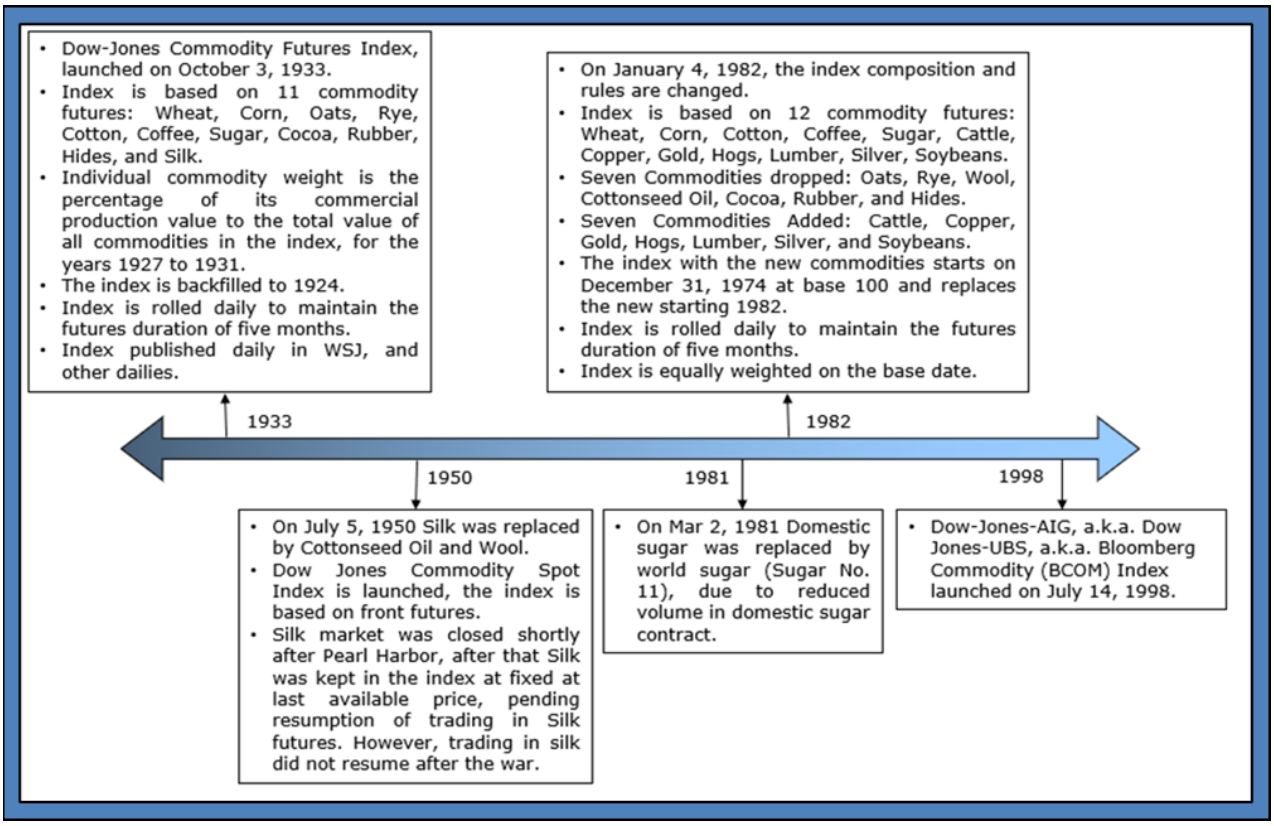
Empirical studies investigating risk premia feature prominently back-tested portfolio returns. The aphorism, "I have never seen a bad back test," captures the skepticism among investment practitioners when evaluating the merit of hypothetical portfolios, an issue also recognized by academic researchers (*e.g.*, Lo and MacKinlay, 1990; McLean and Pontiff, 2016; Harvey *et al*., 2016).

Not accounting for contract failure can lead to an upward bias in estimates of risk premia (Bhardwaj *et al*., 2019). With mounting evidence of a positive commodity risk premium, the question becomes whether the observed risk premium truly reflects a commensurate compensation for investors or is merely a result of selection bias. Does a positive commodity risk premium only account for the results of successful futures contracts and relegate the contract failures to be quietly forgotten? Would we still observe a positive risk premium if commodity futures were chosen with no forward knowledge? Bhardwaj *et al*. (2021) tackle the above questions using a portfolio formed in real time under the prevailing market conditions – an investable index of commodities.

The Dow Jones Commodity Index of 1933

What can the Dow Jones Commodity Index (DJCI) contribute to the risk premium debate? For one, it represents a long (60+ years) track record of a portfolio of commodities selected by an expert index provider dating back to 1933. The index constituents were selected to be representative of the overall commodity market over time, in the same way shares of a small group of industrial companies were selected for the Dow Jones Industrial Average (DJIA). The portfolio was determined in real time, without the benefit of hindsight, *i.e.*, a focus on commodities that would survive to become important today. Just as the DJIA included companies that eventually went bankrupt, the DJCI included commodity contracts that failed (notably silk). Such a long track record is not only rare, but it also avoids many of the pitfalls and of back-tested portfolios used in academic research. Figure 1 on the next page provides an overview of the evolution of the DJCI.

Figure 1
Timeline of the Dow Jones Commodity Index



The DJCI was a spot price index. As such, the change of the index does not represent a rate of return. In order to study the investment returns of the constituent commodities, Bhardwaj *et al*. (2021) calculate the rolling futures returns on the DJCI commodity set in a similar fashion as modern rolling futures indices such as the S&P GSCI Commodity Index (SPGSCI) or Bloomberg Commodity Index (BCOM).

Findings

The rolling futures-based Dow Jones Commodity Index has higher average returns compared to the spot-based DJCI. The futures index earned an average return of 8.5% per year (including collateral return in T-Bills) compared to 3.7% for the spot index. Risk premiums are total returns in excess of the risk-free T-Bill rate, which averages about 4% between 1933 and 1998. The commodity futures premium of 4.5% sits between the equity premium (9.1%) and the bond premium (1.6%). Table 1 on the next page presents a summary of the performance statistics.

Certain commodities experienced trading disruptions (such as WWII) or failures. The DJCI became "underinvested" during these periods. Bhardwaj *et al*. (2021) find that after correcting for underinvestment, the risk premium of the futures-based DJCI is 5.4%, exceeding its underinvested counterpart by 0.9% per annum. This figure offers an estimate of the impact of conditioning on contract survival and tradability for the measurement of the risk premium.

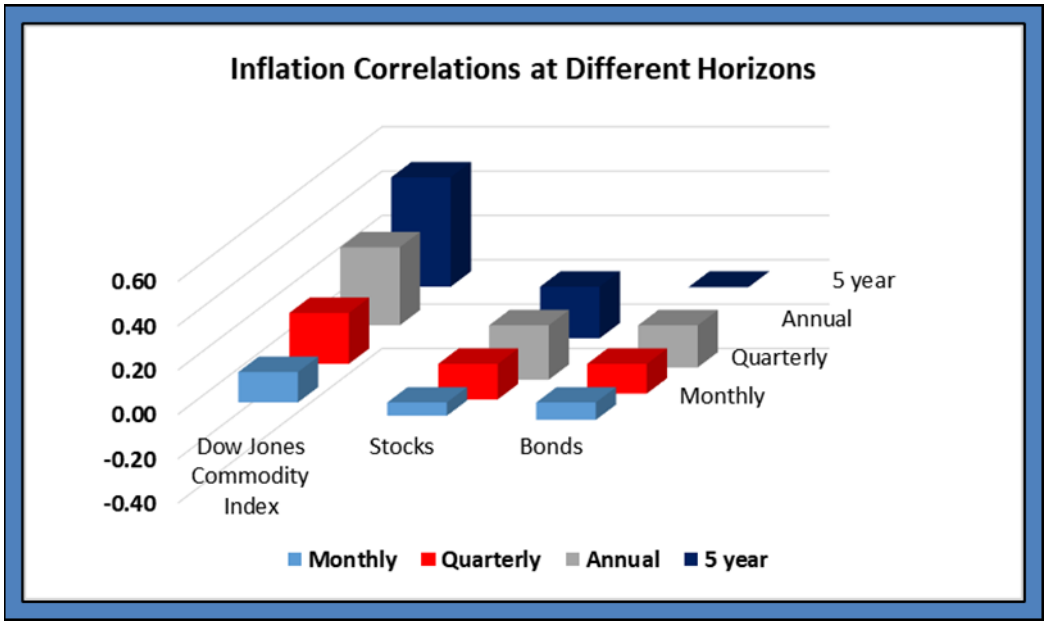
Table 1
Performance Statistics

	Dow Jones Commodity Index	Dow Jones Index Futures TR	Stocks	Bonds
Total Returns	3.7%	8.5%	13.1%	5.6%
Volatility	12.4%	13.0%	15.9%	7.9%
Sharpe Ratio		0.34	0.57	0.20
Risk Premium		4.5%	9.1%	1.6%
Max Drawdown		-44%	-50%	-21%
Skewness		0.66	-0.46	0.88

The estimate of the commodity futures risk premium using the DJCI is very much in line with Gorton and Rouwenhorst (2006) as well as with the longer-term studies of Levine *et al.* (2018) and Bhardwaj *et al.* (2019). It strengthens the overall evidence in support of a positive risk premium in commodity futures.

The study also includes a discussion on the portfolio properties for commodities. From October 1933 to November 1998, the Dow Jones Commodity Index proved to be a useful inflation hedge. On an annual basis, the correlation of inflation and DJCI is 0.35, compared to -0.25 for stocks and -0.19 for bonds. Bhardwaj *et al*. (2021) also find that the DJCI is essentially uncorrelated with stocks and bonds, posting a pairwise correlation of -0.04 with both stocks and bonds over the full sample. Correlations at different horizons are shown in Figure 2. These properties echo existing findings using back-test portfolios (*inter alia*, Gorton and Rouwenhorst, 2006).

Figure 2
Inflation Correlations for Different Assets and Horizons



Summary

Existing work examining risk premia in commodity markets may overstate the true risk premia because back-tested portfolios often do not account for contract failures or trading disruptions. To overcome potential issues associated with back tests, Bhardwaj *et al*. (2021) use a novel data set free from survivorship bias. The Dow Jones Commodity Index was an index calculated in real time based on prevailing market conditions. Critically, this index does not, and could not, include any information from the future in its construction.

Bhardwaj *et al*. (2021) document a positive risk premium for the DJCI, providing corroboration of a positive risk premium in commodity futures. In particular, the authors conclude two important findings. First, a positive commodity risk premium is present over a long time frame not covered in most commodity databases. Second, the commodity risk premium is positive after adjusting for survivorship bias. The paper also documents diversification and inflation-protection properties that commodities as an asset class provides.

Endnote

1 French (2010).

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Rajkumar Janardanan is a portfolio manager and a member of the research team at SummerHaven Investment Management in Stamford, CT. At SummerHaven he has been involved in collecting the largest history of commodity price data from futures exchanges going back to 1870s. He has also published articles in the *Journal of Commodity Markets*, *Journal of Futures Markets*, and *Journal of Indexes*. Rajkumar has a Bachelor's degree from the Indian Institute of Technology, Madras and an M.B.A. from Yale School of Management.

Rajkumar Janardanan's previous research was featured in the *GCARD* article, "On Commodity Price Limits."