The First Commodity Futures Index of 1933*

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Abstract

We 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. We quantify the impact of trading suspensions and contract failure on the estimates of the risk premium.

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1. Introduction

Commodity futures contracts are important financial instruments for commodity producers, users of commodities, speculators, and investors to manage their exposure to the price risk of physical commodities. Modern futures markets can trace their origins to the Dojima rice market in Osaka, which started trading rice futures in the early 18th century.[1] In the United States, commodity futures have traded for close to 150 years. The Chicago Board of Trade (CBOT) established in 1848 was the first exchange to trade grain futures contracts. The New York Cotton Exchange, founded in 1870, and The Butter and Cheese Exchange of New York, founded in 1872, were other early entrants. In the United Kingdom, the London Metals and Mining Company was formed in 1877 to trade copper and other industrial metals forward contracts.

While commodity futures markets have been around for centuries, commodity futures indices, designed to track the investment performance of the broad market, are a more recent innovation. In 1958, the Commodity Research Bureau ("CRB") published a commodity futures price index tracking a basket of 28 commodities. The CRB index lacked the basic properties of an investable futures index because several of the constituent prices were taken from spot markets instead of futures markets,[2] and the index was geometrically weighted.[3] The origin of investible commodity futures indices is often linked to the creation of the Goldman Sachs Commodity Index ("GSCI") in 1991, followed in 1998 by the Dow Jones-AIG Commodity Index ("DJAIG").[4]

The first contribution of this paper is to document the existence and properties of the Dow Jones Commodity Index ("DJCI"), a futures-based commodity index that predates modern commodity indices by almost 60 years and was calculated in real time between 1933 and 1988. Despite its extensive "live" history, this index has received relatively little attention from academics and practitioners. Second, we use the historical setting to conduct an out-of-sample test of several stylized facts about commodity futures that have been debated in the literature: the existence of a commodity futures risk premium, the portfolio properties of commodity futures, and the source of time variation in the correlation between commodity futures and equities in an era that

[1] Rice served as currency in the Tokugawa economy, and merchants started trading rice futures during late 17th century. the practice was however considered illegal and considered a form of gambling by the shogunate. Following a series of good crops and a drop in the price of rice, the shogunate lifted the official ban on futures transactions in 1728; see, Hamori et al. (2001), and Moss and Kintgen (2010).

[2] The two commodities were New Orleans Cotton and Minneapolis Wheat. The spot commodities continued to be constituents of the index until 1973. Between 1958 and 2005 the index went through 10 methodology revisions. See the Commodity Research Bureau (2008) yearbook, and Gregoriou (2008).

[3] A geometric index cannot be duplicated by a self-financing portfolio, and its growth rate does not correspond to the return on an existing financial asset. See Eytan and Harpaz (1986), and Ritter (1996) for a colorful narrative describing the pitfalls of trading futures on a geometric index.

[4] See Greer (1978, 2000) for other examples of early investable commodity indices. At the time of launch, Goldman Sachs backfilled the index to January 1970; the Dow Jones index of 1988 published a backfilled history to 1991.

predates “financialization” of the markets. The index provides a natural laboratory to study these questions, because its live track record does not suffer from backfill, selection, or survivorship biases. The index composition reflects the real-time choices made by for-profit index providers without the benefit of hindsight. Third, using the DJCI commodity set as a backdrop, we illustrate how contract failure and trading suspensions can affect estimates of the commodity risk premium.

Long-lived track records that can be used to test financial hypothesis are rare. Back-tested portfolio returns feature prominently in academic research and practical applications alike. “I have never seen a bad back test” captures the skepticism among many investment practitioners when evaluating the performance of hypothetical portfolios, and the pitfalls of using hindsight have long been recognized in the academic literature as well. Examples include Lo and MacKinley (1990), who analyze the role of data snooping in tests of asset pricing models. In commodities markets, Elton, Gruber and Renzler (1987, 1989) document that publicly traded commodity funds significantly underperform the track records reported in their prospectus at the time of launch. More recently, McLean and Pontiff (2016) and Harvey, Liu and Zhu (2016) discuss the out-of-sample performance decay of many stock market “anomalies”.

At the time of launch of the GSCI and the DJAIG, the index sponsors published a backfilled index return history. The usefulness of this history can be diminished by factors that bias its performance, such as data snooping and conditioning on surviving contracts. For example, when the GSCI index was launched in 1991, Goldman published a backfilled index history to 1970. In this calculation, the prices of the index commodities at the time of launch are traced back in time, implicitly conditioning on the 20-year survival of the index constituents. This matters for two reasons. First, Bhardwaj et al. (2019) show that not accounting for contract failure can lead to an upward bias in estimates of average futures returns. Second, conditioning on survival can skew index weightings in a backfilled sample if new contracts emerge gradually over time. Returning to our example: the GSCI is known for its large weight on energy futures, but it held positions in only 5 commodities between 1970 and 1973, none of which included energy. As of February 1970, 55% of the GSCI was invested in Live Cattle and 22% in Chicago Wheat. Its Sugar weight in 1974 was 33% (see Dunsby et al (2008)). It seems unlikely that investors seeking diversified exposure to commodities in the early 1970s would have chosen this particular commodity set and weightings, either as an investment or as a performance benchmark – especially considering that more than 30 contracts were actively quoted in newspapers around that time (see Bhardwaj et al. (2019)). It is for these reasons that the study of a commodity set with a long live history that embeds real-time selection decisions is of interest to researchers and practitioners alike. The commodity set tracked by the DJCI may at times seem “suboptimal” in

retrospect, but that is the point of the exercise. Specifically, we will estimate the impact of contract failure and trading suspensions on the performance of the DJCI.

The Dow Jones Commodity Futures Index was launched in October of 1933 and is to our knowledge the first broad-based commodity futures price index. The index methodology remained unchanged until 1982 when the index construction rules and constituents were substantially revised. From inception, the index was calculated hourly and reported on the Dow Jones news ticker. Daily index closing levels were published in multiple national newspapers including the Wall Street Journal and the Chicago Tribune. Dow Jones published an annual "Dow Jones Commodities Handbook" with index data and methodology. The company also published a backfilled index history to 1924 around the time of the index launch. For the reasons mentioned earlier, we discard the backfilled data in our analysis and begin our sample in the month when the index first went live. Our sample ends in 1998 when Dow Jones partnered with AIG to co-brand the DJ-AIG Commodity Index.[5]

Because the DJCI is a price index, the rate of change of the index level does not correspond to an investment return.[6] We construct a self-financing "rolling futures" portfolio of the DJCI index commodities using monthly futures prices of the individual index constituents. We use this total return index to re-examine the properties of commodities as an asset class that have been reported in the recent literature: the presence of a risk premium, the ability to hedge against inflation, and the ability to provide diversification from traditional asset classes such as stocks and bonds.[7] Our analysis follows the roadmap laid out in Bhardwaj, Gorton and Rouwenhorst (2016). We also study the time-series variation in the correlation between stocks and commodities and link this variation to the business cycle during the "pre-financialization" era of commodity futures.

Our main findings are as follows: over the full sample period, the Dow Jones Commodity Index (DJCI) appreciated at a rate of 3.7% per annum, compared to a total return of 8.5% per year for the self-financing portfolio. The futures component of the investible index, representing the risk premium, accounted for 4.5%. This estimate is very similar to the premium reported in Gorton and Rouwenhorst (2006), albeit measured over a different time period, and a different set of commodities. Leaving sampling variation aside, we show that the historical performance of the DJCI is negatively impacted by several adverse events during a period when average returns to commodities futures were high. Contract failure and trading suspensions caused the index to

[5] Both the DJCI and the DJ-AIG indices existed side by side for a brief period, and it is not known why the DJAIG index was not positioned as a reconstitution of the DJCI and inherit its track record.

[6] We have greatly benefited from correspondence with Bob Greer clarifying this aspect of the index construction of the DJCI.

[7] See for example, Bodie and Rosanski (1980), Gorton and Rouwenhorst (2006) and Levine et al (2018).

periodically become "underinvested" in futures. We estimate that these adverse events have likely negatively impacted our estimate of the full sample premium by almost 1%. Despite these adverse effects, our estimate of the risk premium of 4.5% is significantly different from zero (*t*-stat = 2.8). Second, we investigate the returns to commodity futures over the business cycle and inflation cycle. We find positive monthly correlations between the DJCI and inflation, which increases with the investment horizon and reach a maximum of over 0.6 at a five-year horizon. These correlations are of interest, because the DJCI never included energy futures among its index constituents. It illustrates that energy exposure is not critical to the inflation hedging properties of commodity futures. Third, we confirm that commodity futures returns are strongly pro-cyclical, as documented by Gorton and Rouwenhorst (2006). Finally, we examine time variation in the stock-commodity correlation that has been suggested as a barometer of commodity market "financialization" (Tang and Xiong (2012)). Consistent with Bhardwaj, Gorton and Rouwenhorst (2016) we find that the business cycle is an important driver of time-variation in this correlation during our pre-financialization sample.

The paper is laid out as follows. We discuss data sources and details about the history and the construction of the DJCI in Section 2. Section 3 presents estimates of the commodity risk premium under various assumptions about rebalancing and the impact of contract failure on the returns. In Section 4, we discuss the portfolio properties of the DJCITR index, including the correlation with inflation and the business cycle. Section 5 concludes.

2. Data Description and Index History

2.1 Data.

Monthly closing prices for the Dow Jones Commodity Index were hand collected from the *Wall Street Journal*. Futures price data for the constituent commodities was collected from the yearbooks published by the *Chicago Board of Trade* (CBOT), the *Chicago Mercantile Exchange* ("CME"), and the *Annual Report of the Chamber of Commerce of Minneapolis* ("CCM"), when available, and from newspapers; *The New York Times*, the *Wall Street Journal* and the *Chicago Tribune*. A data appendix with the monthly returns for the index and the constituent commodities is available from the authors. For additional detail on the data collection process see Bhardwaj et al (2019). For the return on bonds we use the Citi U.S. Broad Investment Grade Bond Index prior to 1991, and the Bloomberg/EFFAS 10+ Year Bond Index post 1991. Total stock returns are for the S&P500 index. Recession and Expansion periods are based on phases identified by the National Bureau of Economic Research ("NBER").

2.2 Index History.

Dow Jones announced the creation of "Dow Jones Index of Commodities" on October 3, 1933. According to the Wall Street Journal article in Figure 1, the DJCI is "an index of commodity futures prices that is designed to show the fluctuations during the day of commodities enjoying active speculative markets (…). The index is based upon 11 commodities, each of which is actively traded in on a futures basis on one of the country's organized exchanges." The index was calculated hourly and published on the Dow Jones news ticker and bulletins. Commodities included in the index covered three sectors: grains (Wheat, Corn, Oats, and Rye), softs (Cotton, Coffee, Sugar, Cocoa, Silk and Rubber) and animal products (Hides). Index weights of the individual commodities were based on the average value of total production and trading activity over the five-year period from 1927 to 1931. Panel A of Table 1 reports the index weights at inception.

Little is known about the exact reasons for selecting these particular eleven commodities, or for that matter the exclusion of other notable commodities that were trading at that time. For example, in considering contracts from the animal products sector, obvious other candidates would include the Chicago Lard contract that had been trading since the 1870s, Chicago Butter (1926) and Chicago Eggs (1926).[8] Industrial Metals were excluded altogether, despite the presence of Copper (1909), Tin (1905) and Zinc (1915) contracts that traded in New York.

In the context of modern commodity futures indexes, some aspects of the design of the DJCI would be considered "advanced" from today's perspective. In particular, the index holdings were expanded beyond short-dated futures contracts to target a duration of five months.[9] The index calculated a weighted average of the prices of two futures contracts per commodity, and rebalanced daily to achieve the desired average five-month duration.

The DJCI was launched during the Great Depression and futures prices stayed relatively range-bound despite considerable volatility. However, the onset of the Second World War brought about changes to the commodity markets, that led to the first DJCI reconstitution. Silk futures stopped trading soon after the attack on Pearl Harbor in 1941. For the purpose of index calculation, Dow Jones initially assumed that silk prices remained fixed at their last quoted

[8] These alternatives are based on data described in Bhardwaj, Janardanan and Rouwenhorst (2019) who document historical futures prices published by newspapers in the US and the UK. Presumably these represent commodities that were of sufficient economic importance to merit newspaper coverage.

[9] The GSCI Index and other "first generation" indices invest in a single nearby futures contract for each commodity, which introduces the periodic need to roll from expiring contracts to the next nearest contract. The predictability of these roll trades introduces the possibility of Front running the index (see Mou (2010) and Bessembinder et al (2015)). The DJCI invested across the curve which is considered a feature of "second generation" indices (Dunsby and Nelson (2010)).

price.[10] The justification for fixing prices was the expectation that silk futures trading would resume once the war was over. However, after the World War II, nylon became more widely used and the silk futures market never re-emerged. As part of the first change of the index in 1950, the silk contract was replaced by futures on cottonseed, oil and wool. The new weights for the DJCI after this reconstitution are given in panel B of Table 1.

The second major change to the index composition occurred on January 4, 1982.[11] The new index was comprised of 12 commodity futures: Wheat, Corn, Cotton, Coffee, Sugar, Cattle, Copper, Gold, Hogs, Lumber, Silver, and Soybeans. Seven commodities were dropped: Oats, Rye, Wool, Cottonseed Oil, Cocoa, Rubber, and Hides, and replaced with Cattle, Copper, Gold, Hogs, Lumber, Silver, and Soybeans. This reconstitution reflected the growing importance of metals and animal products futures contracts. Figure 2 shows the Wall Street Journal article on the DJCI announcing the changes to the Dow Jones Index.

The revised index history of the new commodities was backfilled to December 31, 1974 and started at a base level of 100. We ignore the backfilled portion in our analysis and concatenate the two indices such that new index starts from the launch day of January 4, 1982, thereby maintaining the out-of-sample property of the concatenated index. Like the original index, the new Index is re-weighted daily to maintain a futures duration of five months. One major change in methodology was the weighting of the index constituents: on the base date of December 31, 1974 the index was equally weighted across all twelve commodities. Weights in subsequent periods would drift over time in accordance with the evolution of prices.

The DJCI continued to be calculated in this way until 1998. On July 14, 1998 Dow Jones launched the Dow Jones-AIG Commodity Index, with a backfilled history to 1991. Instead of being a weighted average of prices, the DJ-AIG index calculation was based on rolling futures positions, collateralized by US T-bills. The two indices were calculated side by side for a while, but there is no indication that the collaboration of Dow Jones with AIG was intended to be a continuation of the original index. The last available data point for the DJCI is November 1998. Figure 3 summarizes the key developments for the original Dow Jones Index.

For the purpose of analyzing the commodity futures risk premium, we construct a "rolling futures" version of the DJCI index, that invests in the front-month futures of the constituent commodities collateralized by US T-bills. Because we lack the exact commodity weights for the

[10] "When the silk market was closed shortly after Pearl Harbor, an expedient had to be adopted to continue the future index. Silk was kept in it at a fixed price, the last quotation available being the one used. The idea was that when silk trading was resumed everything would be all right." *Wall Street Journal*, July 5, 1950

[11] Prior to this, a minor change took place on March 2, 1981, in which domestic sugar was replaced by world sugar (Sugar No 11), as trading volume migrated from the former to the latter.

DJCI, the construction of the "DJCITR" index proceeds in 2 steps. We first calculate a monthly rebalanced "simplified" spot index that matches the DJCI set, but only tracks the front-month futures for each commodity. This simplified spot index matches the DJCI weights in 1933 and its weights subsequently drift with the evolution of front-month spot prices until 1950. At that point we rebalance the positions to match the new commodity set and corresponding official new DJCI weights. A similar procedure is followed around the 1982 revision. In the second step, we create an excess return index by rolling the futures positions of the simplified spot index such that, each month, the excess return index rebalances to the commodity weights of the simplified spot index. For clarity, the excess return for commodity *i* in month *t* is calculated using the nearest-to-maturity (front-month) contract and defined as follows:

$$R_{i,t} = \frac{F_i(t,T) - F_i(t-1,T)}{F_i(t-1,T)}$$

where $F_i(t,T)$ is the futures price at the end of month *t* for a futures contract maturing on date *T>t*. As in Gorton and Rouwenhorst (2006) we construct total returns for the DJCITR index by adding the US Treasury Bill returns to the rolling futures excess returns.[12]

Figure 4 compares the cumulative performance of the resulting spot and rolling futures indices. The first observation from Figure 4 is that the simplified front-month spot index closely tracks the DJCI. Hence, targeting a 5-month duration has little impact on the long-term evolution of the DJCI. Second, the figure confirms an important stylized fact documented in Gorton and Rouwenhorst (2006): that the long horizon return on collateralized futures has historically exceeded the appreciation of spot prices by a wide margin. Long-term trends in commodity spot prices are not indicative of average futures returns, because futures embed expectations about trends in spot prices. And futures prices embed a risk premium that is an important driver of investment returns that is absent from spot commodity prices. We will examine this in the next section.

3. Average Futures Returns of the Dow Jones Index Commodities

There is a longstanding debate about the existence of a risk premium in commodity futures markets. Ever since the formulation of the Keynesian theory of normal backwardation, academics have been divided on the topic. Early researcher often selectively focused on a small subset of the commodities, discounting the importance of others (see Gray (1961) and for surveys Gray and Rutledge (1971), Rouwenhorst and Tang (2012)). More recently Bodie and Rosanski (1980), Fama and French (1987) and Gorton and Rouwenhorst (2006) provide evidence of a positive risk premium for a diversified portfolio of commodity futures, whereas Erb and Harvey (2006) and

[12] From January 1934 we use the 3-Month Treasury Bill: Secondary Market Rate as a proxy for T-Bill return, prior to that we use IA SBBI US 30 Day T-Bill Total Return.

Irwin et al. (2020) argue against the existence of such a premium. We test for a risk premium in the DJCI commodity set which represents an early sample of futures that was selected by a leading index firm in real time, and without the benefit of hindsight.

Table 2 shows that over its 65-year history, the DJCITR earned an (arithmetic) average risk premium of 4.5% annualized (*t*-statistic = 2.8). The geometric average premium of the index was slightly lower at 3.7%. The table also gives a breakdown of the risk premiums of the 20 constituents that were part of the DJCI over its 65-year history. Constituent risk premiums calculated during the period that they were included in the index. Of the 20 index constituents, 15 (12) earned a positive arithmetic (geometric) average risk premium. For five out of 15, the risk premium was significantly different from zero at the 5% level.

3.1 Underinvestment and the risk premium

As discussed in the previous section, the DJCI became "underinvested" in futures during the suspension of silk trading during WWII. As reported in Bhardwaj et al. (2019), silk was not the only commodity to experience trading halts during the WWII period. For example, corn trading was suspended in June 1943 (*Wall Street Journal*, June 26, 1943), and did not resume for more than a year, until September 1944.[13] While we do not know how the index calculation accounted for corn and the other commodities that did not trade, it is fair to assume that Dow Jones followed a methodology that was similar to Silk. Between June 1943 and March 1944 only 5 of the 11 index commodities traded, and only 4 traded until September 1944. A second period of underinvestment occurred during 1970s, when the legacy contracts on Hides, Rubber, Cottonseed Oil, Rye and Wool started to fail. Both were periods when commodities significantly rallied.

In considering whether our estimate of the index risk premium should be corrected for the underinvestment, two perspectives can be taken. The first is that no risk premium can accrue in a market that is closed, so no correction is needed. An alternative is to adjust the futures notional of the index during periods of market closures, and rescale the notional over which the premium is calculated to one dollar to make it equal across time periods. This re-calculates the returns as if investors had proportionally re-allocated their risk to the remaining index commodities away from the markets that were closed. Figure 4 shows the DJCITR and the rescaled "fully invested" index side by side. The average risk premium of the fully invested version of the index of 5.4% exceeds its underinvested counterpart by 0.9% annually. Depending on the perspective taken this 0.9% would be interpreted in two different ways. Under the second perspective, it would

[13] "Corn futures trading was suspended on June 25, 1943 at the request of the government, which commandeered cash grain in Chicago elevators to obtain much needed supply of corn for industrial purposes." *Chicago Tribune*, September 13, 1944

suggest that our estimate of the risk premium of 4.5% for the DJCITR is likely a conservative estimate of the risk premium of commodities during this period, using the remaining commodities as a barometer of the performance of commodity markets. From the alternative perspective, it provides an example of the impact of conditioning on contract survival and tradability for the measurement of the risk premium.

4. Portfolio Diversification and Inflation Hedging

To further put the DJCITR returns in perspective, we make a comparison to stocks and bonds over the period from October 1933 to November 1998. We re-examine the basic stylized facts of diversification and inflation hedging that have been documented as important characteristics of commodity futures by Gorton and Rouwenhorst (2006), using the DJCI and the DJCITR as our benchmarks. We report results for both the spot index (DJCI) and the rolling futures index (DJCITR) in this section, to examine whether the distinction between spot and futures returns matters for the higher order moments in the same way as it does for the mean rates of change. Because the DJCI index never included Energy futures among its holdings the out-of-sample test is also informative about the sensitivity of these stylized facts to the inclusion of energy commodities. Second, the DJCI history predates the period of "financialization" of commodity markets and allows us to examine alternative explanations for time variation in correlations that are often attributed to the recent inflow of investor capital into commodity futures markets.

Panel A of Table 3 shows that stocks earned the highest average returns over this period of 13.1%. The DJCITR earned an average return of 8.5% over the full sample. The ranking of assets classes in terms of volatility and Sharpe Ratio is identical to the average return ranking. Another notable empirical observation is that the skewness of the distribution of monthly stock returns is to the left, while bonds and the DJCITR returns are positively skewed. Figure 5 compares the total cumulative returns of commodities, stocks, and bonds over time. These findings confirm most of the results reported in Bodie and Rosanski (1980) and Gorton and Rouwenhorst (2006): (i) commodity futures have positive risk premium, (ii) comparable volatility and drawdowns as stocks, but (iii) unlike stocks commodity futures returns are positively skewed.

Panel B of Table 3 confirms the strong procyclical nature of both commodities and stocks; the DJCITR returns during NBER expansions is 9.3% as compared with 3.9% in recessions. Spot returns (DJCI) and total returns (DJCITR) have similar cyclical properties and similar correlations to inflation. The panel also compares inflation correlations for the DJCITR to those of stocks and bonds. During the 1933- 1998 sample, stocks and bonds are negatively correlated with inflation at most investment horizons, while inflation correlations of the DJCI and DJCITR are positive and increase with the holding period. The inflation correlations closely mirror those reported in

Gorton and Rouwenhorst (2006), and appear robust for commodity portfolios that exclude energy.

Finally, Panel B of Table 3 confirms the low historical correlations of commodities with stocks and bonds. The correlation of commodities and equities has received attention in recent literature debating the financialization of commodity markets. Tang and Xiong (2012) emphasize the role of the inflow of speculative capital for the increase of the stock-commodity correlation during the Great Recession of 2008.[14] Bhardwaj et at (2016) provide an alternative hypothesis for the increase in stock-commodity correlation, linking variation to business cycle movements in general. Figure 6 plots rolling 37-month correlation of DJCITR and stock returns along with the default spread (as a measure of business activity), and recession periods as identified by NBER. The figure shows substantial fluctuation in the commodity-stock correlation over time. Correlations of 0.5 that were observed during the 2008 recession, were also observed during the recession of 1930's, and 1950's. Smaller spikes in the DJCITR-stock correlation also occurred during other recession periods. Clearly these fluctuations in the DJCITR-stock correlation cannot be attributed to a financialization of commodity markets. The evidence further suggests that business cycle factors provide an alternative explanation for spikes in commodity-stock correlation.

5. Conclusion

Real-time investment track records provide a unique opportunity for financial economist to test hypotheses about financial markets. The Dow Jones Commodity Index launched in 1933 provides such a laboratory for the pricing of commodity futures. Unlike backfilled indices or benchmarks portfolios which are constructed with the benefit of hindsight, real time index histories do not suffer from look-ahead or survivorship biases that can lead to upward estimates of average returns. We use the DJCI commodity set to examine the properties of commodity futures prices. A rolling futures transformation of the Dow Jones Commodity Index earned a risk premium of about 4.5% per annum over its 65-year life, despite the setbacks posed by contract failures and trading suspensions of index constituents. We quantify the negative impact of these setbacks on our estimate of the risk premium to be around 1% annualized. We show that the DJCI shares many of the properties that have recently been documented about commodities futures. From today's perspective the DJCI index constituents may seem like an unlikely choice set for an index, but that underscores the significance of studying the real time decision record of a prominent for-profit company with a long reputation of index construction in equity markets.

[14] This literature is surveyed by Cheng and Xiong (2014).

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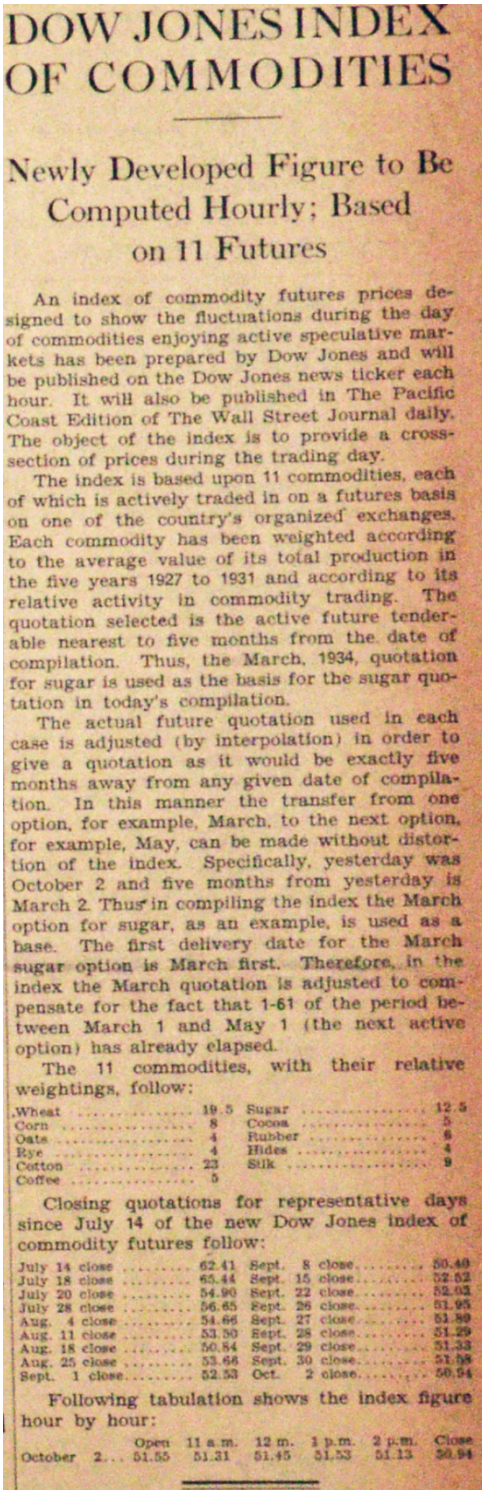
Figure 1: Wall Street Journal Announcement of the Dow Jones Index

The Wall Street Journal on October 3rd, 1933 showing the announcement of the newly developed "Dow Jones Index of Commodities".



DOW JONES INDEX OF COMMODITIES

Newly Developed Figure to Be Computed Hourly; Based on 11 Futures

An index of commodity futures prices designed to show the fluctuations during the day of commodities enjoying active speculative markets has been prepared by Dow Jones and will be published on the Dow Jones news ticker each hour. It will also be published in The Pacific Coast Edition of The Wall Street Journal daily. The object of the index is to provide a cross-section of prices during the trading day.

The index is based upon 11 commodities, each of which is actively traded in on a futures basis on one of the country's organized exchanges. Each commodity has been weighted according to the average value of its total production in the five years 1927 to 1931 and according to its relative activity in commodity trading. The quotation selected is the active future tenderable nearest to five months from the date of compilation. Thus, the March, 1934, quotation for sugar is used as the basis for the sugar quotation in today's compilation.

The actual future quotation used in each case is adjusted (by interpolation) in order to give a quotation as it would be exactly five months away from any given date of compilation. In this manner the transfer from one option, for example, March, to the next option, for example, May, can be made without distortion of the index. Specifically, yesterday was October 2 and five months from yesterday is March 2. Thus in compiling the index the March option for sugar, as an example, is used as a base. The first delivery date for the March sugar option is March first. Therefore, in the index the March quotation is adjusted to compensate for the fact that 1-61 of the period between March 1 and May 1 (the next active option) has already elapsed.

The 11 commodities, with their relative weightings, follow:

Wheat	19.5	Sugar	12.5
Corn	8	Cocoa	5
Oats	4	Rubber	6
Rye	4	Hides	4
Cotton	23	Silk	9
Coffee	5		

Closing quotations for representative days since July 14 of the new Dow Jones index of commodity futures follow:

July 14 close	62.41	Sept. 8 close	50.40
July 18 close	65.44	Sept. 15 close	52.52
July 20 close	54.90	Sept. 22 close	52.03
July 28 close	56.65	Sept. 26 close	51.95
Aug. 4 close	54.66	Sept. 27 close	51.89
Aug. 11 close	53.50	Sept. 28 close	51.29
Aug. 18 close	50.84	Sept. 29 close	51.33
Aug. 25 close	53.66	Sept. 30 close	51.58
Sept. 1 close	52.53	Oct. 2 close	50.94

Following tabulation shows the index figure hour by hour:

	Open	11 a.m.	12 m.	1 p.m.	2 p.m.	Close
October 2...	51.55	51.31	51.45	51.53	51.13	50.94

Figure 2: Wall Street Journal Article on the Change of the Dow Jones Index

The Wall Street Journal on January 4th, 1982. The article describes the change in index composition rules including commodities added, removed, and new roll schedule.

New Dow Jones Commodity, Spot Price Indexes
By ROBERT D. PRINSKY Special to THE WALL STREET JOURNAL
Wall Street Journal (1923 - Current file); Jan 4, 1982;
ProQuest Historical Newspapers: The Wall Street Journal
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New Dow Jones Commodity, Spot Price Indexes

By ROBERT D. PRINSKY
Special to THE WALL STREET JOURNAL

NEW YORK—Dow Jones & Co. today begins publication of a new commodity futures index and a companion index of spot commodity prices.

The new Dow Jones commodity indexes substantially update the content of these market indicators. They include such active commodities as gold and soybeans, which weren't traded in futures markets when the previous indexes were formulated. All 12 commodities in the new indexes have equal weights, to avoid giving extra influence to any one.

Like the indexes they replace, the new ones will be published daily in The Wall Street Journal. The futures index will be published hourly during the trading day on the Dow Jones News Service, which also will carry the spot index at the close of markets.

Commodity indexes have a variety of uses. They give an indication of the general trend of futures markets. They enable traders to compare the performance of their own holdings to the general trend. They provide economists with a reading on prices of raw materials generally. Many analysts regard changes in the difference between the futures and spot indexes as an indicator of future price movements.

The hardest part of designing a new index is deciding what it should contain. After consultation with numerous commodity experts, it was determined that the new indexes should be as consistent as possible with the old ones. Thus, they measure prices of 12 widely traded commodities and the futures index calculates prices five months in the future. The spot index measures prices for immediate delivery of the same commodities that are in the futures index.

The old indexes measured only agricultural commodities. The new ones add metals, animals and wood. They don't include financial futures, notably because other indexes of interest and currency rates exist and because financial instruments are of a considerably different nature than raw materials.

The 12 commodities covered are cattle, coffee, copper, corn, cotton, gold, hogs, lumber, silver, soybeans, sugar and wheat.

The base date for the new indexes is Dec. 31, 1974, the day gold trading resumed in the U.S.

To give users an immediate history of the indexes, both have been calculated by Drexel Burnham Lambert Inc. for every trading day since the end of 1974, when both were 100.

The accompanying chart and graph give a seven-year history of the indexes for the last trading day of each month. A complete daily history of the indexes is available from Dow Jones (see below).

The weighting of the indexes is neutral. That is, each commodity's price on a given day is divided by its price on the base date and the results are totaled. The total is divided by 12 and multiplied by 100 to yield the index.

To estimate the price of a commodity five months in the future, two contract months are used, one expiring in fewer than 150 days and one expiring in more than 150 days. It is assumed that each contract expires on the 15th of the month it relates to.

For each commodity, weights are assigned to the two contracts, based on the number of days between the 150th and the theoretical expiration date of the contract. Then, the price of each contract is multiplied by its weight, the results are added and the sum is divided by the number of days between the expiration dates of the two contracts. The result is the estimated price of the commodity for delivery in exactly five months, or 150 days.

A Seven-Year History

History Available

A seven-year daily history of both indexes, including a history of the five-month prices for each commodity, will be available later this month, priced at $50 a copy. Orders may be sent to Commodity Index, The Wall Street Journal, 200 Burnett Road, Chicopee, Mass. 01021.

Single copies of this article may be ordered at no charge from Dow Jones Educational Service Bureau, P.O. Box 301, Princeton, N.J. 08540.

Figure 3: Timeline of the Dow Jones Index

The diagram summarizes the timeline of the major changes to the Dow jones Commodity Index, from its inception in 1933 to its discontinuation in 1998.

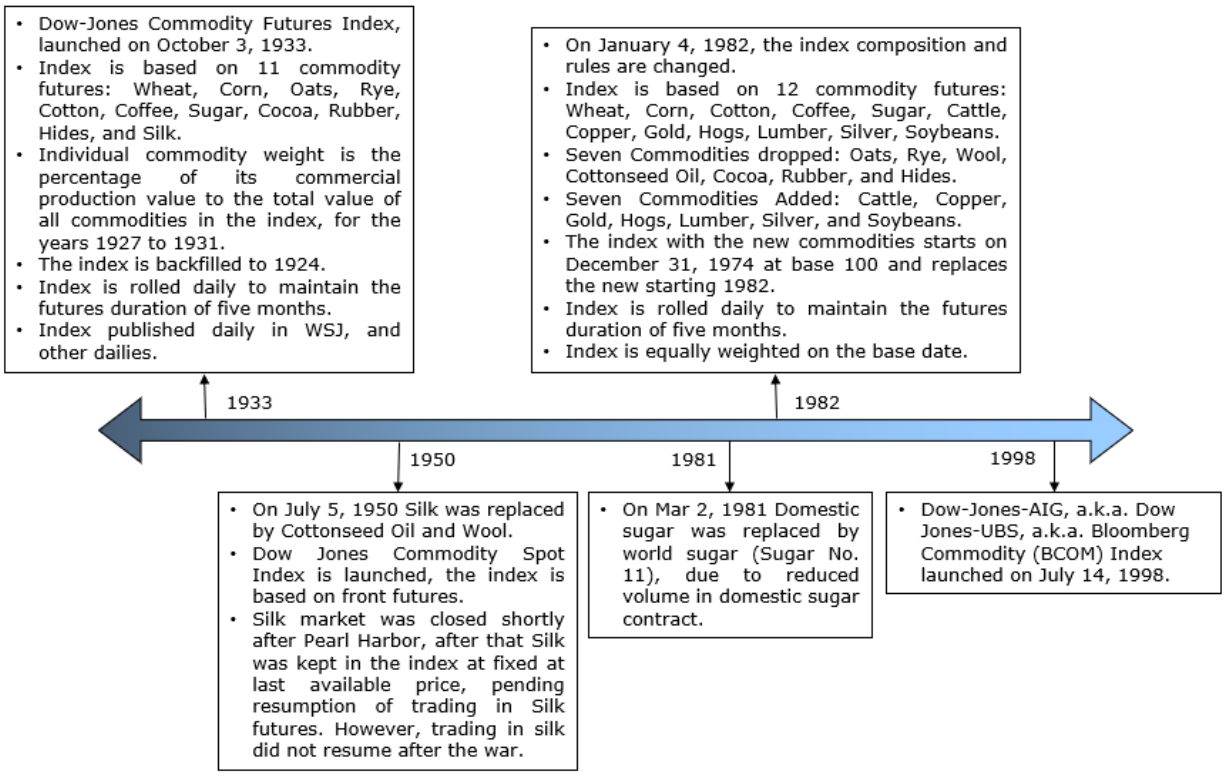

Figure 4: Total Returns of the Dow Jones Index and the Impact of Underinvestment: October 1933 - November 1998

The figure shows the level of the Dow Jones Commodity Index (DJCI) since inception on a logarithmic scale. The "Simplified" spot index matches the DJCI set, but only tracks the front-month futures for each commodity. This simplified spot index matches the DJCI weights in 1933 and its weights drift with the evolution of spot prices until 1950. At that point we rebalance our positions to match the new commodity set and corresponding new DJCI weights. A similar procedure is followed around the 1982 revision. DJCITR is a rolling futures version of the index that rebalances monthly to the commodity weights of the "simplified" spot index. We construct total returns for the DJCITR index by adding the Treasury bill returns to the rolling futures excess returns. From January 1934 we use the 3-Month Treasury Bill: Secondary Market Rate as a proxy for T-Bill return, prior to that we use IA SBBI US 30 Day T-Bill Total Return. The "Fully Invested" DJCITR rescales the futures position to match T-Bill positions during months when underlying contract trading was suspended. Suspensions are indicated by a drop in the number of commodities that is plotted on the right axis.

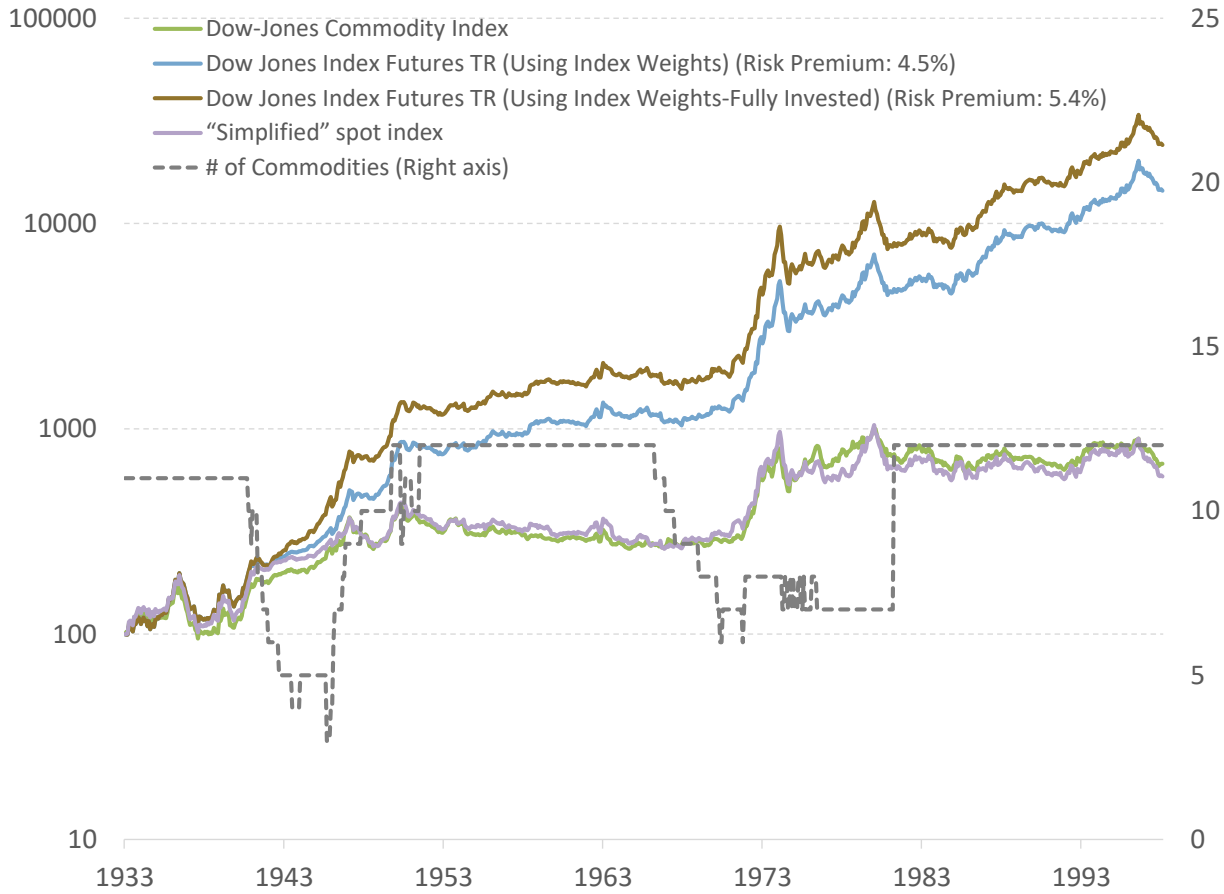

Figure 5: Cumulative Total Returns of the Dow Jones Index, Stocks, and Bonds: October 1933 - November 1998

The figure plots the cumulative return on the DJCITR, Equities and Long-term Bonds, over the period that the DJCI was calculated in real time. The return on bonds is the Citi U.S. Broad Investment Grade Bond Index prior to 1991, and the Bloomberg/EFFAS 10+ Year Bond Index post 1991. Total returns on stocks are for the S&P500.

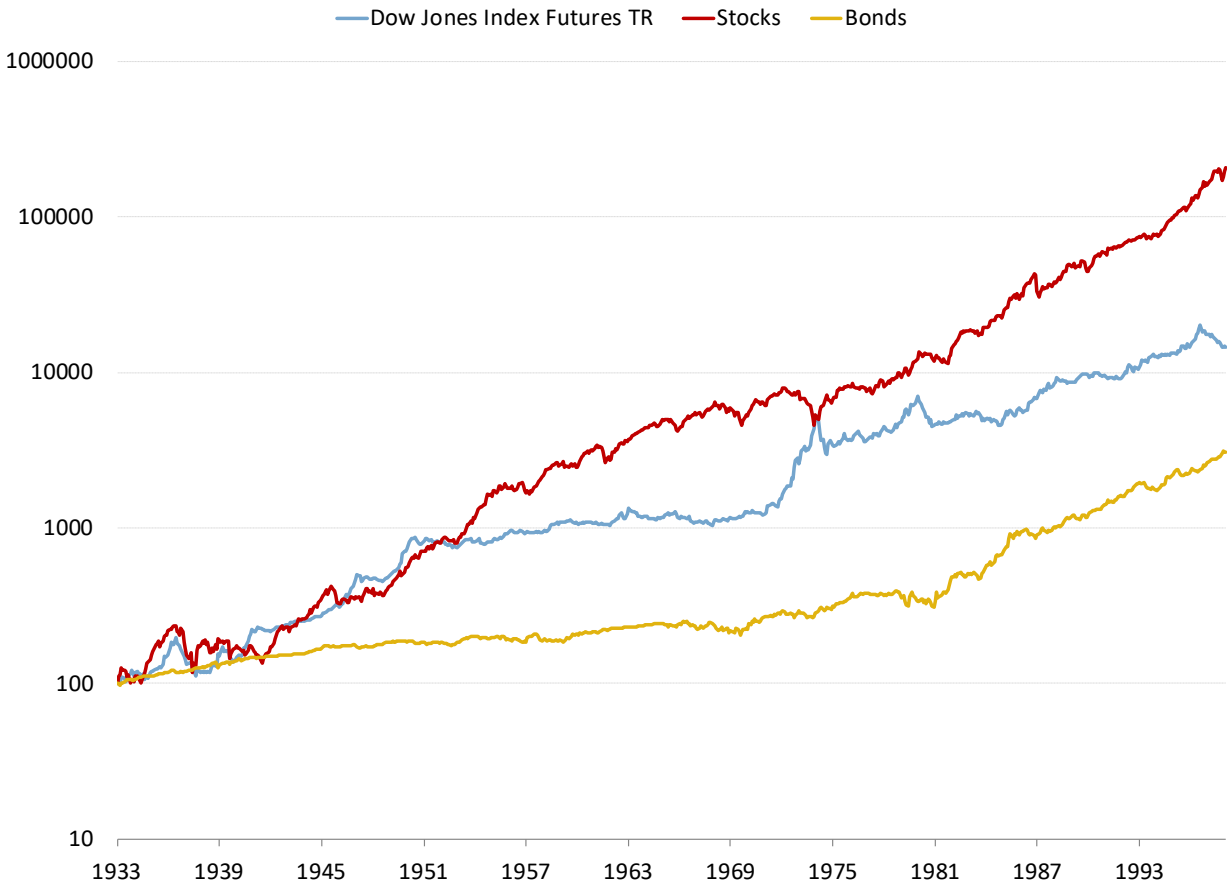

Figure 6: Stock Commodity Correlation

The figure plots centered 37-month correlation of DJCITR and stock returns. On the right axis we plot the default spread (%), defined as the difference between Baa and AAA corporate yields. The shaded regions indicate recession periods as identified by NBER

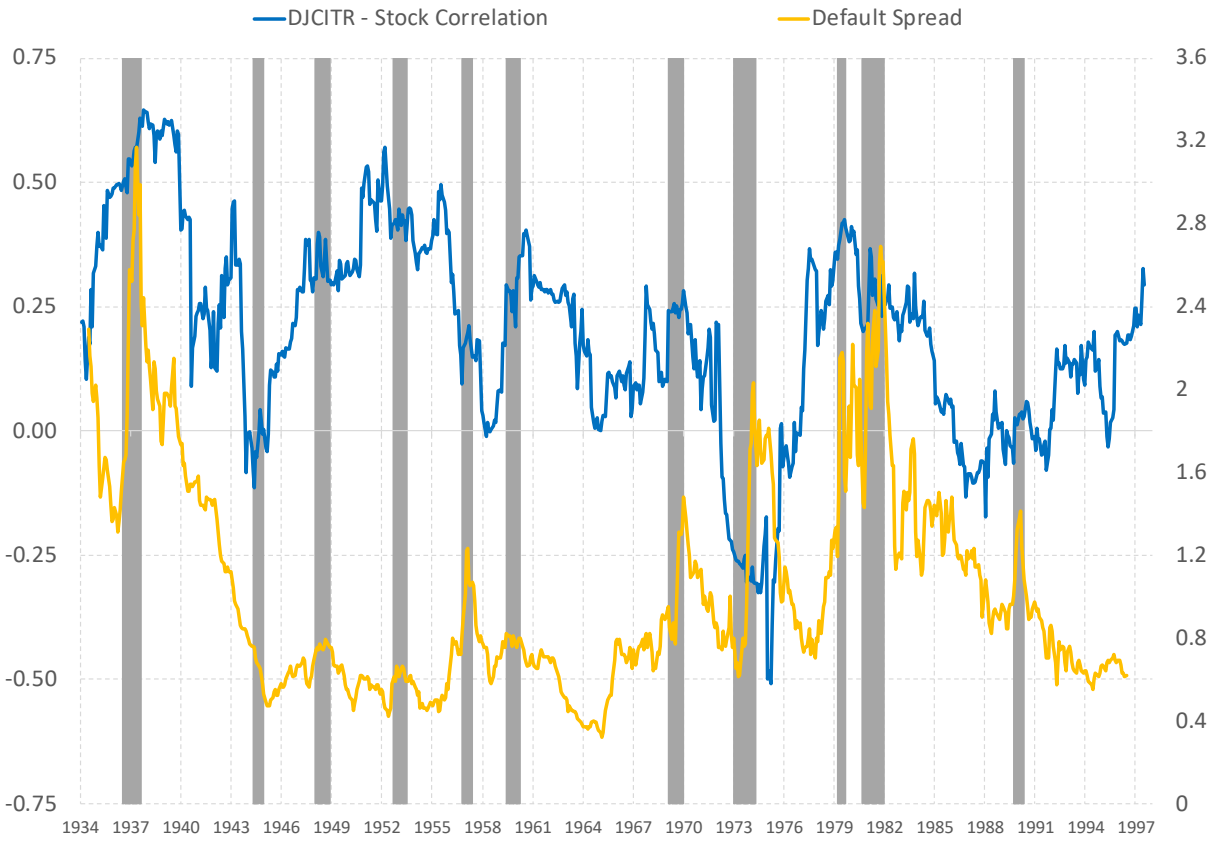

Table 1: Weights of the Dow Jones Commodity Index Constituents

The Table gives the individual commodity weights in the DJCI when it was launched in 1933 (Panel A) and following the first major reconstitution in 1950 (Panel B)

Panel A: at inception in 1933

Commodity	Weight (%)	Commodity	Weight (%)	Commodity	Weight (%)
Wheat	19.5	Cotton	23	Rubber	6
Corn	8	Coffee	5	Hides	4
Oats	4	Sugar	12.5	Silk	9
Rye	4	Cocoa	5		

Panel B: following the reconstitution of 1950

Commodity	Weight (%)	Commodity	Weight (%)	Commodity	Weight (%)
Wheat	19.5	Cotton	23	Rubber	6
Corn	8	Coffee	7	Hides	4
Oats	5	Sugar	8.5	Cottonseed	4.5
Rye	4	Cocoa	5	Wool	5.5

Table 2: Risk Premium of DJCI and Constituents, October 1933 - November 1998

The table reports the arithmetic average risk premium of the constituents underlying DJCI, as well as their geometric average excess returns expressed in percent per annum. Over the 65-year history at various points 20 commodities constituted the index. Risk premia are calculated over the period commodities were part of the index. Following the arithmetic average, we report a *t*-statistic for the hypothesis that the arithmetic average risk premium is zero.

	Arithmetic Average Premium	t-stat	Geometric Excess Returns		Arithmetic Average Premium	t-stat	Geometric Excess Returns
Wheat	2.5%	0.9	0.3%	Silk	16.3%	1.6	13.0%
Corn	3.1%	1.1	0.7%	Cottonseed Oil	4.6%	1.0	2.9%
Oats	5.7%	1.6	2.7%	Wool	1.4%	0.3	-1.3%
Rye	-2.5%	-0.6	-5.5%	Cattle	7.0%	**2.0**	6.1%
Cotton	7.6%	**3.1**	5.9%	Copper	6.5%	1.0	3.0%
Coffee	12.9%	**3.1**	8.5%	Gold	-6.7%	-1.8	-7.6%
Sugar	1.0%	0.2	-5.2%	Hogs	6.9%	1.2	4.3%
Cocoa	11.5%	**2.4**	6.4%	Lumber	-0.3%	0.0	-4.9%
Rubber	17.1%	**3.0**	13.9%	Silver	-7.0%	-1.1	-10.1%
Hides	2.9%	0.5	-1.7%	Soybeans	-1.5%	-0.3	-3.7%
DJCI ER Index					4.5%	**2.8**	3.7%

Table 3: Stocks Bonds and Commodities: October 1933 - November 1998

Panel A summarizes the return distributions of the monthly return distribution of commodities (DJCI and DJCITR), as well as stocks and bonds. Panel B gives the average returns over the business cycle, expressed as percent per annum, as well as the correlations of returns with inflation. For stocks we use dividend reinvested stock returns from Shiller, R. J. (2000), "Irrational Exuberance." Princeton University Press prior to 1988; and S&P 500 TR for the period 1988-1998. For bond returns, we use the Citi U.S. Broad Investment Grade Bond Index prior to 1991, and the Bloomberg/EFFAS 10+ Year Bond Index post 1991. Recession and Expansion periods are based on phases identified the National Bureau of Economic Research. Inflation data is based on U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers.

Panel A: Average Returns and risk

	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

Panel B:

DJCI correlations to Stocks, bonds and inflation, and performance over the business cycle:

	DJCI	DJCITR	Stocks	Bonds
Recession- Total Returns	-2.3%	3.9%	9.0%	12.8%
Expansion - Total Returns	4.8%	9.3%	13.8%	4.3%

	Return Correlation to DJCITR			
	DJCI		Stocks	Bonds
Monthly	0.90		0.19	-0.04
Quarterly	0.89		0.09	-0.07
Annual	0.89		-0.01	-0.15
5 year	0.87		-0.23	-0.02
	Correlation to Inflation			
	DJCI	DJCITR	Stocks	Bonds
Monthly	0.14	0.12	-0.06	-0.08
Quarterly	0.23	0.20	-0.16	-0.13
Annual	0.35	0.35	-0.25	-0.19
5 year	0.49	0.39	-0.23	0.00