PGIM

DC SOLUTIONS

ALLOCATING TO COMMODITIES FOR THE LONG RUN

October 2025

INTRODUCTION

The perceived efficiency of an investment can change based on investment horizon and how risk is measured. This is something we explored in a Research Brief recently released through the CFA Institute *Research Foundation* titled "Investment Horizon, Serial Correlation, and Better (Retirement) Portfolios."

In this piece, our focus narrows to how the optimal allocation to real assets, in particular commodities, varies by investment horizon, especially when considering inflation. We demonstrate that while commodities may appear to be relatively inefficient when focusing just on annual (calendar year) historical risk and return values, when viewed over longer time horizons (i.e., considering serial dependencies) the asset class becomes significantly more efficient and worthy of consideration in client portfolios, particularly for inflation sensitive investors like those savings for retirement.

In addition, we believe that we are in the early stages of a longer-term bull cycle for commodities, that makes it an attractive asset class to incorporate into strategic portfolio allocations. The first section of this paper provides an overview of this belief.

ARE WE IN A COMMODITIES SUPERCYCLE?

To provide a broad long-term perspective, market cycles vary and may last from only a few weeks to many years. The average peak-to-peak length of a market cycle between 1945 and 2020 was around 6.25 years[1]. Structural bull and bear cycles in commodity markets, on the other hand, often last for a decade or more, typically much longer than other market cycles. These long commodity cycles are often referred to as "supercycles". There have been four distinct commodities supercycles since 1899, lasting 30 years on average, each with a well-defined bull and bear phase. These cycles are typically sparked by a sustained and unexpected demand shock and prolonged by slow-moving supply responses. The bull phase of these cycles also tends to coincide with rapid industrialization in a significant part of the global economy. We believe a structural bear phase in commodities ended with the onset of the COVID-19 pandemic and its aftermath, and a new structural bull phase has now begun.

Several recent fundamental developments have been identified that are comparable to events of past supercycles:

- Massive fiscal and monetary policy stimulus in response to the pandemic drove a significant positive global demand shock.
- Decarbonization and the global transition to green sources of energy will require massive amounts of new green infrastructure requiring significant raw material inputs, a process akin to a global re-industrialization.
- Increased geopolitical tension and lessons learned from the pandemic are leading to a reorganization of global supply chains, which will require commodity-intensive capital spending.
- On the supply side, chronic underinvestment in commodity production during the past decade due to sharply falling prices, environmental policies and the rise of ESG investing, and investor demand for capital discipline have meant that commodity production is likely to satisfy only a portion of expected demand in the coming years.
- The Russia-Ukraine conflict is an amplifier of the trend toward commodity scarcity (by removing Russian and hampering Ukrainian supply) and increased commodity demand (increased military spending from NATO's European members).

We believe we are in a higher-inflation regime that will be sustained for the balance of the decade and commodity prices have exhibited historical strength during higher-inflation environments. Commodities also become more powerful diversifiers to equities during higher inflation regimes while bonds become less powerful diversifiers. Given the view that we are in the early stages of a commodity structural bull phase and a higher-inflation regime, it's likely that commodities and commodity-related assets will exhibit strong relative performance over the next several years. This supports the case to include/increase strategic exposure to commodities in investor portfolios in the current environment.

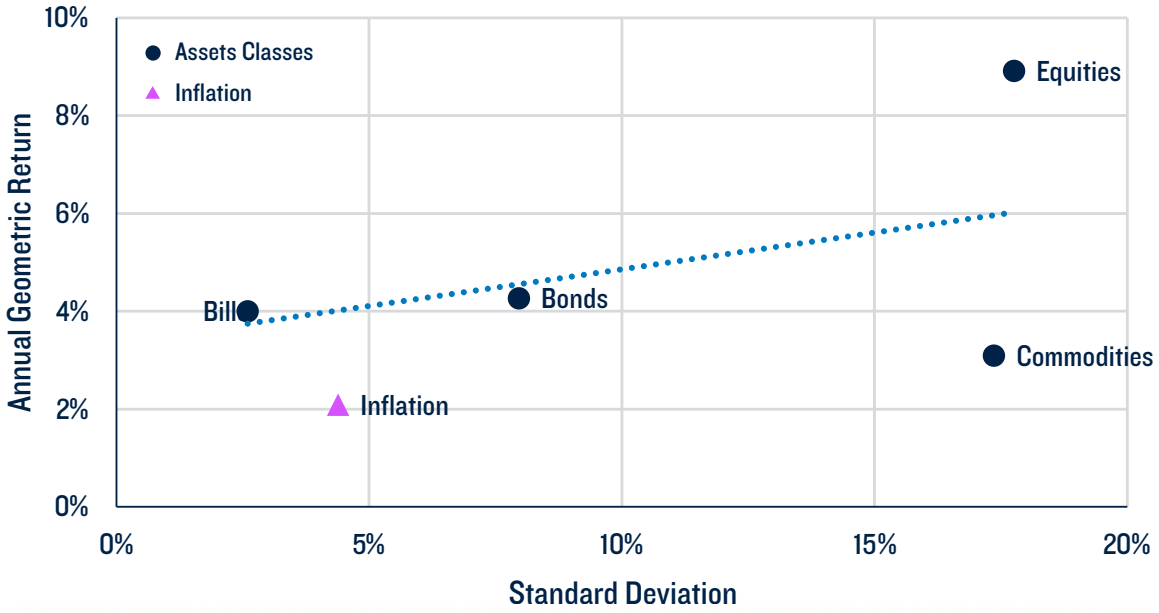
The following sections address important considerations when modeling appropriate allocations to commodities in a portfolio and how the approach taken can have a meaningful impact on the results.

[1] "US Business Cycle Expansions and Contractions" National Bureau of Economic Research. March 14, 2023. Accessed February 23, 2024.

LONGER TERM BENEFITS OF ALLOCATING TO COMMODITIES

Real assets, such as commodities, often appear to be relatively inefficient within a larger opportunity set when focusing on annual returns and risk, and therefore often receive little (or no) allocation in common portfolio optimization routines such as mean variance optimization (MVO). This historical inefficiency of commodities is documented quite clearly in Exhibit 1 which includes the historical annualized returns for US cash, US bonds, US equities, and commodities from 1872 to 2023[2].

Exhibit 1: Historical Standard Deviation and Geometric Returns for Asset Classes: 1872-2023



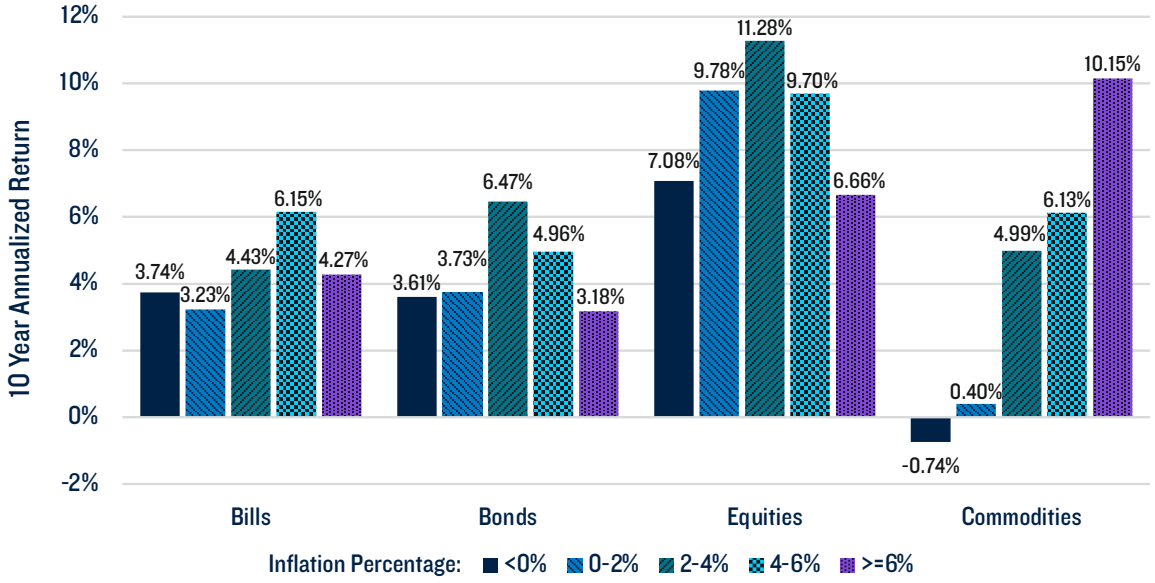
Source: Jordà-Schularick-Taylor (JST) Macrohistory Database. Bank of Canada. Morningstar Direct. Authors' calculations. The commodity return series uses returns from Bank of Canada[3] commodity price index (BCPI) from 1872 to 1969 and the S&P GSCI Index[4] from 1970 to 2023[5].
These two commodity index proxies, in particular BCPI, are used primarily for data availability (e.g., returns going back to 1872) and familiarity.
Past performance is not a guarantee of future results.

Commodities appear to be incredibly inefficient when compared to bills, bonds, and equities. For example, commodities have a return just slightly below the returns of bills and bonds but introduce significantly more risk. Alternatively, commodities have the same approximate annual standard deviation as equities, but a return that is approximately 600 basis points lower. This would suggest allocations to commodities would be relatively low in most optimization frameworks based entirely on these values.

What this perspective ignores is the potential long-term benefits of owning commodities, especially during periods of higher inflation. Exhibit 2 includes the average returns for bills, bonds, equities, and commodities, during different inflationary environments.

[2] The primary returns for US cash, US bonds, and US equities are obtained from the Jordà-Schularick-Taylor (JST) Macrohistory Database from 1872 (the earliest year the complete dataset is available) to 2020 (the last year available) and the Ibbotson SBBI series thereafter.
[3] https://www150.statcan.gc.ca/n1/pub/11f0019m/11f0019m2017399-eng.htm.
[4] https://www.spglobal.com/spdji/en/indices/commodities/sp-gsci/.
[5] The BCPI is a chain Fisher price index of the spot or transaction prices in U.S. dollars of 26 commodities produced in Canada and sold in world markets. The GSCI was the first major investable commodity index and is a is broad-based and production weighted to represent the global commodity market beta. The GSCI was selected due its long history, similar component weights to the BCPI, and the fact that there are a number of publicly available investment products that can be used to roughly track its performance (e.g., the iShares ETF: GSG , which has an inception date of July 10, 2006).

Exhibit 2: Average Return for Asset Classes in Different Inflationary Environments: 1872-2023



Source: Jordà-Schularick-Taylor (JST) Macrohistory Database. Bank of Canada. Morningstar Direct. Authors' calculations.
Past performance is not a guarantee of future results.

We can see that while commodities have had a relatively low (or negative) return when inflation is low, they outperform dramatically when inflation is high. The correlation of commodities to inflation increases notably over longer investment horizons, from approximately .2 for 1-year periods to .6 for 10-year periods. In contrast, the correlation of equities to inflation is only approximately -.1 for 1-year periods and approximately .2 for 10-year periods. In other words, commodities become an increasingly attractive inflation hedge over longer holding periods, which could dramatically change the perceived efficiency in a portfolio optimization routine focusing on longer investment periods.

So, the question is how does one appropriately incorporate the long-term benefit of investing in commodities during high inflationary environments into an asset allocation model?

A BETTER WAY TO MODEL ALLOCATIONS TO COMMODITIES

While inflation can be explicitly considered in certain types of optimizations (e.g., a "surplus" or liability-relative optimization), one potential issue when considering inflation is that changes in the prices of goods or services do not necessarily move in sync with the changes in the financial markets (i.e., there could be lagged effects). For example, while financial markets can experience sudden changes in value, inflation tends to take on more of a latent effect, where changes can be delayed and take years to manifest. Focusing on the correlation (or covariance) of inflation with a given asset class (e.g., equities) over one-year periods may hide potential longer-term benefits of certain assets.

To determine how allocations to commodities would have varied over time, a series of portfolio optimizations are performed for investment horizons from one to 10 years, in one-year increments. Optimal allocations are determined using a Constant Relative Risk Aversion (CRRA), which risk-adjusts the cumulative growth in wealth over a given investment horizon.

Optimal allocations are determined to correspond to equity allocations from 5% to 100%, in 5% increments. Four asset classes are included in the portfolio optimizations: bills, bonds, equities, and commodities. Exhibit 3 includes the optimal allocations to commodities for each of the scenarios considered using historical returns.

Exhibit 3: Optimal Allocation to Commodities by Wealth Definition, Equity Risk Target, and Investment Period: 1872-2023

Panel A: Nominal Wealth

Equity Risk Target	Investment Period (Years)									
	1	2	3	4	5	6	7	8	9	10
5	0	1	1	0	4	4	4	3	0	0
15	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	1	0	0	1
45	0	0	0	0	0	0	1	1	1	1
55	0	0	0	0	0	0	1	1	1	1
65	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0

Panel B: Real Wealth

Equity Risk Target	Investment Period (Years)									
	1	2	3	4	5	6	7	8	9	10
5	0	4	2	0	0	0	10	29	35	12
15	1	3	2	0	0	4	12	21	24	15
25	1	5	7	0	4	14	18	19	22	21
35	0	5	7	5	9	17	21	20	24	24
45	0	4	6	6	11	17	20	20	22	22
55	0	4	5	6	10	15	17	17	19	19
65	0	3	4	5	9	13	13	13	14	14
75	0	2	3	3	7	9	9	9	10	11
85	0	1	1	1	4	5	5	6	7	7
95	0	0	0	0	1	1	2	2	3	3

Source: Jordà-Schularick-Taylor (JST) Macrohistory Database. Bank of Canada. Morningstar Direct. Authors' calculations.

While the allocation to commodities remains at approximately zero for virtually all equity allocation targets when wealth is defined in nominal returns, when wealth is defined in real terms (i.e., includes inflation), the allocations to commodities can be relatively significant over longer investment periods, especially for investors targeting moderately conservative portfolios (e.g., ~40% equity allocations), where the optimal allocation to commodities would be roughly 20%. In other words, the perceived historical benefits of allocating to commodities have varied significantly depending on the definition of wealth (nominal versus real) and the assumed investment period (e.g., moving from one year to 10 years).

Another important factor to consider is that forward-looking expectations for the returns of commodities are not typically as bleak as historical long-term averages. For example, while commodities have historically underperformed equities by approximately 600 basis points on a risk-adjusted basis, expected underperformance is closer 200 basis points[6].

If we rerun the portfolio optimizations using the same historical time series, but recenter the historical returns so that they match the expected returns[7] and standard deviations[8] for cash, bonds, equities, commodities, and inflation, we can see that the optimal allocations to commodities increase markedly, regardless of whether wealth is defined in nominal or real terms in Exhibit 4.

[6] Based on either PGIM Quantitative Solution's Q4 2023 returns or the Horizon Actuarial (https://www.horizonactuarial.com/_files/ugd/f76a4b_1057ff4efa7244d6bb7b1a8fb88236e6.pdf) survey of 42 investment managers (focusing on 10-year expected returns).
[7] 3.6%, 5.4%, 8.4%, 6.1%, and 2.5% respectively
[8] 2.0%, 5.6%, 15.3%, 14.7%, and 2.0%, respectively

Exhibit 4: Optimal Allocation to Commodities by Wealth Definition, Equity Risk Target, and Investment Period: Expected Returns

Panel A: Nominal Wealth

Equity Risk Target	Investment Period (Years) 1	2	3	4	5	6	7	8	9	10
5	2	4	4	0	3	3	4	5	3	2
15	7	8	5	2	3	3	4	5	5	4
25	12	10	6	3	3	4	6	6	6	6
35	12	10	7	4	5	6	7	8	7	7
45	12	11	7	5	6	7	9	9	9	8
55	12	11	8	6	7	8	10	10	9	9
65	12	11	8	7	8	9	10	10	10	10
75	12	12	8	7	8	9	11	11	10	10
85	12	12	9	8	8	10	11	11	10	10
95	12	12	9	8	9	10	11	11	11	10

Panel B: Real Wealth

Equity Risk Target	Investment Period (Years) 1	2	3	4	5	6	7	8	9	10
5	2	3	4	0	8	25	34	39	40	42
15	9	10	9	2	11	17	23	30	32	31
25	15	15	13	10	14	17	20	22	23	23
35	14	15	13	12	15	17	20	21	22	22
45	14	15	13	12	15	17	20	20	21	21
55	14	15	13	12	15	17	19	20	20	20
65	14	15	13	13	15	17	19	19	20	20
75	13	15	13	12	15	17	19	19	19	19
85	13	14	12	12	14	16	18	18	19	19
95	13	14	12	12	14	16	18	18	18	18

Source: Jordà-Schularick-Taylor (JST) Macrohistory Database. Bank of Canada. Morningstar Direct, and PGIM Quantitative Solutions. Authors' calculations.

The allocations to commodities are approximately 10% when focused on nominal wealth, regardless of equity risk target or investment horizon and roughly double, closer to 20% (or higher) when focused on real wealth. These results suggest the potential benefits of allocating to commodities are notably higher using expected, versus historical, returns and risk levels.

CONCLUSION

Real assets, such as commodities, often appear to be relatively inefficient within a larger opportunity set of choices and therefore often receive little (or no) allocation in common portfolio optimization routines. It's important to realize that it's not always possible to capture its potential benefit of an asset class if you focus on returns and covariances over a one-year investment horizon. Asset classes such as commodities have historically had notable diversification benefits, especially for investors with longer time horizons focused on inflation risks that may not be appropriately captured using shorter periods (e.g., calendar year returns).

While commodities have historically had relatively low returns when inflation is lower, they have dramatically outperformed during periods of high inflation. Our analysis suggests a more nuanced view of commodities may be beneficial when building diversified portfolios, given how the risks can vary by investment horizon.

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