Building Stronger Portfolios

The Case for Investing in Broad Commodities

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Executive Summary

Despite being traded on exchanges for more than a century, commodities are the least well understood of the main asset classes. Over the last 20 years, this gap has begun to close, with many renowned academics pointing out that commodities, or more precisely commodity futures contracts, should become a staple component in long-term strategic asset allocations.

Firstly, commodity futures contracts pay a risk premium above inflation over the long term. Academics have demonstrated this many times over, making the asset class a clear candidate to consider for inclusion in a multi-asset portfolio.

Furthermore, commodities can add value to any strategy through their unique attributes:

- Adding to the potential long-term performance thanks to the risk premium.
- Providing diversification from equities, as shown in Figure 8 and Figure 9.
- Providing diversification during early recessions and late expansions, as shown in Figure 14.
- Acting as an inflation hedge, including in markets where inflation jumps unexpectedly, which is not the case for other assets as outlined in Figure 17.
- Benefitting from US dollar weakness. In most five-year periods, their correlation is negative, as shown in Figure 22.

Broad commodities can therefore contribute to a multi-asset portfolio in two ways:

1. Performance: Due to their risk premia.
2. Risk: Due to their diversifying behaviour versus other assets.

To maximise the impact of a commodity investment in a portfolio, implementation is key. Depending on the investor's circumstances, the best solution will differ, as shown in Figure 38. However, there are a few trends that both academic research and our analysis point towards:

- Physical replication is nearly impossible and very impractical for most commodities except precious metals.
- Physically-backed investments in gold have outperformed any other form of exposure to gold in most historical periods.
- For commodities excluding precious metals, an investment based on futures contracts is the most efficient for exposure.
- Newer, 2nd generation or enhanced commodity indices have demonstrated their ability to outperform their relative benchmarks over the last 20 years while delivering all of the diversification benefits typically offered by the asset class.
- Commodity-linked equities behave like high-beta equities and do not deliver commodity-like diversification or inflation hedging.

[1] (Bodie & Rosansky, 1980), (Fama & French, 1987), (Ankrim & Hensel, 1993), (Greer, 2000), (Jensen & Mercer, 2011), (Bhardwaj, et al., 2005) and (Bhardwaj, et al., 2015).

Finally, applying Markowitz's mean-variance[3] analysis using different assets and hypotheses, we find that:

- A US dollar-based, diversified, multi-asset investor would have benefited from a strategic allocation in broad commodities for the period of 1969-2021. For most levels of volatility, the historical return and Sharpe ratio would have been improved, with the optimal commodities weight oscillating between 10-20% (see Figure 39).
- Commodity-linked equities do not provide any of the diversification benefits broad commodities offer. Therefore, they are not featured in 'efficient portfolios' for the period 1969-2021.
- On a forward-looking basis, USD, EUR and GBP investors could all benefit from an investment in broad commodities. For most volatility target levels, the allocation to commodities appears to be between 10 and 25% (see Figure 42, Figure 44 and Figure 45).
- Gold and broad commodities both have a place in strategic asset allocations. On a forward-looking basis, most efficient portfolios would own some gold (0-8%) and some broad commodities (0-35%), as shown in Figure 49.

[2] Mean-variance analysis is the process of weighing risk, expressed as variance, against expected return. Mean-variance analysis allows investors to find the biggest reward at a given level of risk or the least risk at a given level of return.

[3] (Markowitz, 1952).

Introduction

Commodities are the least well understood of the main asset classes. Equities and bonds have been studied in great detail, and their behaviour is fairly well documented. On the contrary, commodities have suffered from the lack of long, clean historical data, despite being traded on exchanges for more than a century. The Dojima Rice market, for example, was the first regulated commodity futures exchange in the world, starting in 1752 in Japan. Commodities futures listed in Chicago started trading in 1865.

Commodities also suffer from the dichotomy between the commodity itself, i.e. the grain of wheat or the barrel of oil and the financial asset: the futures contract on the commodity. This paper aims to look holistically at the potential opportunities offered by investments in commodities and to try to clear up any misconceptions about this asset class.

But before we can start on this fascinating journey together, let's start at the beginning. While commodities themselves are pretty concrete, this is not the case for commodity futures contracts. A commodity futures contract is a legal agreement to buy or sell a particular commodity (the cotton, the wheat or the oil itself) at a predetermined price (the strike) at a specified time in the future (the expiry). In theory, sellers and buyers of the futures contract are obligated to deliver/receive the commodity asset at the expiration date[4]. However, the commodity investor, i.e. usually the futures buyer, does not have to receive the physical commodity at any point in time as the futures contract can be sold to someone else before the expiry. Most of the time, a commodity investor will enter (buy) a futures contract with a given expiry. When the expiry of this futures contract nears, the investor will sell that futures contract and buy another futures contract on the same commodity with an expiry further in the future. This is called rolling, and it allows the investor to remain continuously exposed to the commodity without ever receiving the physical commodity itself. Remember, some investors are looking for investment exposure, and other investors are hedging the risk of a future movement in underlying commodity prices. Some businesses, think of airlines and jet fuel as an example, actually want the delivery of that physical commodity in the future.

Today's futures contract price is meant to reflect the spot price of the commodity when the contract matures. If market participants expect the commodity to appreciate over the period, the futures contract price will be higher than the current spot price (the curve is in contango). On the contrary, if market participants expect the commodity's price to depreciate, the futures contract will be lower than the current spot price (the curve is in backwardation). Note that the futures contract price is set in relation to the expected spot price of the commodity at maturity of the contract, not the current spot price. Of course, this expected spot price in the future is unknown. It is where the risk of the futures contract lies. If the commodity spot price ends up higher than expected, then the futures contract holder will make money. If not, he will lose money irrespective of the shape of the curve. It is worth noting that historically, the prices of futures contracts have been a pretty bad predictor of where the spot price really happened to be at maturity. However, at any time before the maturity, it is still the best possible market expectation and reflects what the market thinks the commodity will be worth at maturity.

[4] Nowadays, some futures contract are cash settled i.e. there is no physical exchange of the commodity at maturity of the contract. Only the gains or losses are effectively settled between participants. However, an investor looking for a continuous exposure to a given commodity will roll cash-settled futures or physically-settled contracts in the same way.

A quick overview of roll yield, contango and backwardation

A commodity is in contango when the price of a distant futures contract is higher than the price of a nearer future. A commodity is in backwardation when the price of a distant futures contract is lower than the price of a nearer future.

The shape of the futures curve is very important for an investor because the performance of the futures contract depends on it. The total return performance of a commodity is related to the three elements below:

- **Spot return:** Movement of the spot price of the physical commodity.
- **Roll return:** Generated yield due to the rolling of one futures contract to the next designated contract by ensuring a continual exposure to futures prices and avoiding physical delivery and contract expiry. The roll return is mainly impacted by the shape of the futures curve and how it changes over time. The roll return can result in a loss or profit to the investor.
- **Collateral yield:** The interest earned on the cash value of the investment.

In Contango

A commodity will be in contango when it is expected that there will be a net cost to owning the underlying commodity, such as transporting, storing, or insuring the physical commodity. Assuming that the shape of the curve remains unchanged, as time passes and the future's expiry nears, the net cost to owning the underlying commodity until expiry diminishes, and the futures price draws closer to the (lower) spot price. Therefore, the roll return in contango tends to have a negative price impact on the futures return.

In Backwardation

A commodity will be in backwardation when for example, there is a temporary increase in demand on the physical commodity, increasing its price. Assuming that the shape of the curve remains unchanged, as time passes and the future's expiry nears, the net benefit to owning the underlying commodity until expiry diminishes, and the futures price draws closer to the (higher) spot price. The roll return in backwardation, therefore, may have a positive price impact on the futures return.

Important: The shape of the curve is the market expectations of the commodity spot price therefore, when entering a futures contract, the shape of the curve does not presume the investment outcome for an investor.

Spot return and roll return are intimately linked. A negative roll yield is not indicative that the investment will lose money for sure. It indicates that the market expects the spot price to rise over the period. If a commodity is currently trading at $50 with a one-month futures contract trading at $60 (contango), the market expectation is that in a month time, the commodity will trade at $60, not at $50. Assuming that the market is right and the commodity spot does trade at $60 at the end of the month, the investor will not lose money over the one month despite the apparent negative roll yield of the investment. The spot movement will compensate for the negative roll yield. In other words, a curve in contango does not automatically means a losing investment.

Similarly if the one-month futures contract is trading at $40 (backwardation), the market expectation is that in a month time, the commodity will trade at $40, not at $50. Assuming that the market is right and the commodity spot does trade at $40 at the end of the month, the investor will not gain money over the one month despite the apparent positive roll yield of the investment. The spot movement will compensate for the positive roll yield.

The Case for Investing in Broad Commodities

I. Commodities for the long run

When investing strategically in assets that encompass risks like equities or bonds, investors expect to be rewarded for that risk. That reward is called the risk premium, and it is defined as the investment return an asset is expected to yield in excess of the risk-free rate.

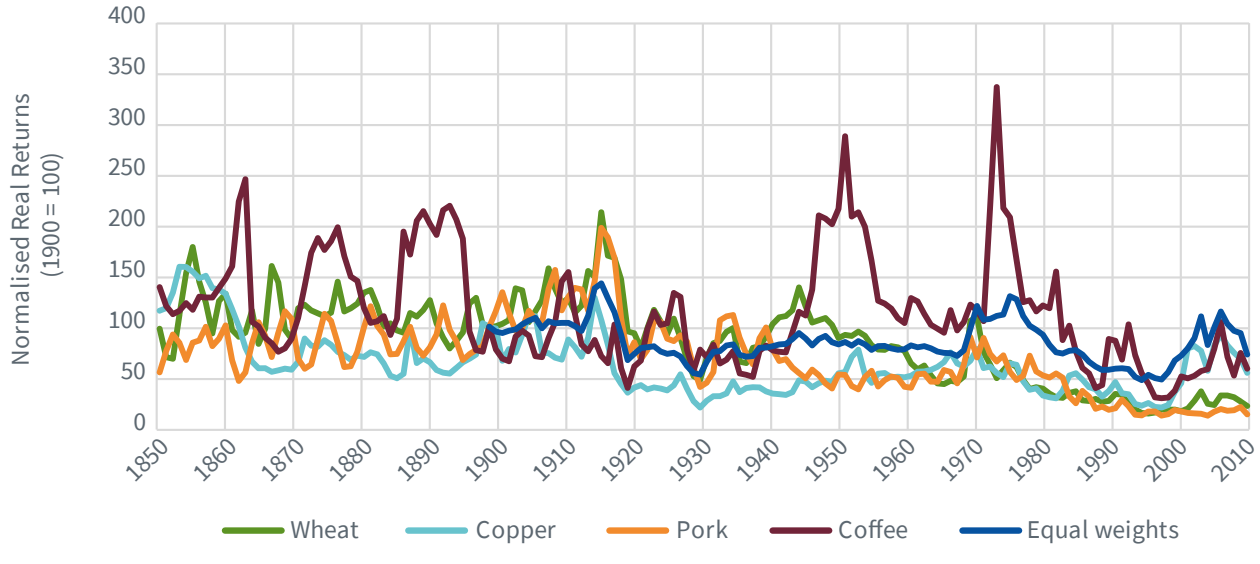
There may be tactical reasons to invest in assets that do not pay a risk premium, like trying to benefit from an imbalanced market or unexpected scenarios, but these are short-lived opportunities. Long-term investors aim to harness the risk premia attached to the assets they invest in. When it comes to commodity investments, the first and foremost question is, therefore, if commodities offer a risk premium.

A. An asset class with a recognisable risk premium

Can we expect physical commodities to offer a risk premium over inflation for the long-term? For many practitioners the answer is no. In many cases, the price of commodities is part of the calculation of inflation. The cost of food products like wheat, corn or sugar and the price of energy sources like crude oil are part of the basket of goods considered when calculating inflation worldwide. So it feels logical to think that an investment in a diversified basket of commodities will match but not outperform inflation.

Figure 1 shows the long-term annual real spot prices for a few commodities and an equal-weight basket of 40 individual commodities (animal products, energy products, grains, metal, minerals, precious metals, softs) since 1850. The price series are expressed in US dollars and deflated by the US Consumer Price Index (inflation). Those series are the results of the work by Dr David S. Jacks in (Jacks, 2013). In Figure 1, a level of 100 indicates that the commodity's price has not increased in real terms since 1850. Most of the commodities represented here oscillate around 100 or even get cheaper over time. The author concludes that many commodities have registered decreases in real prices over the period. However, real commodity prices in the aggregate may have been modestly on the rise, depending on weighting schemes. More generally, there is no academic consensus on the existence of a commodity spot risk premium that would reward investors for the systemic risk embedded in the movement of their prices. Some analysies find a small one, and some don't.

Figure 1: Commodity spot prices have not beaten inflation over the long-term



Source: (Jacks, 2013). Data from 1850 to 2015 in US dollar. **Historical performance is not an indication of future performance and any investments may go down in value.**

In his paper, Dr Jacks makes two very interesting observations:

- "Commodities to be grown" seem to experience a secular decline in real prices when "commodities in the ground" do not. The price of the first one is linked to the balance between the capacity of producers to increase the production of those commodities with the increased demand from a growing population. Over time, with technology improving, this supply appears to have outpaced the demand. On the other hand, the supply of "commodities in the ground" is physically limited by the existing reserves and seems to have historically failed to match the demand.

- Each commodity has exhibited, since the mid-nineteenth century, medium-term price deviations over multiple decades. These historical booms and busts are pervasive across history. In most cases, they are linked to demand-driven events such as industrialisation or urbanisation episodes. During those episodes, demand increases faster than supply, and prices go up for multiple year stretchs. Then a countervailing supply response appears, either through new technology or the discovery of new stocks, and the commodity prices normalise. When many commodities experience such demand shocks, practitioners tend to talk about 'super-cycles'. While not relevant to the risk premium discussion, section I.C discusses those cycles and their impact in more detail.

There does not seem to be any conclusive evidence of a real risk premium in spot commodity investments. This lack of risk premium is the source of many misunderstandings regarding commodity investments. As discussed earlier, most investors do not invest in commodities directly; they invest in commodity futures contracts. So, the real question is not whether physical commodities have a risk premium but do commodity futures contracts offer a risk premium.

Here the answer is a lot clearer. Academics have, very explicitly, shown that commodity futures have offered a sizable risk premium historically. So while commodity spot prices may trade in a range around an inflation trend, investments in commodity futures contracts have historically significantly outperformed inflation.

In (Bhardwaj, et al., 2005) and (Bhardwaj, et al., 2015), the authors study an equally-weighted index of commodity futures starting in July 1959 and demonstrate that fully-collateralised commodity futures had historically offered a risk premium similar to equities. Over the period July 1959 to December 2014, the equally-weighted index of commodity futures offered a risk premium, i.e. a performance above inflation, of 4.95%, while equities offered 5.91% and bonds 2.93%. The authors also looked at the stability of the risk premium over time. They note that the commodity risk premium tends to vary from one decade to the next, as does the equity risk premium. For example, the period from 1965 to 1974 stands out with its double-digit risk premium. However, they also note that in every decade in the study, the risk premium is positive. Even in the last decade of the study, i.e. 2005-2014, the risk premium is below average but still positive at 3.67%. (Bhardwaj, et al., 2019), using an equal-weight basket of a large array of commodity futures also shows that for the period 2010-2018, the risk premium for broad commodities was 2.1%. This is better than in the 1980s or 1990s, for example. Besides, all commodity sectors except industrial metals show a positive risk premium for that period. This is specifically noteworthy because the poor performance of broad commodity indices during this last decade is often used as proof that commodities can not be used strategically in portfolios.

Misconception #1

"Commodities trade in a range and do not outperform over the long term" or "Commodities are a tactical asset only".

Physical commodities are fundamental building blocks of our society. They are our food, our fuel, our building materials. Therefore, it is no surprise that their price movements largely explains what is called inflation. By extension, this means that physical commodities' prices tend to match inflation over the long term.

However, commodity investors most often invest in futures contracts and not in the physical commodities. These futures contracts have been designed as hedging tools to allow commodity producers and miners to hedge their production forward, making their businesses sustainable because they are insulated from the commodity prices' short-term volatility.

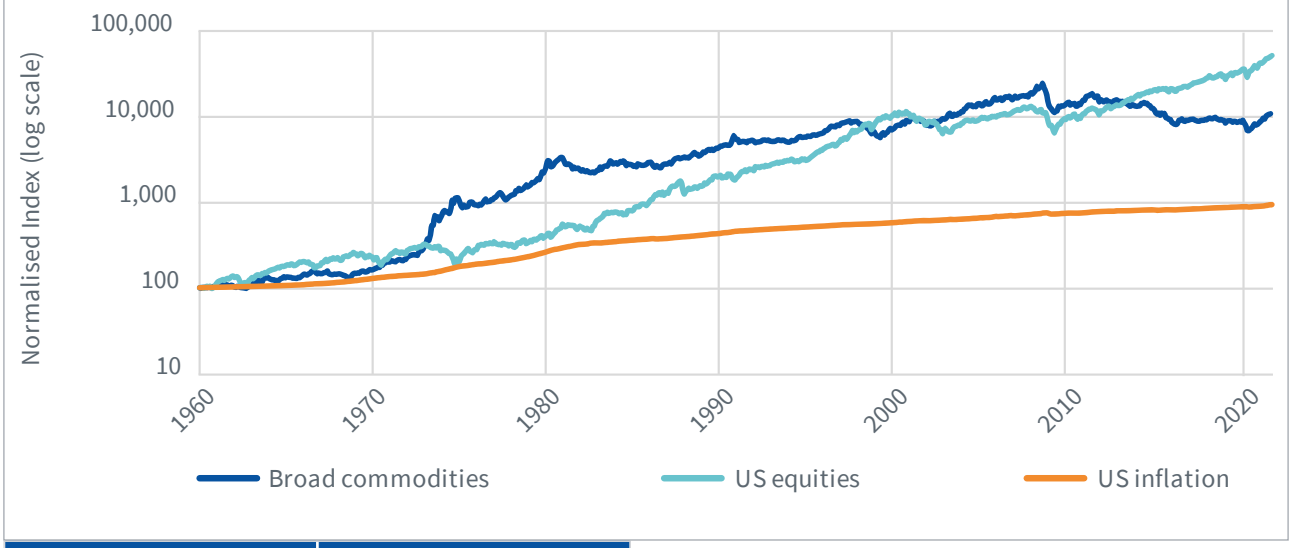
Producers are willing to pay for this hedge, just as they would pay for insurance. Therefore, investors who provide this hedge by buying futures contracts receive an insurance premium that allows them to beat inflation over the long term.

Commodity futures contracts benefit from a long term risk premium similar to an insurance premium.

(Levine, et al., 2018) ran a similar analysis going back to 1877 using their own dataset. They demonstrated that over the period, an equal-weighted portfolio of commodity futures contracts returned 4.8% versus 6.7% for stocks and 1.1% for bonds, demonstrating the long-term potential of commodity investments. Those findings are coherent with multiple other studies demonstrating that the long term performance of commodities futures contracts has been comparable to equities: (Bodie & Rosansky, 1980), (Fama & French, 1987), (Ankrim & Hensel, 1993), (Greer, 2000), (Jensen & Mercer, 2011).

Figure 2 shows that one of the oldest commodity futures contract benchmarks, the Bloomberg commodity total return index (BCOM), has outperformed inflation since the 1960s. While commodities have suffered in the last decade compared to equities, both assets have outperformed inflation and delivered a sizable risk premium. Looking at the academic evidence, fully-funded, delta-one, long investors in commodities futures contracts should expect to earn the risk-free rate plus the risk premium and some spot price deviation.

Figure 2: Bloomberg commodity index outperformed inflation since 1960



	Anualised Returns
Broad Commodities	3.91%
US Equities	5.26%
US Inflation	1.85%

Source: WisdomTree, Bloomberg, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. US Equities stands for S&P 500 gross TR Index. Broad commodities stands for Bloomberg commodity TR index. US Inflation stands for US Consumer Price Index Urban Consumers Seasonally adjusted. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #1: Commodity futures contracts, contrary to physical commodities, deliver a long term risk premium above inflation and, therefore, could warrant an exposure in a strategic asset allocation.

The main objective of this paper is to discuss the case for broad commodities, i.e. a diversified basket of commodities, as strategic assets. However, it does not mean that we can gloss over the fact that the different commodity sectors and single commodities are very different and carry varying risk premiums. (Bessembinder, 2018) showed that the majority of US stocks (48%) did not earn lifetime buy-and-hold returns above the return of one-month US Treasury Bills ("T-Bills"). This does not mean that the equity risk premium does not exist. However, it highlights that this risk premium is not evenly spread across all individual stocks.

Similarly, in (Bhardwaj, et al., 2019), the authors compiled a database of 230 different commodity futures dating from 1871. They found that, while on average, those futures did produce an estimated risk-premium of 5.3% per annum over the full period, 58% of the individual futures contracts earned a positive risk premium. They also find that the premium post-1960 is slightly reduced from 6.2% to 4.3% and that the lower premium is mostly concentrated in agricultural commodities (softs[5], animal products and grains & oilseeds). Interestingly enough, they find that "while the equality of average sector risk premiums cannot be rejected in the early period, the F-test for the post-1960 period rejects equality at the 5% level." In other words, while the risk premium of broad commodities appears to have eroded somewhat since the 1960s, this is not the case for some of the sub-sectors like energy, precious metals or industrial metals. This raises interesting implications for some variations on broad commodities investments like commodities ex-agriculture for example.

Figure 3: Commodity risk premium by sector 1871-2018

	All	Softs	Animal products	Grain & Oilseeds	Energy	Precious metals	Industrial metals
All period	5.30%	5.20%	3.90%	5.40%	9.80%	3.70%	5.70%
1871-1959	6.20%	6.80%	5.50%	6.70%	-4.00%	3.80%	4.30%
1960-2018	4.30%	3%	2.40%	3.00%	9.90%	3.70%	6.80%

Source: (Bhardwaj, et al., 2019). **Historical performance is not an indication of future performance and any investments may go down in value.**

Their last significant finding is the strong link between the risk premium offered by a futures contract and its market viability. They find that most futures contracts with negative risk premiums have had a very short lifespan in the market ("survival times"), and the risk premium offered by a contract in its early years is a good predictor of its chance of survival. In other words, if a commodity futures contract does not "pay" a positive risk premium to investors/hedge providers, that futures contract's chance to survive is limited. A good example is the egg futures contract. The futures contract started to fail when technology dampened the seasonality of fresh eggs production, diminishing the need to hedge the spot price risk of eggs inventories. At that point, eggs producers were unwilling to pay for such a hedge rendering the futures contract useless.

Figure 4: Risk premium of commodity futures contracts by survival times – 1871-2018

Futures contract survival times	2 years or less	2-10 years	10-50 years	50+ years
# commodities	36	50	99	45
# surviving	0	1	30	18
Average returns	-8.00%	0.20%	5.90%	5.10%

Source: (Bhardwaj, et al., 2019). **Historical performance is not an indication of future performance and any investments may go down in value.**

[4] Soft commodities, or softs, are commodities such as coffee, cocoa, sugar, corn, wheat, soybean, fruit and livestock. The term generally refers to commodities that are grown, rather than mined; the latter are known as hard commodities.

B. What are the drivers of the commodity risk premium

As with the equity risk premium, observing and proving the existence of the risk premium is not enough to build an investment case. To ensure the longevity of the risk premium, it is important to understand its underlying causes and ensure those causes are stable over time. Academics have tried to explain the existence of the commodity futures contract risk premium, and they have formulated and proven multiple theories.

1. The insurance role of futures contracts

Explaining the commodity risk premium is intimately linked to explaining the relationship between futures contracts prices and spot prices. The first explanation for the commodity risk premium came from John Maynard Keynes (Keynes, 1930). The theory focuses on the risk management function of the futures market. It explains the risk premium as an insurance premium paid by commodity producers to futures contract buyers to protect against commodity price volatility. In his "normal backwardation" theory, he explains that the seller of the futures contracts (usually the commodity producer) agrees to sell at a discount to protect himself against the spot price volatility. In other words, the seller pays a premium to insure against the price risk. The buyer on the other side of the futures contract takes the volatility risk of the commodity price but, in exchange, receives a gain: the risk premium. In this theory, the futures contract price can be described as the expected spot price of the commodity at maturity of the futures contract plus the risk premium. (Hicks, 1939) continued to flesh out Keynes' hypothesis, further defining the insurance role of futures contracts in commodity markets and extending this thought process from producers to all commodity holders.

Investors should, therefore, expect to harvest a positive premium by providing spot price insurance to commodity producers irrespective of the state of the market. The premium is paid as protection against the price risk regardless of whether the futures curve is in contango or backwardation.

Misconception #2

"When commodities trade in contango, losing money is guaranteed"

Contango and backwardation are used to describe the state of the futures curve. It describes the relative position of the current spot price and the futures contract price. It is the result of storage costs, financing costs, and convenience yield.

The fact that Keynes' theory is called "normal backwardation" has caused some terminology confusion. However, what is described by Keynes is the fact that futures contracts are generally priced at a discount to the expected spot price at expiry. It has nothing to do with the current spot price. In other words, the curve can be in contango, and the future price can still be at a discount to the expected spot price at maturity, i.e. be in normal backwardation as well.

Using a numerical example, let's say that WTI Crude Oil is worth $50 today. The market expects WTI Oil to trade at $55 in a month (expected spot price) because of storage and other costs. Keynes' theory hypothesis is that the 1-month futures contract will be priced at a discount to $55, let's say $54, to incentivise speculators to provide the hedge to producers. In this situation, the curve is in contango ($54>$50), and the expected risk premium is still positive at $1.

So, a curve in contango and a positive risk premium can coexist simultaneously.

While the shape of the curve has an impact on the performance it is not a good predictor of future performance.

2. The theory of storage

A complementary explanation for the long-term risk premium of commodities is the "supply of storage" theory. (Kaldor, 1939) and (Working, 1948) introduced a notion of convenience yield as the benefit of being able to use the inventories when they are the most needed. It is a very important concept because it quantifies the benefit of buying and storing certain commodities and because its existence explains the incentive for economic actors to store commodities in backwardation (i.e. when the price they would get for the commodity is higher now than in the future). It usually stems from local shortages and the ability to keep production processes running. An oil refiner, for example, would prefer to hold oil physically than to be subject to a potential increase in demand or a potential shortage of crude oil, which would force them to close their installations. Therefore the convenience yield is usually assumed to be negatively linked to inventory levels.

(Brennan, 1958) defined it as what is left when the marginal cost of storage and the financing cost are removed from the basis (i.e. the difference between the price of the futures contracts and the spot price). In mathematical form, the price of the futures contract at maturity T ($F_{t,T}$) can be defined as:

$$F_{t,T} = S_t e^{(r_{t,T}+u_{t,T}-c_{t,T})(T-t)}$$

where S_t is the spot price of the commodity at time t, $r_{t,T}$ is the continuously compounded riskless rate of interest from t to T, $u_{t,T}$ is the annualized cost of holding the commodity (storage, insurance..) from t to T and $c_{t,T}$ is the convenience yield.

From this formula, we can deduct that a backwardated market (downward sloping curve) is linked to the convenience yield being higher than the costs associated with holding the commodity (interest rate, storage and insurance costs). A market in contango indicates that the costs are higher than the convenience yield. From the point of view of the futures contract buyer, a positive convenience yield leads to a lower contract price and, therefore, an expected gain. (Cootner, 1967) summarised it this way: "hedging, unlike arbitrage, is not riskless. What it accomplishes is not the elimination of risk, but its specialisation: its decomposition into its components. (...) we would expect merchants with a presumed comparative advantage in basis speculation (i.e., in predicting demand for stocks) to specialise in that field and to buy from others the speciality of speculation on absolute price." In other words, since convenience yield and inventory risk are intimately linked, the risk premium can be seen here as the reward for taking inventory risk.

In summary, looking at the existing academic literature on commodity futures contracts, an investor could expect to be rewarded by a risk premium that derives from hedging pressures and inventory risk.

Finding #2: Commodity's risk premium is anchored in the commodity ecosystem because producers benefit from hedging their price risk through future contracts.

Misconception #3

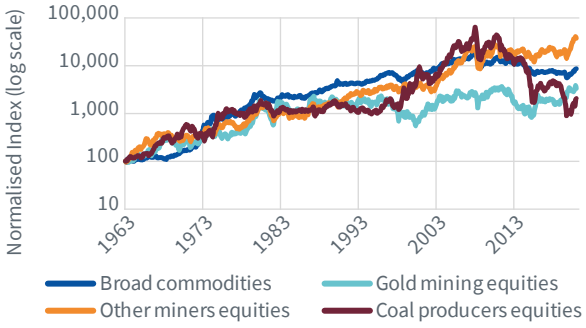
"Commodity-linked equities (miners, oil producers) perform better than commodities especially since they pay high dividends."

Many investors feel that commodity-linked equities like mining companies or oil producers provide an exposure very similar to commodity futures while benefitting from high dividends and not being subject to roll yields. However, looking at the historical performance of 3 US sub-industries (gold mining, non-metallic and industrial metal mining and coal producers), we observe that two of them underperformed very clearly broad commodities, and only one of them outperformed.

Also, as discussed later in this paper both the volatility, the drawdowns and the Value at Risk of commodity-linked equities are significantly higher than for commodity futures, ofter twice higher.

More importantly, their correlation to broad commodities is very low, between 29% and 38% over the period (barely above the 12% correlation exhibited by the S&P 500). So while, being equities, they benefit from the long term equity risk premium and can be used for strategic investments, they fit into the equity asset class and not the commodity one.

Long Term performance of commodity-linked equities



Source: WisdomTree, Bloomberg, S&P, Kenneth French data library. June 1963 to August 2021. Calculations are based on monthly returns in USD. US Equities stands for S&P 500 gross TR Index. Broad commodities stands for Bloomberg commodity TR index. US Inflation stands for US Consumer Price Index Urban Consumers Seasonally adjusted. Historical performance is not an indication of future performance and any investments may go down in value.

Commodity-linked equities have not outperformed markedly historically, and their correlation to commodities is tenuous.

C. The impact of super-cycles on commodities performance

As discussed above, commodity prices tend to exhibit medium-term price deviations over multiple decades. In (Erten & Ocampo, 2012), the authors demonstrate that while commodities rise and fall along with normal business cycles, there are often longer undercurrents driving the direction of commodities known as "super-cycles". These super-cycles are less frequent than normal business cycles, but they are longer lasting. Full super-cycles (including the 'up' and 'down' phase of the cycle) between 1865 and 2009 have ranged between 30 and 40 years, with amplitudes of 20% to 40% higher or lower than the long-term trend. Interestingly, these super-cycles follow world GDP, indicating that they are essentially demand-determined. (Jacks & Stuermer, 2020) confirm that the effects of demand shock strongly dominate commodity supply shocks in driving prices of commodities higher over long periods of time. So while futures-based broad commodity investments deliver a risk premium over the long-term, spot price movements can add in the up part of super-cycles or subtract in the down part when considering overall total returns. Remember that this does not mean that the performance of broad commodities are negative in the down part of the super-cycle but that the performance could be lower than the expected risk premium.

The table below from (Erten & Ocampo, 2012) identifies four super-cycles in the spot price of non-oil commodities over the last 120 years. The authors use a band pass filter to separate super-cycles from business cycles. Between 1894 and 1917, commodity prices rose 50.2%, coinciding with the second industrial revolution in the US[6]. This was a period in which the supply of commodities could not keep up with demand growth. The next major 'up' cycle started in 1932 and lasted till 1951. That was a period of post-war reconstruction in Europe and further enhanced by Japan's post-war economic emergence. The third 'up' phase of a super-cycle, according to Erten and Ocampo, started in 1971 and only lasted two years before peaking. It was followed by 26 years of down cycle. The final super-cycle identified by the authors started in 1999 and peaked in 2010. This super-cycle was driven by China's rapid industrialisation and urbanisation, combined with its integration into the global economy.

Misconception #4

"Commodities only offer the potential to outperform when they are in the upward phase of a super-cycle."

Academics have demonstrated that broad commodity futures beat inflation over the long-term. For example, the risk premium, calculated over the period July 1959 to December 2014, is 4.95%. They have also demonstrated that the risk premium is positive in most decades, including 2010-2018.

Having said that, returns of futures are not purely linked to the risk premium, they are affected by spot price movements. There is evidence of super-cycles in commodity prices that dictate the long-term direction of the market. In the up part of the super-cycle, investors can benefit from the commodity risk premium and the uptrend in spot prices (which transfers into an uptrend for futures contracts), leading to strong performance. But that doesn't necessarily mean that commodities only offer an opportunity when in the 'up' phase of super-cycles.

Downtrends have historically lasted between 10 and 30 years, covering multiple business cycles. While commodities usually suffered from deep drawdowns earlier in the downtrend, the rest of that part of the super-cycle ended up being driven more by business cycles. This led to periods of stronger performance and weaker performance in line with the economy. Broad commodities are a cyclical asset after all, as discussed in Chapter II.

In any case, we believe that in 2021, we could be entering another 'up' phase of a commodity super-cycle, driven by a combination of inflation, an infrastructure boom and an energy transition that could leave the supply of certain commodities short of demand. Once again, there could be prospects for commodities spot price outperformance.

While upward phases of commodities' super-cycle are historically advantageous for commodity investors, future-based broad commodity investments can deliver a risk premium in any part of a super cycle.

[6] The second industrial revolution lasted from 1870 to 1914 (i.e. the start of the First World War) https://en.wikipedia.org/wiki/Second_Industrial_Revolution

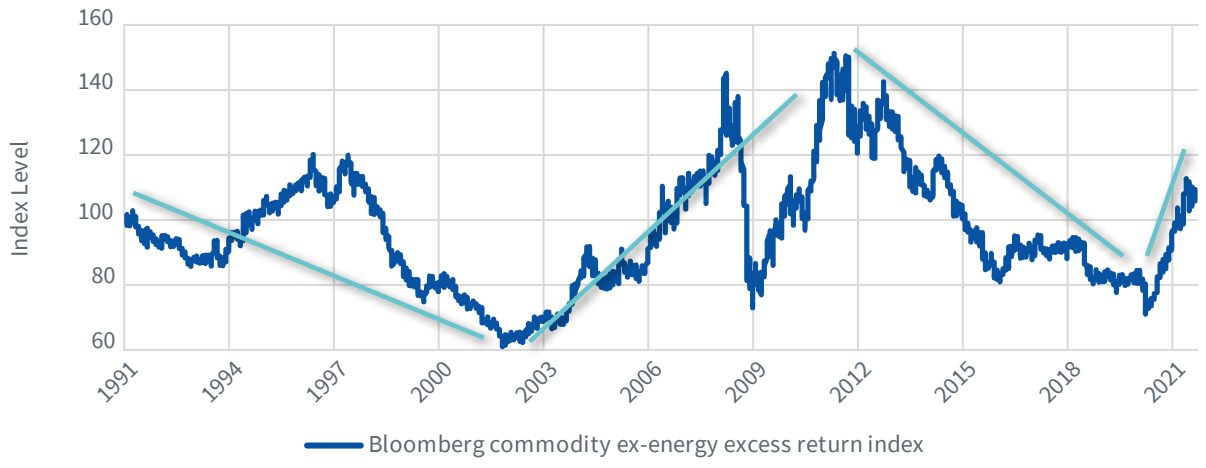
Figure 5: Descriptive statistics of super-cycles in total non-oil commodities				
	1894-1932	1932-1971	1971-1999	1999-ongoing*
Peak year	1917	1951	1973	2010
Percent rise in prices during upswing	50.20%	72.00%	38.90%	81.30%
Percent fall in prices during downswing	-54.60%	-43.30%	-52.50%	-
Length of cycle (years)	38	39	28	-
Upswing	23	19	2	11
Downswing	15	20	26	-
Mean (of full cycle)	157.3	119.4	86.2	82.2
Standard deviation	24.8	15.6	18.8	17
Coefficient of variation	15.8	13.1	21.8	20.8
Skewness	-0.7	0.9	0.6	0.5
Kurtosis	3.6	4	2.6	1.6

Source: (Erten & Ocampo, 2012). **Historical performance is not an indication of future performance and any investments may go down in value**.*With the paper being published in 2012, the cycle's full 'down' leg had not been completed.

Although this last cycle was not complete when they wrote their paper, in Figure 6, we are trying to assess how events unfolded since 2012. To do so, we use the Bloomberg Ex-Energy Excess Return index. This data series is futures-based and will incorporate more than the spot price, but is useful for illustration. We can see that between 2010 and 2020, commodity prices fell close to 50% from peak to trough (i.e. a similar magnitude to all previous 'down' phases of super-cycles). This leads us to think that the cycle's 'down' phase could have ended around 2020. Furthermore, structural changes could signal the next super-cycle. We have started to see a substantial increase in non-oil commodity prices, and there are many structural reasons for this to continue. Catalysts for this 'up'" phase include:

1. A higher inflationary environment than we have seen in recent decades.
2. A structural increase in demand for commodities driven by an infrastructure boom.
3. A renewed focus on the environment which will increase the demand for certain commodities and, at the same time, present challenges for supply growth.

Figure 6: Bloomberg commodity ex-energy excess return Index



Source: WisdomTree, Bloomberg. From January 1991 to August 2021. In USD. **Historical performance is not an indication of future performance, and any investments may go down in value.**

'Up' phases of super-cycle are relatively rare, but they can offer significant advantages to commodities investors. During such periods, investors can benefit from both the commodity risk premium and the uptrend in spot prices (which transfer into an uptrend for futures contracts), leading to strong performance.

However, that does not mean that there are no opportunities in commodity markets outside of those uptrends. Downtrends have historically lasted between 10 and 30 years, covering multiple business cycles. While commodities usually suffered from deep drawdowns earlier in the downtrend, the rest of that part of the super-cycle ended up being driven more by the business cycles. This led to periods of stronger performance and weaker performance in line with the economy. As we will discuss in chapter II, broad commodities are a cyclical asset after all.

For example, in the 1971-1999 'down' phase, we saw a substantial upturn in ex-energy commodity futures prices between 1993 and 1996 (37%). While equity markets may have also been performing strongly in this period overall, in the calendar year 1994, we saw ex-energy commodity futures prices rise 12% while the S&P 500 fell 2%. In 1994, the US and global economy were posting strong results, providing a tailwind for commodities, even though the stock market in the US was subdued. Once again, in the post-Great Financial Crisis recovery period between November 2008 and September 2011, we saw an 85% recovery in ex-energy commodity prices, with final prices ending up 4% above the March 2008 peak. Returns on the S&P 500 were only 24% over that recovery period. In other words, while broad commodities tend to suffer markedly in the early part of the downtrend of a super-cycle, there are many periods of opportunities in subsequent years.

Also, as discussed earlier, across a full super-cycle, commodity spot prices will mean revert, erasing any gain or losses above inflation, but futures-based broad commodities investment will deliver a risk premium.

As the Bloomberg ex-energy excess return index excludes collateral yield (i.e. three-month T-Bills), we can think of it as a return net of inflation expectations as per (Fama & Schwert, 1977) (See A great hedge against unexpected inflation section for further discussion on this concept). The fact that we have seen positive returns since the inception of this index in 1991 to date, Figure 6, shows that there has been a positive risk premium above inflation over the period.

Finding #3: While upward phases of commodities' super-cycle are typically advantageous for commodity investors, future-based broad commodity investments can deliver a risk premium in any part of a super-cycle.

The Case for Investing in Broad Commodities

II. Commodities: A multi-faceted investment

Chapter 1 summarised the long-term investment case for futures contracts on commodities, highlighting a historical commodity risk premium similar to the equity risk premium, grounded in the market ecosystem. However, like for equities, the risk premium is not the only consideration when investing in broad commodities. In a portfolio, commodities can bring value along three distinct dimensions.

- **The defensive dimension:** Commodities are an effective downside hedge, i.e., they tend to do better when equities pull back sharply. This property is achieved because broad commodity baskets include so-called safe-haven assets like gold. But portfolios also need defending on the upside, especially when inflation starts to rise. Broad commodity baskets offer a natural hedge against rising prices and unexpected inflation.

- **The cyclical dimension:** During an economic upswing, aggregate demand from consumers, businesses, and governments rises. There is a greater need for resources like energy and industrial metals. Holding broad commodity baskets allows investors to participate in this growth phase of the economic cycle.

- **The thematic dimension:** Due to their growing use in emerging technologies such as 5G, electric vehicles, and renewable energy, metals are increasingly seen as thematic investments. For example, copper's use in passenger electric vehicles is forecast to rise from less than 0.5 million tonnes (Mt) in 2020 to over 2.5Mt by 2035.

The defensive and cyclical dimensions are the focus of this second chapter.

A. The super diversifier

1. Positive skew, a protection against exceptional events

Looking at the distribution of monthly returns of the Bloomberg commodity total return index and the S&P 500 total return index since January 1960, in Figure 7, we observe that:

- Commodity futures contracts have exhibited slightly higher volatility than equities over the period, but this tends to vary between periods. In 58% of the rolling 3-years periods since 1960, equities have suffered from higher volatility.

- The returns of commodities and equities deviate from a normal distribution (a perfect normal distribution would exhibit a skew of zero and a kurtosis of 3).

- The returns of equities are negatively skewed, meaning that the distribution has more weight on the left tail (i.e. the negative side of the distribution). On the contrary, commodities are positively skewed, meaning that the distribution has more weight in the right tail (i.e. the positive side of the distribution). In other words, large positive returns tend to be more common for commodities than large negative returns when it is the contrary for equities.

- Commodities' returns also exhibit higher kurtosis indicating even fatter tails, meaning a greater chance of more extreme return observations, probably on the positive side thanks to the positive skewness.

Those distribution differences can be observed anecdotally. We can, for example, calculate the Value at Risk at 98% of equities and commodities by ranking their monthly returns from worst to best over the historical period and looking at the monthly return that separates the best 98% of the monthly returns of the worst 2% monthly returns. The historical one month Value at Risk at 98% of equities is -8.7% which means that between January 1960 and August 2021, in 2% of the months, equities lost more than -8.7%. Commodities' Value at Risk is -7.7%. So 1% better than equities. Historically equities have been riskier with deeper losses which could come from the negative skew of equities. On the other side of the distribution, commodities have benefited from 16 months with a performance above +10%, while equities benefitted from only 12.

[7] Wood Mackenzie 2019 Forecasts.

Figure 7: Risk statistics for commodities and equities from Jan 1960 to July 2021		
	Broad commodities	US equities
Annualised volatility	15.9%	14.7%
Skewness	0.91	-0.44
Kurtosis	7.10	1.87
1 Month VaR 98%	-7.7%	-8.7%
#months with performance below -5%	59	60
#months with performance above +10%	16	12

Source: WisdomTree, Bloomberg, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. US Equities stands for S&P 500 gross TR Index. Broad commodities stands for Bloomberg commodity TR index. **Historical performance is not an indication of future performance and any investments may go down in value.**

An example of when this positive skew came into play was during the 1973 oil crisis, a period when US oil production had seemed to have peaked, and the members of the Organization of Arab Petroleum Exporting Countries or the OAPEC (consisting of the Arab members of OPEC) imposed an oil embargo on the US in retaliation for the country's support for Israel during the Yom Kippur war. That led to energy prices rising across the board in the United States. If WTI oil futures had existed at that time (they were only created in 1983), that would have had an obvious and immediate impact on commodity futures price indices. Even in the absence of an oil inclusion in commodity indices, the oil price shock substantially impacted agricultural commodity prices, increasing commodity futures indices. Meanwhile, the oil price shock had a detrimental impact on companies faced with higher input costs, a margin squeeze and demand for higher wages. Stock markets reacted negatively. Overall in 1973, the Bloomberg commodity total return index rose 130%, while the S&P 500 fell 18%.

A very similar event occurred in 1979, during the Iranian Revolution. Disruption to oil supplies raised prices across the board, with agricultural commodities responding quickly. Although US equity markets were performing strongly in a period of monetary excess on this occasion, they did not keep pace with commodity futures indices. In 1979, the Bloomberg commodity total return index rose 98%, while the S&P 500 rose 40%.

While performance distributions are important, the relative relationship between those two distributions is even more important for investors.

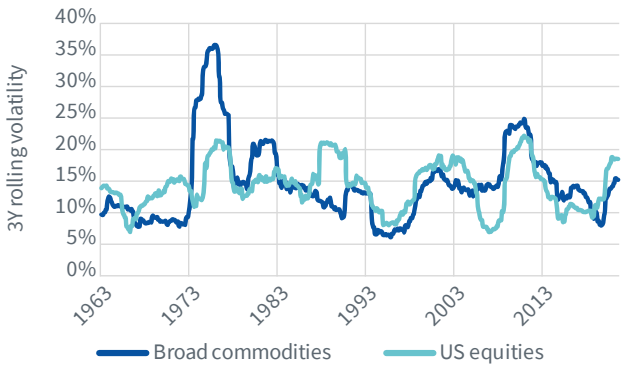
Misconception #5

"Commodities are riskier and more volatile than equities."

Equities and commodities are similar asset classes statistically. Their historical returns and their historical volatility are quite close indeed. Historically, commodities have exhibited higher volatility than equities in 42% of the 3Y periods since 1960. In 58% of the periods, equities have shown higher volatility.

More importantly, the two asset's distributions differ from a normal distribution with significantly higher skew. But, commodities have the advantage. They exhibit a positive skew, i.e. a tendency for higher than expected positive returns when equities are known for their negative skew i.e. their tendency to surprise on the downside.

Commodity and equity 3Y annualised rolling volatility over time



Source: WisdomTree, Bloomberg, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. US Equities stands for S&P 500 gross TR Index. Broad commodities stands for Bloomberg commodity TR index. Historical performance is not an indication of future performance, and any investments may go down in value.

Commodities have exhibited lower volatility than equities in 58% of the time rolling 3-year periods we studied historically and benefit from positive skew.

2. Commodities offer diversification from the main asset classes

Commodities are known as powerful diversifiers. Commodity futures contracts do show the lowest correlation with most of the main asset classes. Commodities are negatively correlated to US treasuries and US corporate bonds. They also offer a low correlation to equities and US high yield bonds. The highest historical correlation of 39% is with emerging markets equities, which is easily explainable by the fact that many emerging economies are still largely driven by commodity producers. Organization of the Petroleum Exporting Countries Plus ("OPEC+") countries' economies, for example, are intimately linked to oil and its performance.

Figure 8: Correlation between main asset classes

	US equities	Global equities	EM equities	US treasuries	US corporate bonds	US high yield bonds
Broad commodities	12%	19%	39%	-14%	-3%	25%
US equities		90%	67%	5%	34%	60%
Global equities			73%	2%	33%	61%
EM equities				-17%	26%	59%
US treasuries					79%	2%
US corporate bonds						55%

Source: WisdomTree, Bloomberg, MSCI, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US equities (S&P 500 gross total return index) data started in Jan 1960. Global equities (MSCI world gross total return index) data started in Dec 1969. EM equities (MSCI emerging market gross total return index) data started in Dec 1987. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.**

It is worth noting that this very low correlation has been observed by academics as well. In (Bhardwaj, et al., 2005), the authors use their equal weight index of commodity futures contracts and highlight a negative correlation between commodities and equities/bonds over long periods. These findings are also consistent with those of (Edwards & Liew, 1999) and (Levine, et al., 2018).

Finding #4: Commodity offers decorrelation from equities and bonds.

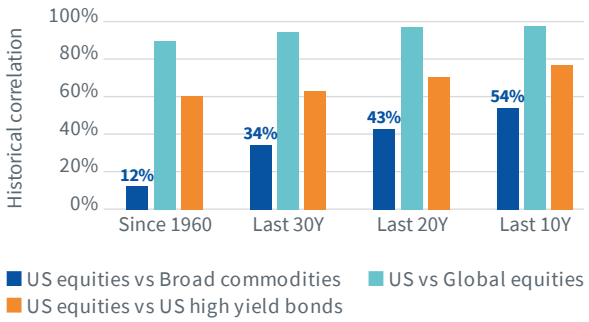
Misconception #6A

"Markets have changed. Commodities do not provide diversification vs equities anymore."

Markets are indeed becoming more and more efficient. With those changes, assets have become more correlated. Looking at the figure below, it is clear that commodities have been more correlated to equities in the last 10 years than before. However, this is true of most asset pairs as well. US equities are more correlated to global equities. Equities are more correlated to high yield bonds. In a globalised world where correlations are more elevated, commodities still stand out for their lower level of correlation.

It is worth noting that commodities have continued to provide a cushion against equity crises in recent periods. In November 2019, equities lost -12.4% when commodities gained 5.0%. In Dec 2017, equities lost -9% when commodities gained 2%.

Correlations have been rising



Source: WisdomTree, Bloomberg, MSCI, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad Commodities (Bloomberg Commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. Global equities (MSCI world gross total return index) data started in Dec 1969. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.**

Commodities continue to offer better diversification than other asset classes.

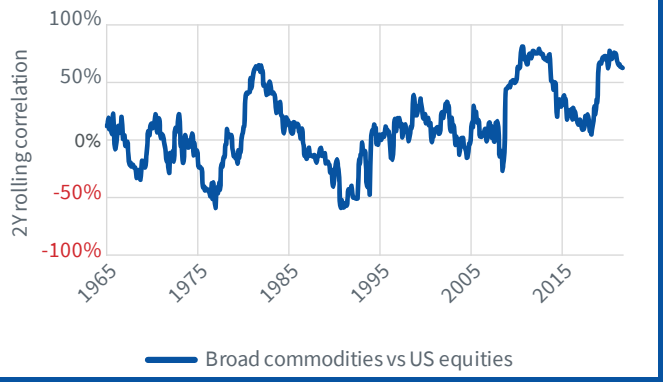
Misconception #6B

"2008 changed everything. There is no diversification left to be had."

While 2008 marked an all-time high for the correlation between equities and commodities, their correlation has always oscillated. There have been earlier spikes of similar magnitude in the 1960s and 1980s. Ten years on, we observe that this spike, like previous ones, has been temporary.

Therefore there is little evidence that anything drastic has changed regarding the relative performance of those two asset classes.

Correlations are volatile and change over time



Source: WisdomTree, Bloomberg, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad Commodities (Bloomberg Commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. **Historical performance is not an indication of future performance and any investments may go down in value.**

Commodity vs equity correlation tend to oscillate and has remained within normal historical ranges.

3. Increased diversification in crisis

While its low correlation with equities has always been a strong argument for proponents of commodity investments, critics have historically argued that this low correlation does not hold in periods of crisis. Figure 9 shows the correlation between different asset classes during the months when US equities are down -5% or more to test this hypothesis. It is worth noting that the correlation matrix is not significantly different to Figure 8. Commodities and US Treasuries still offer the most diversification versus other asset classes. The correlation between commodities and the various asset classes remains very low, which should blunt most critics from that angle.

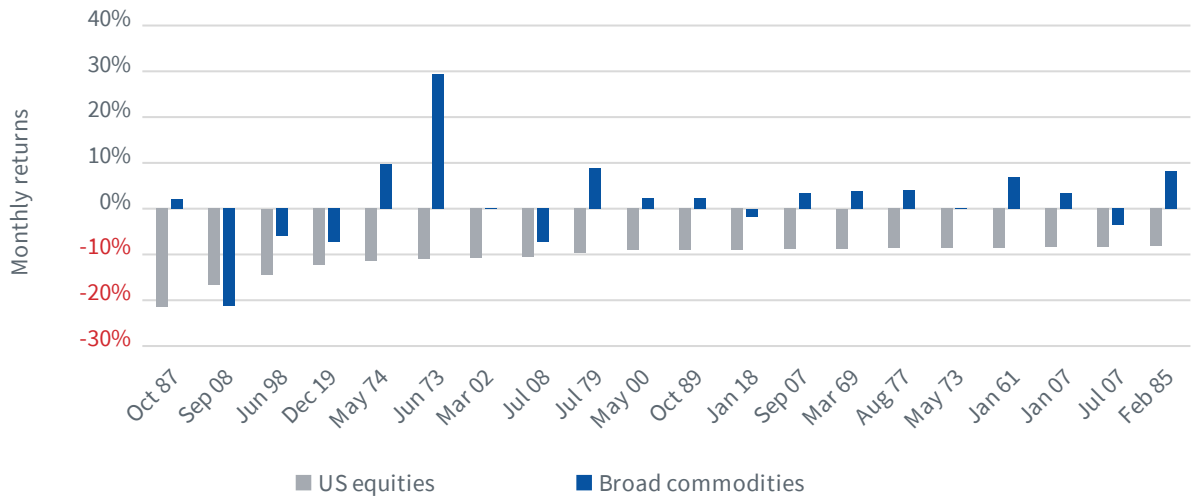
Figure 9: Correlation between the main asset classes when US equities are down more than -5% in a month

	US equities	Global equities	EM equities	US treasuries	US corporate bonds	US high yield bonds
Broad commodities	19%	35%	48%	-11%	28%	49%
US equities		80%	69%	-25%	10%	44%
Global equities			82%	-20%	28%	62%
EM equities				-4%	49%	63%
US treasuries					55%	-25%
US corporate bonds						56%

Source: WisdomTree, Bloomberg, MSCI, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. Global equities (MSCI world gross total return index) data started in Dec 1969. EM equities (MSCI emerging market gross total return index) data started in Dec 1987. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.**

Digging further into the relative behaviour of commodities in periods of equity crisis, Figure 10 illustrates the performance of the Bloomberg Commodity Total Return Index in the worst 20 months for the S&P 500. We observe that commodities have offered very strong differentiation to an investor. Taking the example of the worst month for equities in the last 60 years or so, US equities lost -21.5% in October 1987, following "Black Monday", the name coined after the sudden drop in global equity markets on 19th October 1987. During that same month, the BCOM index gained 2.1%. This would have provided incredible help to any investor during that month. In fact, commodities have outperformed equities in 19 out of those 20 months. In 14 months, commodities have even performed as positively as they did in October 1987.

Figure 10: Broad commodities performance in the worst 20 months for the S&P 500 since 1960



Source: WisdomTree, Bloomberg, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #5: In stressed markets or geopolitical crises, commodities can deliver both diversification and outperformance.

B. Not just another cyclical asset

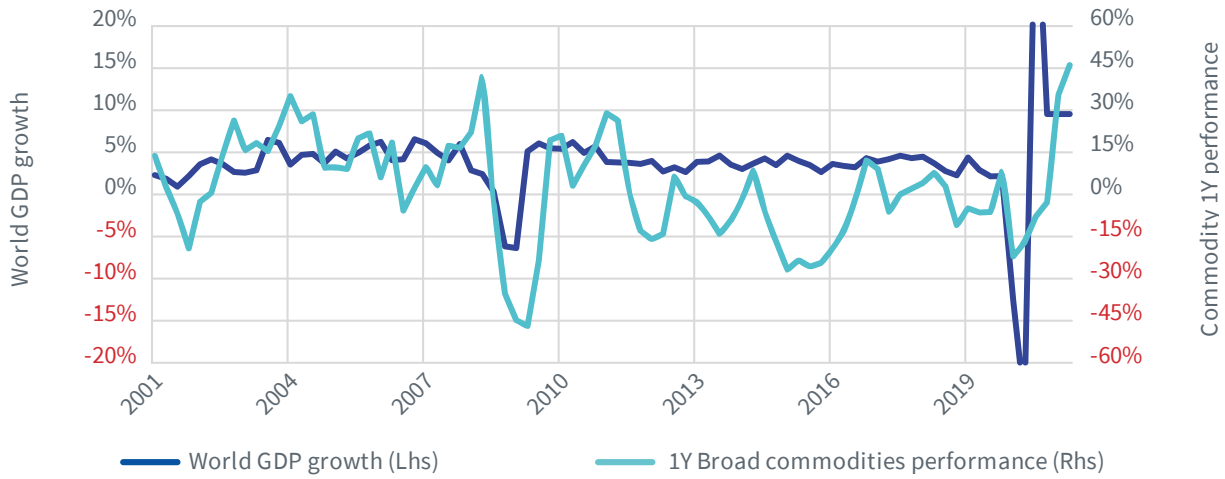
While the relationship between commodities and other assets is very important to portfolio construction considerations, the relationship between commodities and the economy or the business cycle is also critical. In the Capital Asset Pricing Model (CAPM) framework[8], each asset comprises systematic risks and unsystematic or idiosyncratic risks. Idiosyncratic risks are specific to each asset and can be reduced through diversification. Part II. A allowed us to demonstrate the advantages of commodities when it comes to reducing the idiosyncratic risk of a portfolio through lower correlation. However, in this part, we aim to analyse the relationship between commodities and systematic risk, i.e. the business cycle risk.

1. Commodities benefit from economic expansions

Intuitively, it feels like commodities should benefit from a positive economic environment. When the economy grows, it needs base materials to do so. Metals are required to build new homes, new factories, new infrastructure, new cars and so on. More energy is consumed to move goods and people around. So overall, there is a logic to commodities behaving like a cyclical asset.

Figure 11 illustrates, very clearly, this positive relationship over the last 20 years. In periods where the gross domestic product (GDP) is growing, the price of commodity futures contracts also does, and when the GDP is contracting, the cost of commodities also reduces through a decline in demand.

Figure 11: Commodity prices closely aligned with the economy



Source: WisdomTree, Bloomberg. March 2001 to August 2021. Broad commodities stands for Bloomberg commodity total return index. **Historical performance is not an indication of future performance and any investments may go down in value.**

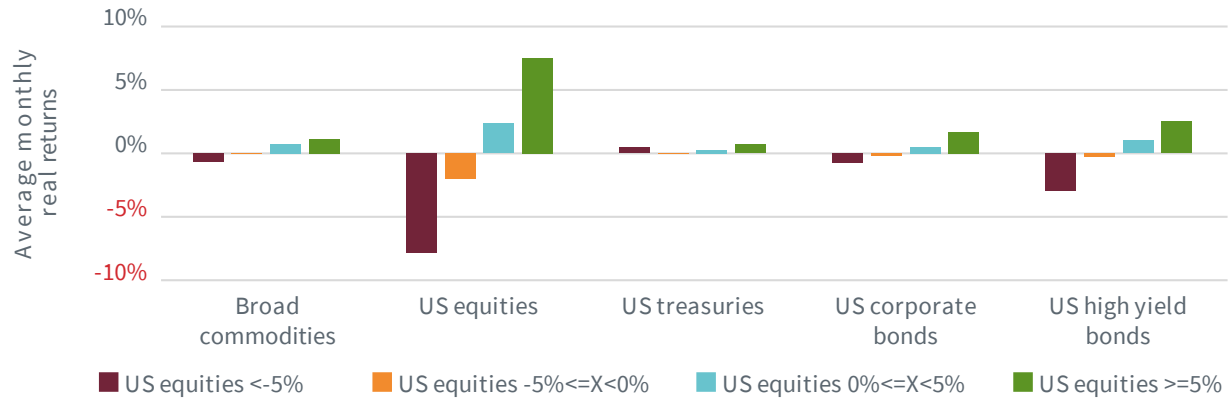
While logical, this cyclicality may seem difficult to reconcile with the low correlation between commodities and equities. Equities are also very cyclical, so how can two cyclical assets be so uncorrelated? On average, in all the months since the 1960s where US equities have lost more than -5%, commodities have lost -0.65%. In all the months where US equities gained more than 5%, commodities gained 1.13%. This compares to -7.8% and 7.5%, respectively, for US equities themselves. So while commodities are cyclical, i.e. they tend to lose and gain broadly at the same time as equities, the amplitude of such gains is significantly more

[8] The capital asset pricing model is a model used to determine the theoretical rate of return of an asset, in order to make decisions about adding assets to a portfolio. The model takes into account the asset's sensitivity to non-diversifiable risk (also known as systematic risk or market risk), often represented by the quantity beta (ß), as well as the expected return of the market and the expected return of a theoretical risk-free asset. In this framework, the risk of a portfolio comprises systematic risk, also known as undiversifiable risk, and unsystematic risk which is also known as idiosyncratic risk or diversifiable risk.

muted. This supports our decorrelation hypothesis. It appears that while commodities and equities tend to gain during the expansion phase of the business cycle, they may not gain at the same time, i.e. during the same part of the cycle.

In comparison, US Treasuries gained 0.45% on average in months where US equities lost 5% or more, a testament to their defensiveness. They are definitely not a cyclical asset. US corporate bonds, on the contrary, also exhibited a cyclical behaviour aligned with equities but in a very muted way due to their low correlation and low volatility.

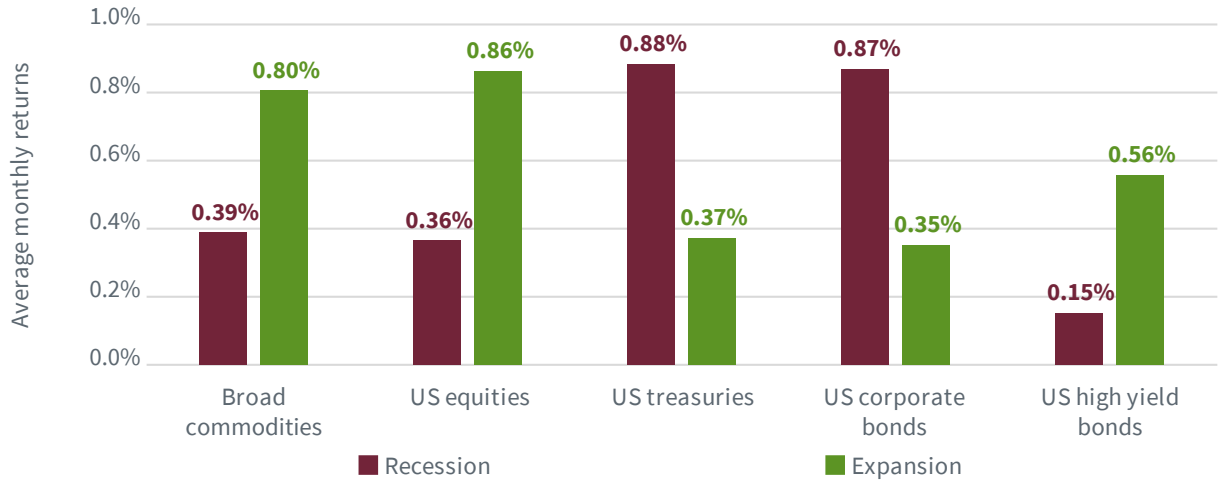
Figure 12: Cyclical and defensive assets



Source: WisdomTree, Bloomberg, S&P. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.**

To fully assess the relationship of commodities with the business cycle, we turn to the National Bureau of Economic Research (NBER) Business Cycle Dating Committee, which maintains a chronology of US business cycles. The chronology identifies the dates of peaks and troughs that frame economic recessions and expansions. A recession is a period between a peak of economic activity and its subsequent trough or lowest point. Between trough and peak, the economy is in an expansion. By comparing the performance of different assets in those recession and expansion periods, it is possible to assess their cyclicality. Figure 13 shows that equities have gained on average 0.86% per month in periods of expansion. This is the largest performance among the asset classes tested. They are followed by commodities (+0.8%), high yield bonds (+0.6%) and then corporate bonds (+0.4%). In periods of recession, high yield bonds (+0.2%) and equities (+0.36%) have performed less strongly. On the other side of the spectrum, US treasuries (+0.9%) have the strongest performance in a month when the economy is in recession. Again, this analysis points to equities, commodities and high yield bonds as cyclical assets, with equities and commodities being the strongest. It also points to the strength of US treasuries as a defensive asset.

Figure 13: Performance of various asset classes in periods of economic expansion and recession



Source: WisdomTree, Bloomberg, S&P. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.** Expansion and Recession phases are defined using the NBER website.

Finding #6: Commodities tend to benefit from economic expansion and as such are cyclical in nature.

2. A surprisingly robust asset in early recessions

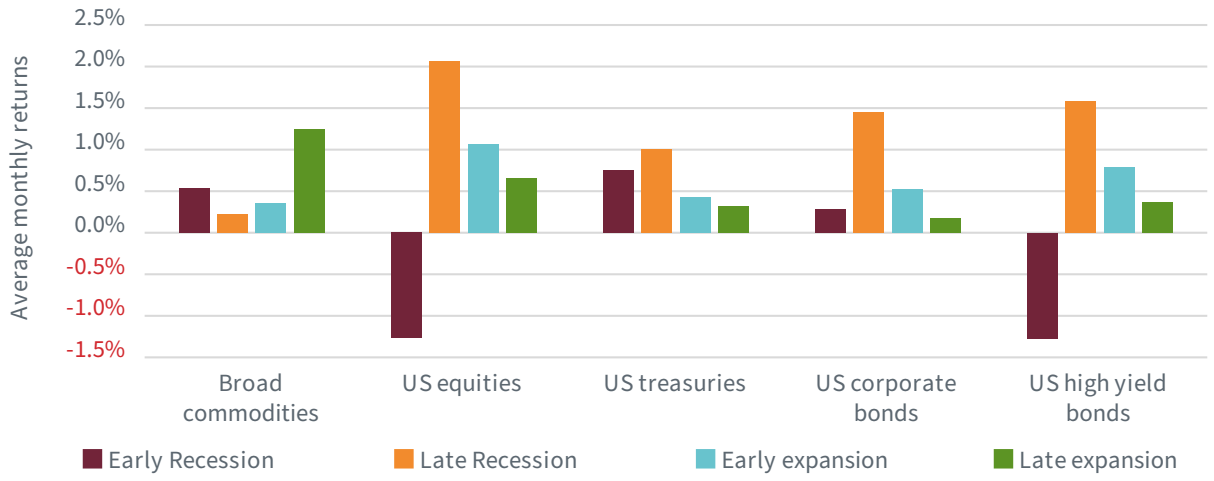
However, digging further into the link between asset classes and the economic business cycle, Figure 14 refines the analysis by splitting expansion and recession periods into two parts of equal duration. Through this lens, the results are pretty different. Equities and high yield bonds appear to behave very similarly:

- They suffer the most from the early recession part of the cycle but rebound the strongest in the late part of that recession.
- While they benefit from the expansion part of the cycle, they rise faster in the early part of that expansion.

On the contrary, commodities tend to hold up well in the early phase of a recession, posting on average a positive performance of 0.54% (vs -1.3% for equities). However, they suffer more in the late phase of a recession and trail both equities and high yield bonds. In the cycle's expansion phase, commodities perform better in the second half, contrary to equities that prefer the first half. Commodities are the strongest performers among all the asset classes in that late part of the expansion cycle.

So overall, while commodities are a cyclical asset, their behaviour is very decorrelated to equities or high yield bonds. They offer great diversification in early recession and late expansion phases when other cyclical assets (equities, high yield bonds) struggle. In other words, commodities offer some diversification of the systematic risk component of the CAPM as well. This finding aligns with (Weiser 2003), which showed that commodity futures return performed well in unusual parts of the business cycle.

Figure 14: Performance of equities and commodities across different parts of the business cycle



Source: WisdomTree, Bloomberg, S&P. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.** Expansion and Recession phases are defined using the NBER website. To define early and late expansion/recession, the periods are split in half time-wise.

Finding #7: While cyclical, commodities offer some diversification to the systematic component of risk by responding uniquely to different parts of the business cycle.

C. A powerful inflation hedge

One of the most talked-about characteristics of commodity investments is their capacity to hedge against inflation. Most assets are a poor hedge against inflation, which is a significant issue to investors who want to protect the purchasing power of their wealth. Bonds are by definition meant to compensate investors for the expected inflation through an agreed yield paid regularly. This makes bonds a good hedge against expected inflation. However, bonds' yields do not change in the face of increasing, unexpected inflation. In such scenarios, bond investors face negative real returns.

Equities should be a better hedge against inflation and unexpected inflation in particular. By owning stocks, investors own a part of a company and therefore a part of its assets such as equipment and factories. Through this ownership, investors should get some form of protection against inflation. However, companies also face costs through supply, and labour costs, creating a negative exposure to inflation. Both effects, while not identical, tend to blunt the capacity of stocks to hedge inflation and, in particular, high, surprise inflation.

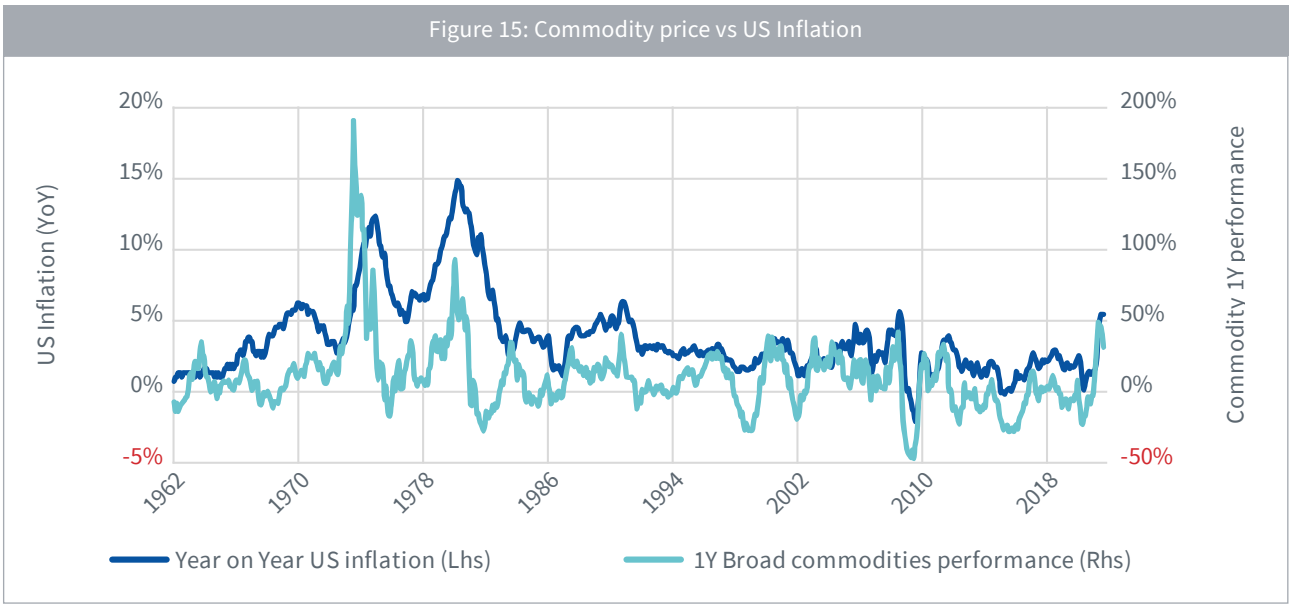
Commodity futures contracts' prices are directly linked to commodity spot prices. Commodity spot prices are themselves directly linked to inflation. Commodities are our food, our energy and the building blocks of our manufactured goods. An increase in commodity prices would generally translate into an increase in the cost of producing goods derived from those commodities, pushing prices up and increasing inflation.

Academics have studied the link between commodities and inflation in detail over the years and have concluded that over the long run and over most historical periods, commodities are positively correlated to inflation, even if this may vary from one commodity sector to the next. This is the case of (Halpern & Warsager, 1998), (Erb & Campbell, 2006), (Kat & Oomen, 2007a), (Bhardwaj, et al., 2005) (Levine, et al., 2018).

1. Commodities are a better hedge against inflation than most assets

As always, to understand the future, we need to understand our past. So Figure 15 shows the year-on-year performance of commodity futures overlapped to the US Consumer Price Index (CPI) year-on-year. It is pretty clear that both series are strongly correlated and that commodities have typically risen in times of higher inflation. In the 1970s, for example, when inflation became particularly elevated, commodities did an exceptional job hedging against increasing price pressure.

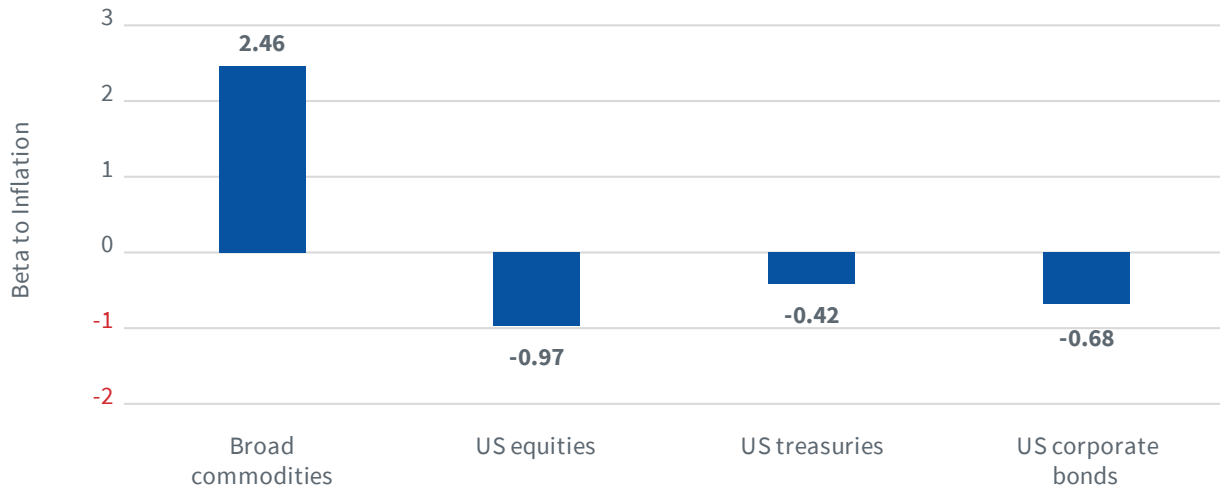
Figure 15: Commodity price vs US Inflation



Source: WisdomTree, Bloomberg. Commodity price is based Bloomberg commodity total return (BCOMTR Index); US CPI inflation. March 1973 to March 2021. Using Quartey frequency of data. **Historical performance is not an indication of future performance, and any investments may go down in value.**

Digging further into this comovement, Figure 16 exhibits the Beta between US headline Inflation CPI and the main asset classes. All asset classes but commodities show a negative beta to inflation, i.e. performance tended to be negatively correlated to inflation. While expected for equities, it is more surprising for bonds and indicates that, historically, unexpected inflation has had a big influence on overall inflation numbers. In any case, this makes commodities the only realistic inflation hedge from a numerical point of view.

Figure 16: Beta to US headline inflation (CPI) of different assets



Source: WisdomTree, Bloomberg, S&P. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US equities (S&P 500 gross total return index) data started in Jan 1960. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #8: Commodities are the only main asset class with positive beta and positive correlation to inflation over the long term.

2. A great hedge against unexpected inflation

The next step in this analysis is to look at the potential impact of expected and unexpected inflation on the different asset classes. Several asset classes should respond well to 'expected inflation', where expectations are often formed by monetary conditions and judgements over the strength of demand in the economy. These expectations are often demand-focused. However, inflation can also be generated by supply-side shocks. For example, the cyber-attack on the Colonial Pipeline in May 2021 increased the price of gasoline fuel for consumers. Or, the multiple droughts in Brazil in 2021 have pushed up the cost of many food items, including coffee, sugar, corn and soy. Most asset classes tend to react a lot less well to this type of inflation, but commodity prices are directly linked to many supply-side shocks, making it an excellent hedge for those situations. Those examples of supply-side shocks often tend to squeeze companies' margins and are not positive for equities or corporate bonds.

In Figure 17, inflation movements are split into their expected and unexpected parts. To do so, we follow a straightforward method proposed by (Fama & Schwert, 1977) and (Schwert, 1977). The idea is to use the short-term T-bill rate as a proxy for the market's inflation expectations. Therefore, unexpected inflation is measured as the actual Conusmer Price Inflation ("CPI") rate minus the nominal interest rate at the beginning of each period.

Results show that equities exhibit a negative beta to both expected and unexpected inflation making them less suited to be used as a hedge among the asset classes considered. US Treasuries and US corporate bonds exhibit a positive beta to expected inflation but, as discussed above, fail to do so for unexpected inflation.

Commodities stand out as the only assets with a positive beta to both expected and unexpected inflation.

It is noteworthy that their beta to unexpected inflation is higher than with expected inflation when all the other asset classes show a deeper negative beta to such unexpected moves in prices.

Misconception #7

"TIPs and inflation-linked bonds are better inflation-hedge than commodities."

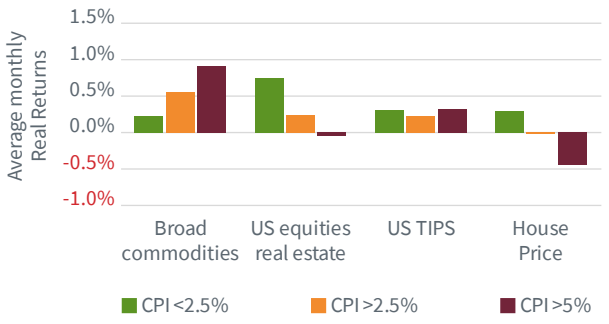
Some assets are often considered good inflation hedges, such as inflation-linked bonds (TIPS) or real estate.

However, their beta to inflation historically is significantly lower than that of commodities (2.46): US TIPS (0.38), US Equity Real Estate Sector (1.66), House Prices (0.24).

Furthermore, while broad commodities' average monthly performance tends to increase when the CPI increases, this is not the case for other assets. The performance of TIPS appears to be relatively unrelated to the level of CPI. The performance of real estate, being equities or real assets, seems to worsen when the CPI increases.

Overall, we observe in this paper that the capacity to hedge unexpected inflation is what separate commodities from the rest.

Asset class performance in varying inflation regimes

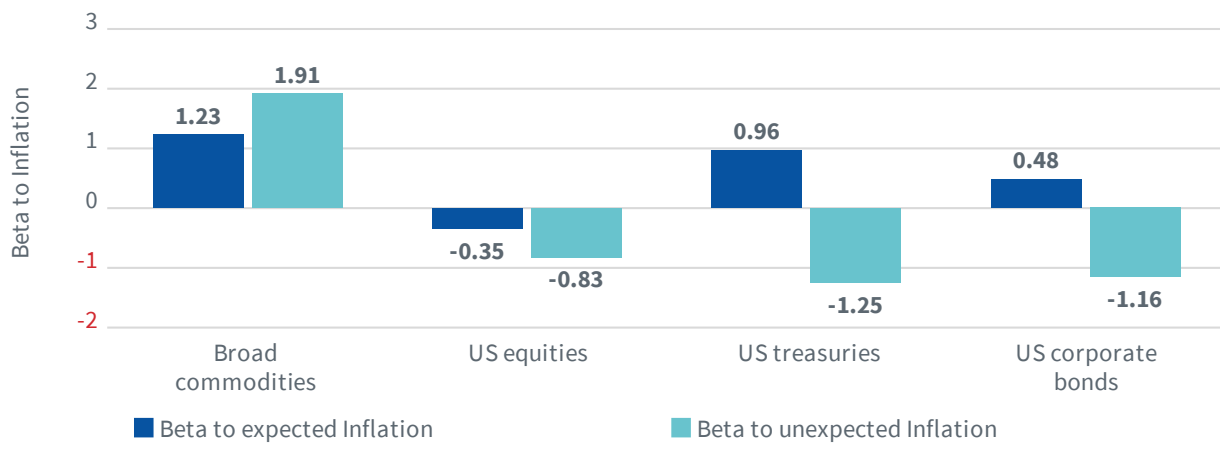


Source: WisdomTree, Bloomberg, S&P. January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad Commodities (Bloomberg Commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. **Historical performance is not an indication of future performance and any investments may go down in value.**

Real estate suffers from the fact that while rental incomes are linked to inflation (rents are part of the CPI basket, for example), the capital values themselves are not, and yet have a larger impact on the asset's price. Similarly, inflation-linked bonds are linked to inflation, but their price is also tied to real yields changes (through a duration multiplier) which tends to dilute the relationship to inflation itself.

Overall, commodities are historically a better hedge to inflation than TIPS or real estate assets.

Figure 17: Beta to expected and unexpected inflation of main asset classes



Source: WisdomTree, Bloomberg, S&P. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US equities (S&P 500 gross total return index) data started in Jan 1960. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #9: Commodities can provide an effective hedge to unexpected inflation as well.

Moving away from traditional asset classes, investors usually try to hedge inflation using more niche assets. One can mention:

- Inflation-linked bonds
- Real assets such as real estate or infrastructure
- Real estate equities
- Oil producers/energy equities
- Mining companies
- Food-related equities

Figure 18 examines the beta to inflation as well as unexpected inflation to all those assets using the same methodology as above. It is clear that selecting a certain type of stock makes it possible to improve the relationship to inflation, unexpected or not. However, none of those sub-sectors gets close to the deep link that can be observed between commodities and inflation.

- Food products equities, precious metals miners and construction materials equities exhibit negative beta to US CPI.
- Food products equities and construction materials equities have a negative beta to unexpected inflation.
- Non-metallic and industrial metal mining, real estate equities, precious metals miners and construction materials equities have a negative beta to expected inflation.

Two interesting hypotheses for why commodity-linked equities do not provide the same kind of inflation hedge that commodity futures contracts do is that those companies:

+ tend to hedge their commodity exposure through futures, making them almost market-neutral versus commodities.
+ are exposed to supply and labour costs (they suffer from inflation through costs) that counteracts their natural long exposure to inflation through commodities.

Direct investment in US real estate exhibits a large positive beta to inflation in general and unexpected inflation in particular. However, its beta to expected inflation is very negative. Overall only the US TIPS shows the relationship with expected and unexpected inflation that one would expect from an inflation hedge. However, the betas are lower in magnitude than those of commodities.

Figure 18: A closer look at the hedging properties of commodity-related equities

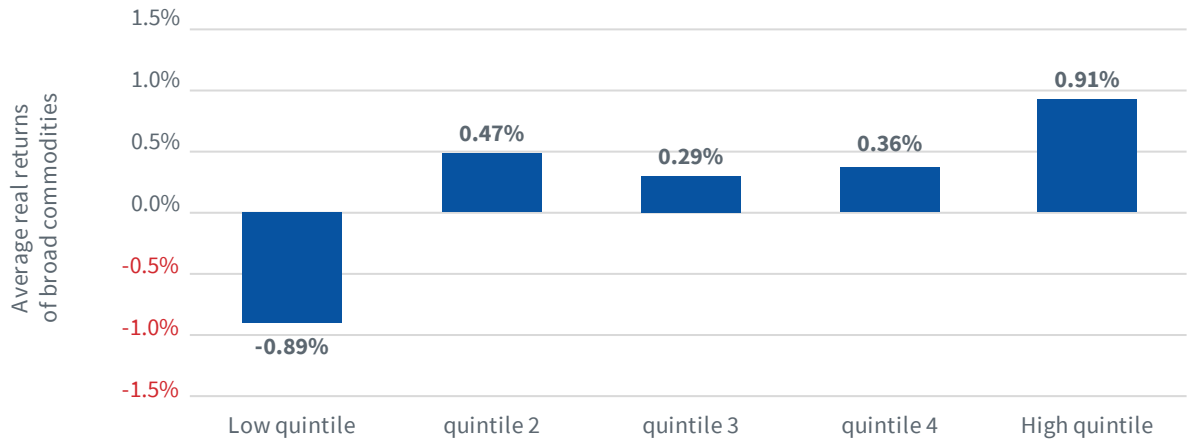
	Beta to US CPI	Beta to expected Inflation	Beta to unexpected Inflation
Broad commodity	2.5	1.2	1.9
US TIPS	0.4	0.4	0.2
US equities - real estate	1.7	-1.8	2.0
US equities - energy sector	0.6	0.0	0.7
US equities - food products	-0.6	0.8	-1.3
US equities - construction materials	-1.3	-1.0	-1.1
US equities - precious metals	-0.8	-1.2	0.1
US equities - non-metallic and industrial metal mining	0.0	-1.5	1.1
US equities - petroleum and natural gas	0.5	0.0	0.7
US real estate (House price)	0.2	-0.1	0.3

Source: WisdomTree, Bloomberg, S&P, Kenneth French Data Library. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) data started in Jan 1960. US TIPS (Bloomberg US Treasury Inflation-linked total return bond index – Series L index) data started in March 1997. US Equity Real Estate (S&P 500 Real Estate sector total return index) data started in October 2001. US House Price (S&P Corelogic Case-Schiller US National Home Price seasonally adjusted index) data started in January 1987. Food products, Construction Materials, Non-metallic and industrial metal mining and Petroleum and Natural gas are US equities sub-industries where monthly returns are sourced from the Kenneth French Data Library from June 1926. Precious metals data started in June 1963. **Historical performance is not an indication of future performance and any investments may go down in value.**

3. Reliable positive performance in high or increasing inflation markets

On top of being positively correlated to inflation, it is also very interesting to look at the behaviour of commodities in different inflation regimes. In Figure 19, we split every month since January 1960 into five quintiles by the level of realised inflation (i.e. US CPI) during those months. The low quintile, i.e. months when inflation is low, is the only type of period where the average broad commodities futures contract has performed negatively. Then as inflation increased, the performance of commodities has also increased. Broad commodities have historically performed the best, by a margin, in months where the inflation is the highest. This is again quite a powerful testament to commodities as an inflation hedge.

Figure 19: Commodity performance depending on the level of realised inflation

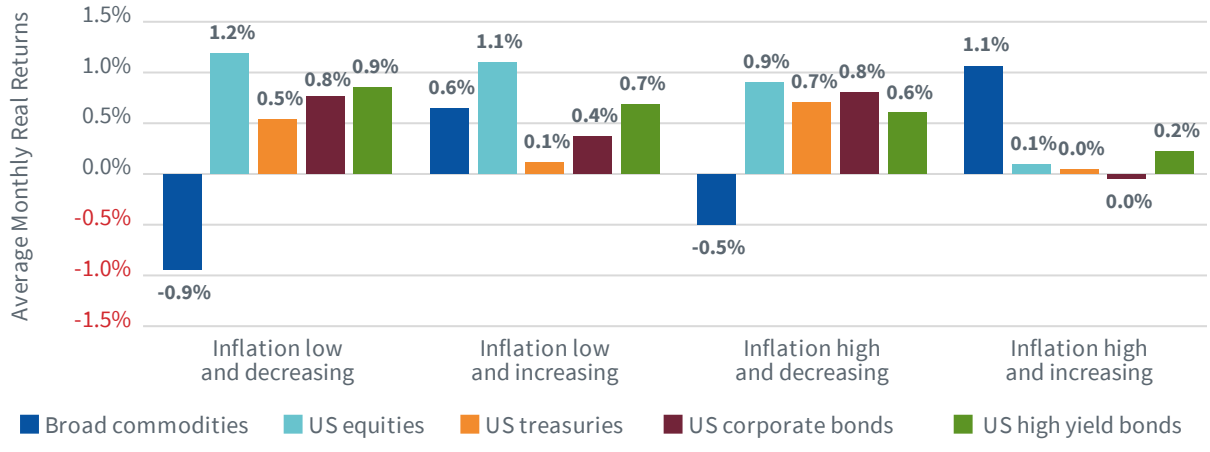


Source: WisdomTree, Bloomberg. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) data started in Jan 1960. **Historical performance is not an indication of future performance and any investments may go down in value.**

While analysing regimes based on inflation levels is instructive, it is even more important to look at inflation regimes dynamically. It is clear from Figure 20 that commodities perform the strongest in an environment where inflation is both high and increasing. While not the best, commodities also do well in periods where inflation is still low but rising. Commodities, overall, tend to benefit from rising inflation. When inflation has passed its peak, it tends not to be as supportive to commodity prices.

Commodity performance suffers from decreasing inflation. In both scenarios where inflation is declining, with high or low inflation, commodities post the worst average real returns among the traditional asset classes. As indicated by the large beta of commodity returns with inflation, the correlation works both ways. Returns go up with inflation but also go down with it.

Figure 20: Average performance of assets in different inflation regimes



Source: WisdomTree, Bloomberg, S&P. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US Equities (S&P 500 gross total return index) data started in Jan 1960. US treasuries (Bloomberg US treasury total return unhedged USD index) and US corporate bonds (Bloomberg US corporate total return unhedged USD index) data started in Jan 1973. US high yield bonds (Bloomberg US corporate high yield total return unhedged USD index) data started in July 1983. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #10: Commodities benefit the most from high and increasing inflation.

Misconception #8

"Commodity-linked equities (miners, producers) have similar characteristics as commodities."

Commodity-linked stocks are often used as an easy-access alternative to commodity investments. However, academics have shown that they do not provide any direct exposure to commodities.

An investment into commodity-linked stocks provides exposure mainly to the management, the business lines and the practices of those companies. In many cases, those companies hedge part or all of their commodity exposure, i.e. they pay out the commodity risk premium to futures contract holders.

Quantitatively, we observe that, across all indicators, commodity-linked equities behave significantly more like equities than commodities:

1. Similar long-term performance. Two sectors performed worse than broad commodities over the period. Two sectors performed better than commodities but worse than S&P 500.

2. Significantly higher risk across metrics. Commodity-linked equities have exhibited up to twice the volatility of broad commodities. They also suffered from significantly increased drawdowns. Looking at the worst 1% or 5% monthly performances (the Value at Risk), it was up to two or three times higher than the S&P 500, while broad commodities had smaller VaR than equities.

3. Little diversification versus equities. Commodity-linked equities exhibited a very low correlation to commodities themselves, in the 30% range. Most of the sectors considered exhibited correlation in the 50 or 60s with equities when commodities were only correlated at 12% with equities over the period.

4. No business Cycle diversification. While broad commodities have lost on average only 0.6% (real returns) in the months when equities have lost more than 5%, commodity-linked industries performed inline or worse than equities highlighting their similarities to equities more than commodities. Commodity-linked equities also exhibit equity-like behaviour across the business cycle, suffering in early recession and flying in late recession periods. On the contrary, commodities can provide some diversification in early recession periods.

Commodity-linked equities versus commodities

	Broad commodity	US equities	Precious metal miners	Non-metallic and industrial metal mining	Coal producers	Petroleum and gas exploration and production
Annualised performance	8.0%	10.6%	6.2%	10.7%	5.3%	9.8%
Annualized volatility	15.9%	15.4%	36.1%	25.6%	35.9%	20.3%
Skew	0.9	-0.5	0.8	-0.3	0.1	0.1
Kurtosis	7.1	2.0	4.8	1.7	2.2	4.3
1 month VaR 99%	-10.3%	-11.0%	-22.4%	-16.2%	-29.2%	-12.9%
1 month VaR 95%	-6.2%	-6.8%	-15.4%	-10.5%	-14.5%	-8.6%
Correlation with broad commodities	100%	12%	36%	38%	29%	34%
Correlation with US equities	12%	100%	25%	66%	49%	66%
Average real returns in months where US equities <-5%	-0.6%	-8.1%	-2.2%	-8.2%	-9.5%	-7.8%
Average monthly returns in early recession	0.5%	-1.6%	-1.4%	-2.7%	-2.8%	-1.2%
Average monthly returns in late recession	0.2%	2.1%	4.2%	2.1%	3.7%	1.4%
Average monthly returns in early recovery	0.4%	1.2%	0.5%	1.2%	0.7%	1.4%
Average monthly returns in late recovery	1.2%	0.7%	1.1%	1.7%	1.2%	1.0%

Source: WisdomTree, Bloomberg, S&P, Kenneth French Data Library. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg Commodity total return index) and US equities (S&P 500 gross total return index) data started in Jan 1960. Non-metallic and industrial metal mining, Petroleum and Natural gas and Coal are US equities sub-industries where monthly returns are sourced from the Kenneth French Data Library from June 1926. Precious metals data started in June 1963. Annualised performance is calculated on the longest common period, i.e. from June 1963. **Historical performance is not an indication of future performance and any investments may go down in value.**

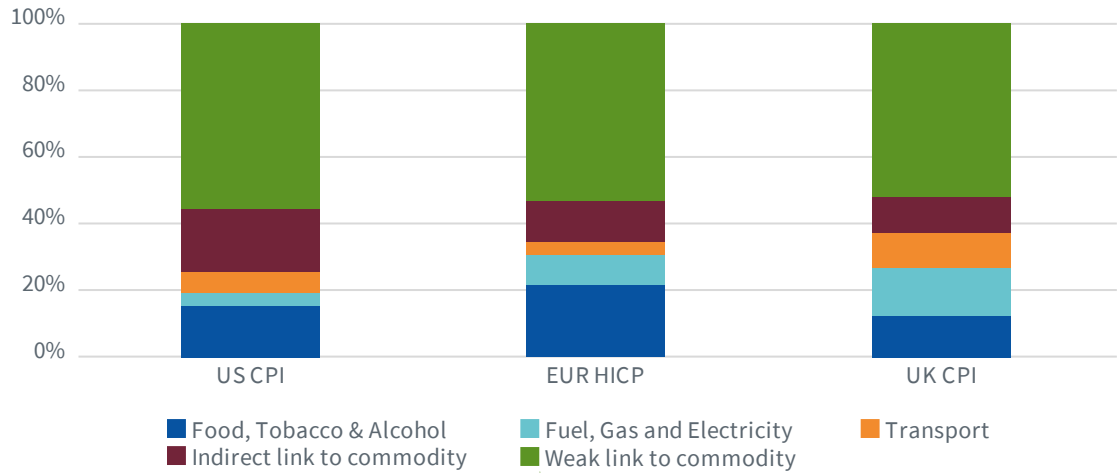
Commodity-linked equities behave a lot more like high beta equities than commodities.

4. Commodity prices are directly linked to the calculation of inflation

Having demonstrated the capacity of commodity futures contracts to hedge investors' portfolios against inflation, it is important to dig into the reasons behind such an effective relationship. Those reasons will help us analyse how long-lasting such a relationship is and if there is any risk of the link breaking down.

Commodities are, in fact, intrinsic components of inflation indices around the world. Figure 21 highlights that up to 50% of inflation baskets are directly or indirectly linked to commodity prices. In the US, 45% of the CPI basket is linked to commodities through food, energy or materials used in cars, buildings and infrastructure. In the Eurozone, this number increases to 47%, reaching 48% in the UK. It is, therefore, no surprise that commodity prices and inflation are positively related. They are linked by construction.

Figure 21: Inflation baskets are intrinsically linked to commodities



Source: WisdomTree, US Bureau of Labor Statistics, European Central Bank, UK Office for National Statistics. As of July 2021.

D. A hedge against US dollar weakness

Commodities have a special relationship with the value of the USD. Most commodities are denominated and traded in US dollars, which means that their behaviour is linked. When the US dollar strengthens, it makes every commodity more expensive for all non-US dollar-based consumers. This, in turn, lowers demand which lowers prices. Also, given that many commodities are produced outside of the US when the US dollar appreciates, producers are willing to sell more (i.e. release more stock) as they get a more attractive price in their home currency. So commodities tend to perform negatively when the USD strengthens against other currencies.

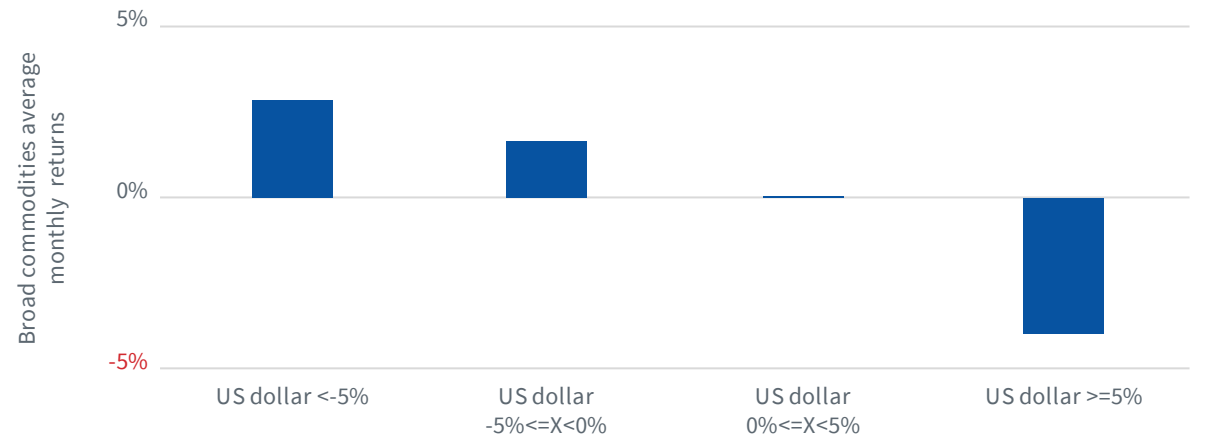
On the contrary, when the US dollar weakens, it drives demand and therefore pushes commodity prices higher. And it drives a negative supply response from non-US producers as they are more willing to build stock than sell at a lower price in home-currency terms. Commodity prices and the US dollar are therefore mechanically negatively correlated. From 1963 to August 2021, the correlation of monthly returns between the USD dollar index and the Bloomberg commodity TR index was -28%. Looking at the correlation on a rolling basis, Figure 22 highlights that the correlation is almost continuously negative with only furtive periods of decorrelation.

Figure 22: 5Y rolling correlation between the Bloomberg commodity Index and the US dollar Index

Source: WisdomTree, Bloomberg. From January 1967 to August 2021. Calculations are based on monthly returns in USD. Broad commodities are proxied by the Bloomberg commodity total return index. US dollar is proxied by the U.S. Dollar Index, which indicates the general international value of the USD by averaging its exchange rate versus major world currencies. **Historical performance is not an indication of future performance and any investments may go down in value.**

As illustrated in Figure 23, a regime-based analysis shows that on average, in months where the US dollar lost more than 5%, commodities futures contracts gained 2.85%. In months where the US dollar gained more than 5%, commodities lost -3.96%.

Figure 23: Average monthly performance of commodities depending on the monthly performance of the US dollar



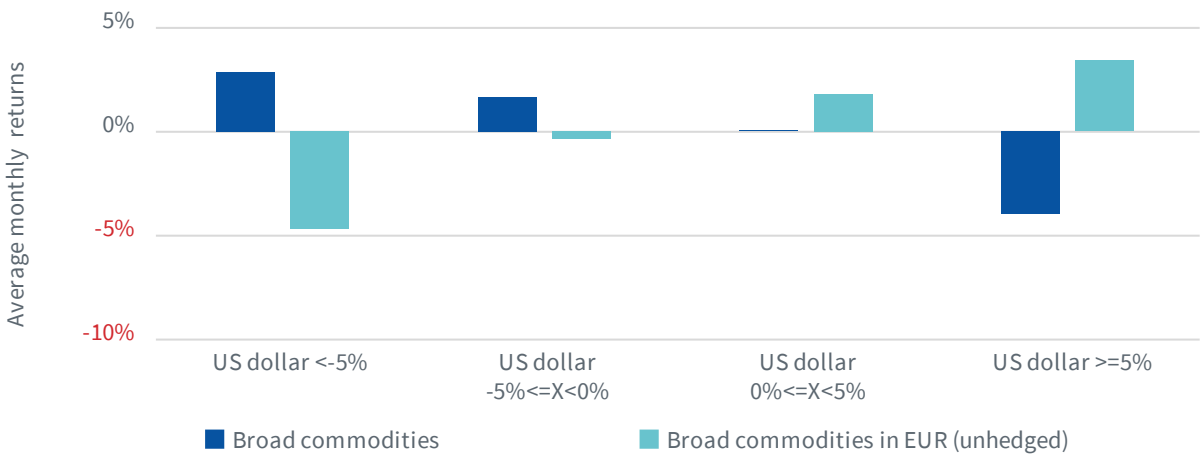
Source: WisdomTree, Bloomberg. From January 1967 to August 2021. Calculations are based on monthly returns in USD. Broad commodities are proxied by the Bloomberg commodity total return index. US dollar is proxied by the U.S. Dollar Index, which indicates the general international value of the USD by averaging its exchange rate versus major world currencies. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #11: In most periods, Commodities are negatively correlated to the US dollar.

This behaviour can be of prime importance for investors depending on the currency their portfolio is denominated in. For non-US based investors, this raises the question of currency hedging. In the case of the US dollar weakening, commodities priced in US dollar would gain, but the investor would also lose out due to the movement of the US dollar once translated into their home currency. In most cases, this would result in a negative performance of the commodity investment, i.e. a positive correlation. In other words, in most cases, an unhedged commodity investment would positively correlate to the US dollar movement when a hedged commodity investment would be negatively correlated.

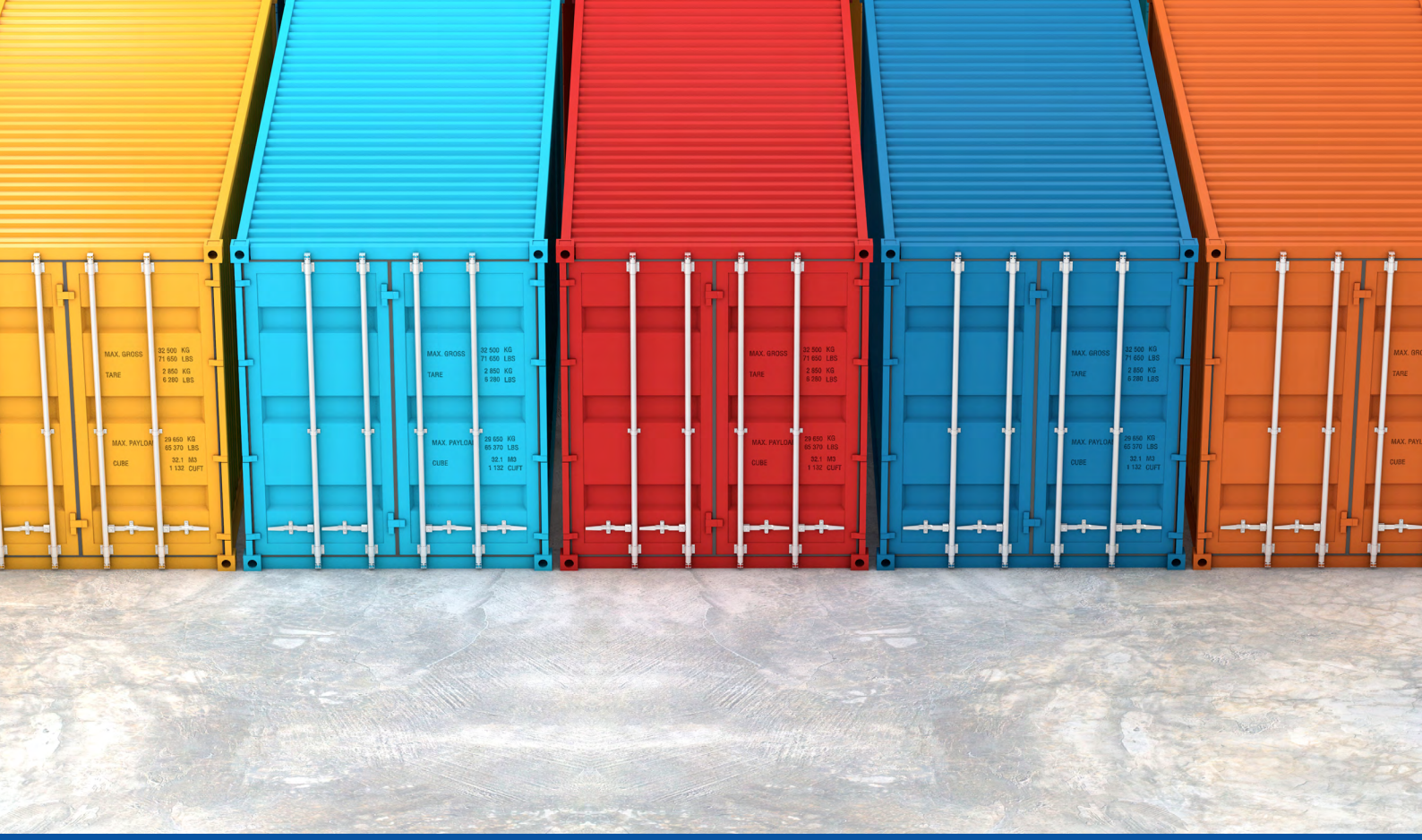
As illustrated in Figure 24, a regime-based analysis shows that on average, in months where the US dollar lost more than 5%, commodities futures contracts gained 2.85% in US dollars but would have lost -4.67% in euro terms. Similarly, in months where the US dollar gained more than 5%, commodities lost -3.96% when denominated in US dollars but would have gained 3.41% unhedged for a euro investor.

Figure 24: Average monthly performance of commodities depending on the monthly performance of the US dollar



Source: WisdomTree, Bloomberg. From January 1967 to August 2021. Calculations are based on monthly returns in USD. Broad commodities are proxied by the Bloomberg commodity total return index. US dollar is proxied by the U.S. Dollar Index, which indicates the general international value of the USD by averaging its exchange rate versus major world currencies. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #12: Unhedged commodities can positively correlate to US dollars for EUR or GBP-based investors. Currency hedging can restore the negative correlation.



The Case for Investing in Broad Commodities

III. Implementation considerations

Having looked in detail at the investment case for broad commodity investments, this third chapter focuses on implementation considerations, i.e. how investors can gain exposure to commodities in the most efficient way.

A. How to gain exposure to broad commodities?

Contrary to most other asset classes, where gaining exposure is usually pretty straightforward, commodities are more difficult. Investors tend to use three main methods to invest in commodities:

- Direct physical investments.
- Commodity futures contracts or broad commodity indices.
- Commodity-linked equities.

However, those three methods are far from equivalent. They can give widely different results performance-wise and risk-wise over the short and long term.

1. Direct physical investments

While the most intuitive way to gain exposure to commodities is to buy them directly, it is in most cases not feasible. The operational complexity of storing physical commodities is very high. Many commodities, like agriculture products, are perishable, and therefore stocks need to be rotated. Places of storage and production may be widely different, leading to potentially high transportation and insurance costs. Furthermore, broad commodity indices can group north of 20 different commodities. Each commodity needs its specialised facility for good quality storage. All of these constraints make the cost of investing physically untenable for investments.

Furthermore, in most cases, the liquidity of the futures contracts is a lot larger than the one of the physical commodities, and many investors face regulatory hurdles to hold physical commodities. Futures contracts are an easily used financial instrument. In any case, as discussed in Chapter I, commodity futures contracts carry a long-term risk premium that direct investments do not. So the logical choice for strategic investors would anyway be to invest through futures contracts independently from the operational issues.The only exceptions are precious metals; thanks to their high price per pound and durability, they can be stored at acceptable prices in bank vaults and are, therefore, viable physical investments. They are so expensive that small amounts can represent large sums of money.

As discussed earlier, while part of broad commodity indices, gold is quite a different animal. (Xu, et al., 2013) tested Keynes' normal backwardation hypothesis on gold futures alone and did not find any evidence of a risk premium over 1980-2005 above the spot price performance. Investigating the behaviour of gold miners, their hypothesis for this lack of premium is the lack of hedging activity by those miners. In other words, gold futures are not that useful to gold producers, and therefore they are unwilling to pay a premium to futures buyers. So, could a direct investment in gold be a better investment than using futures contracts?

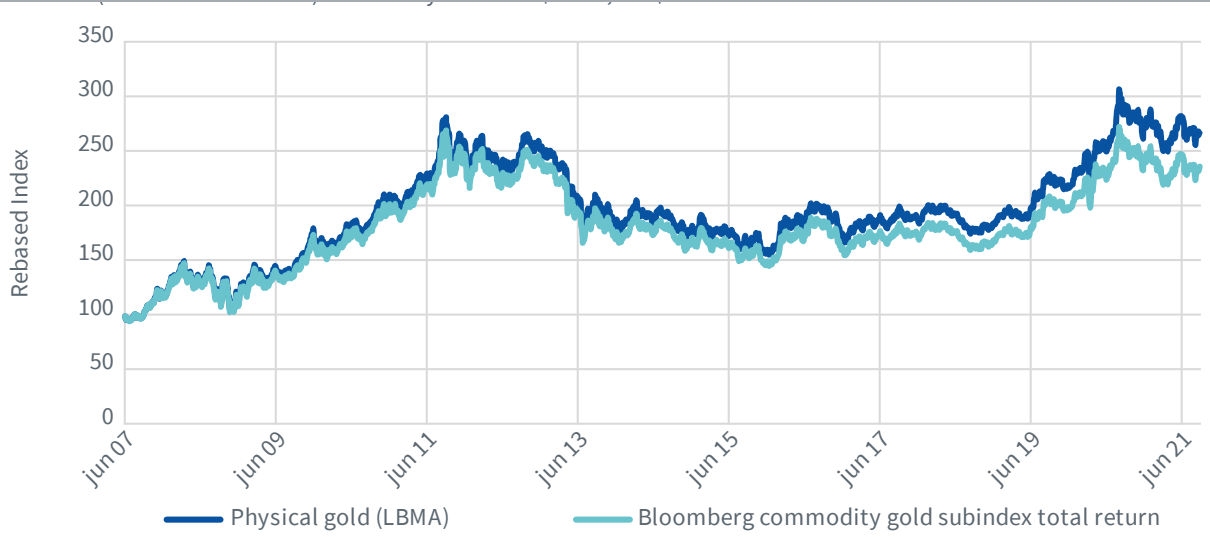
Looking at this quantitatively, Figure 25 shows the performance of:

- A direct investment in physical gold using LBMA[9] PM gold price snapshots as a proxy.
- A futures contract based investment in gold, proxied by the BCOM gold Subindex total return index.

Unfortunately, both times series are not observed at the same time every day. LBMA snaps the gold price at 3 PM London time while the BCOM is calculated at 1.30 PM New York time. To make a like-for-like comparison, we adjusted the BCOM index level using the performance of gold futures contracts between 3 PM London and 1.30 PM New York. The results are compelling. On average, an investment in physical gold has outperformed by 91 bps per year. It means that an investment of $100 in June 2007

[9] The Independent Precious Metals Authority.

Figure 25: Performance comparison between a direct physical investment and a futures contract based investment in gold



	Physical gold (LBMA)	Bloomberg commodity gold subindex total return
Annualised Returns	7.16%	6.25%
Annualised Volatility	18.0%	17.7%
Kurtosis	7.10	1.87

Source: WisdomTree, Bloomberg. From 31st May 2011 to 31st August 2021. Physical gold is proxied by the performance of the LBMA Gold PM Index. The Performance of the Bloomberg commodity gold Subindex is adjusted to consider the fact that those indices are calculated at 1.30 PM Eastern Time while the LBMA Gold PM index is estimated at 3 PM London Time. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

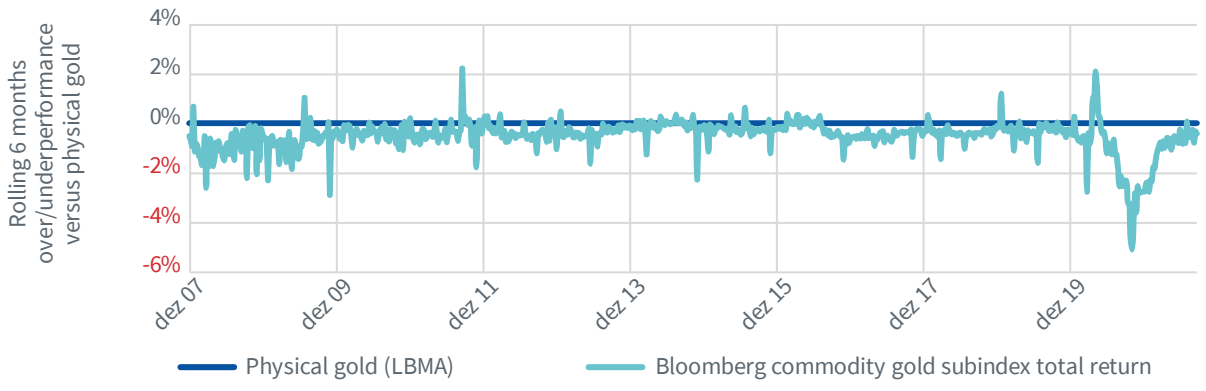
Looking at different periods, we observe that:

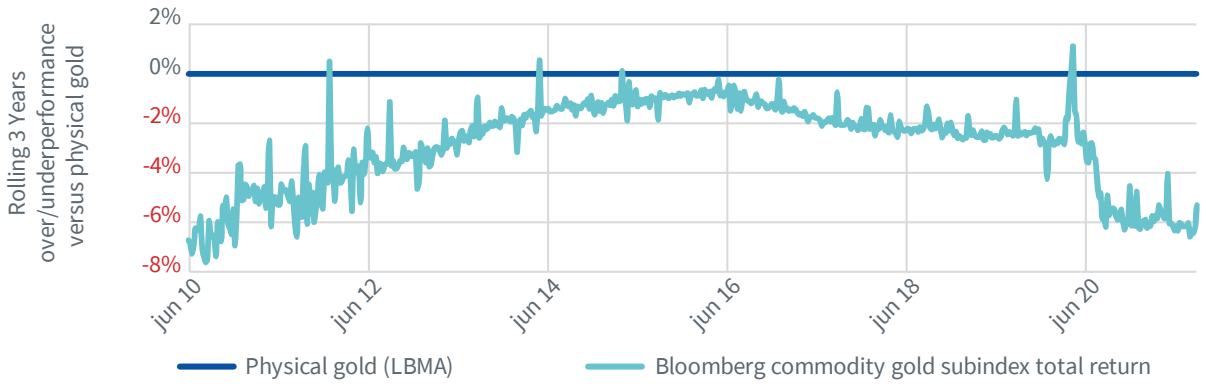
- Physical gold would have outperformed in 82% of the three month periods since 2007. The average outperformance is 24bps over a given three month period.
- Physical gold would have outperformed in 90.9% of the six month periods since 2007. The average outperformance is 50bps over a given six month period.
- Physical gold would have outperformed in 97.2% of the 12 month periods since 2007. The average outperformance is 100bps over a given 12 month period.
- Physical gold would have outperformed in 99.8% of the three year periods since 2007. The average outperformance is 2.9% over a given three year period.

Figure 26 also illustrates that the outperformance or underperformance of the BCOM gold subindex can be pretty erratic and hard to predict when compared to physical gold. The significant widening of the underperformance in March 2020, for example, was both incredibly damaging to future investors and completely unpredictable. The underlying reasons lie in the operational nitty-gritty of gold futures markets and have nothing to do with gold performance itself. Comex gold futures that settle in New York rely on the functioning of an 'Exchange for Physical' mechanism, which is a private agreement between two parties to trade a futures position for the underlying physical gold. But when planes were grounded and refiners had shut or reduced their operations, it was difficult to move the metal from the over-the-counter liquidity centres in London and Zurich and the refiners in Europe, generally, to the US. That widened the price differential between the physical market and futures to levels we had

never seen before. Front-month Comex futures traded at a significant premium to the spot market, and the contango in the front end of the curve, created by operational issues, rose significantly. That presented an enlarged roll drag in a rolling futures strategy. So operational issues created a significant negative performance impact on futures investors when physically-backed investors were completely unaffected.

Figure 26: Rolling performance of the BCOM commodity gold subindex TR vs physical gold





	Bloomberg commodity gold subindex total return
% of 3M periods where performance is higher than physical gold	17.92%
Average 3M over/underperformance vs physical gold	-0.2%
% of 6M periods where performance is higher than physical gold	9.14%
Average 6M over/underperformance vs physical gold	-0.50%
% of 1Y periods where performance is higher than physical gold	2.82%
Average 1Y over/underperformance vs physical gold	-1.00%
% of 3Y periods where performance is higher than physical gold	0.21%
Average 3Y over/underperformance vs physical gold	-2.90%

Source: WisdomTree, Bloomberg. From 31st May 2011 to 31st August 2021. Physical gold is proxied by the performance of the LBMA Gold PM Index. The Performance of the Bloomberg commodity gold Subindex is adjusted to consider the fact that those indices are calculated at 1.30 PM Eastern Time while the LBMA Gold PM index is estimated at 3 PM London Time. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

In conclusion, in most cases, physical gold has exhibited better performance than futures contracts-based investments. However, the above analysis only takes into account market impacts and not other costs. Going a step further, we will try to add those costs in:

- For physical investment in gold, investors could store gold in a vault which is impacted by insurance and storage costs or invest in a physically-backed gold exchange-traded product ("ETP"). The all-in total expense ratio of such ETPs is around 12-15bps. In the following analysis, we will use the cost of 15bps for a physically-backed gold investment. On average, the most liquid European gold ETPs suffer from a bid-offer cost of around 3 or 4 bps on entry and exit, which means that an investor would pay 3 or 4 bps when buying the ETP and 3 or 4 bps when selling the ETP. This would sum up to around seven bps trading costs on average for any investment period, be it one day or ten years. ETPs can indeed be kept from any amount of time with no operational actions, no rolling, and no trading.

- For futures-based investments, the cost of rolling the futures every two months (like in the BCOM index) needs to be considered. Gold futures contracts suffer from bid-ask on entry and exit and from bid-ask on each regular roll necessary to maintain the position. Futures contracts are very liquid, so the average bid-ask to buy or sell a futures contract is pretty tight, around 0.5bps, and the cost of rolling is around 0.25bps.

Figure 27 summarises the estimated total cost of ownership in the two investments over different investment periods. We observe that for medium to long investment holding periods (i.e. longer than a month), the physically-backed ETP has historically delivered better performance because it does not suffer from the same performance drag as futures contracts do. However, for short, tactical investment periods, their lower transaction costs help the futures contracts-based investments.

Figure 27: Gold's total cost of ownership over different investment periods

	Holding Periods	Bloomberg commodity gold subindex total return	Physically-backed gold ETP
3 Year (annualised)	TER (bps)		15
	Average historical drag (bps)	97	
	Transaction costs (bps)	0.5+18*0.25+0.5=5.5	3.5+3.5=7
	Total cost (bps)	102	17
1 Year	TER (bps)		15
	Average historical drag (bps)	100	
	Transaction costs (bps)	0.5+6*0.25+0.5=2.5	3.5+3.5=7
	Total cost (bps)	102	22
3 Months	TER (bps)		4
	Average historical drag (bps)	24	
	Transaction costs (bps)	0.5+3*0.25+0.5=1.75	3.5+3.5=7
	Total cost (bps)	26	11
1 Month	TER (bps)		1
	Average historical drag (bps)	6.5	
	Transaction costs (bps)	0.5+1*0.25+0.5=1.25	3.5+3.5=7
	Total cost (bps)	7.8	8

Source: WisdomTree, Bloomberg. From 31st May 2011 to 31st August 2021. Physical gold is proxied by the performance of the LBMA Gold PM Index The Performance of the Bloomberg commodity gold subindex is adjusted to consider the fact that those indices are calculated at 1.30 PM Eastern Time while the LBMA Gold PM index is estimated at 3 PM London Time. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

[9] It is worth noting here that these trading costs could be lowered further by an over the counter (OTC) net asset value (NAV) convention. In an OTC NAV trade, the client enters into an agreement with a market maker to trade a specified size for end of day NAV of an ETP. This means that the market maker is obligated to deliver the ETP shares to the client at a value reflective of that ETPs fair value NAV, plus trading costs. In this case, the bid ask can be lowered to around 1 bps on entry and exit.

Physical investments also have the net advantage that the total cost of ownership is almost fully known in advance. On the contrary, the performance of a futures contract based investment can vary unexpectedly over time depending on events in the futures markets. Even for short holding periods, market disruptions like we have observed in the first half of 2020 would favour the ETP to the detriment of the futures contracts-based investments. Looking at the Bloomberg gold Subindex only, the underperformance over a month in 2020 was on average of 30bps which would mean an estimated total cost of ownership of almost 31bps just for one month when the total cost of ownership of the physically backed ETP would not change (around 8bps). This is due exclusively to the operational dysfunctions in the Comex exchange that we discussed previously. It is worth pointing out that the bid-ask of both futures contracts and ETPs will widen in disrupted markets but at a different pace.

Instead of futures, investors could also be using swaps to get gold exposure. Swaps deliver identical performance to rolling gold futures but have an operational advantage versus futures because the counterparty takes care of all of the margining and rolling. So from the investor point of view, it is relatively simple, and the cost is relatively transparent through the swap fees. Having said that, gold investors using swaps end up having some counterparty risk as the swap needs to be managed using collateral which can also be cumbersome operationally. The legal setup behind a swap is also not entirely straightforward and may not be available for all types of investors. Getting an ISDA signed with a counterparty is a lengthy process that can take multiple months.

Looking at performance only, it is relatively straightforward to run a comparison. You can find both physically-backed and swap-based gold exchange-traded products in the market. It is then possible to run a simple performance comparison between those two products, correcting for the total expense ratio ("TER"). Figure 28 shows that $100 invested in a physically-backed gold ETP in June 2007 would be worth $279 in August 2021, assuming a zero TER. The same amount invested in a swap based gold ETP would be worth $226, i.e. $53 less. So whether we consider a future based or a swap based gold investment, historically, a physically-backed investment would have done markedly better. At the end of the day, unless the swap fee is significantly below 0.15% a year (the typical TER for a physically-backed ETP), the appeal of a swap based investment is not obvious.

Misconception #9

"Futures contracts are the most efficient way to invest in gold for large institutional investors."

Futures markets tend to be extremely liquid and offer very low transaction costs. Therefore, investors assume that, if they can, it is always the most efficient way to implement a trade.

However, futures markets respond to their own constraints where banks tend to provide most of the hedging. Over the last few years, banks have suffered from ever-increasing regulations and operating costs that they have translated in their pricing of futures contracts, leading to significant tracking differences with the physical asset (being commodities or equities). Sometimes futures contracts are the only way to access a commodity but for precious metals this is not the case.

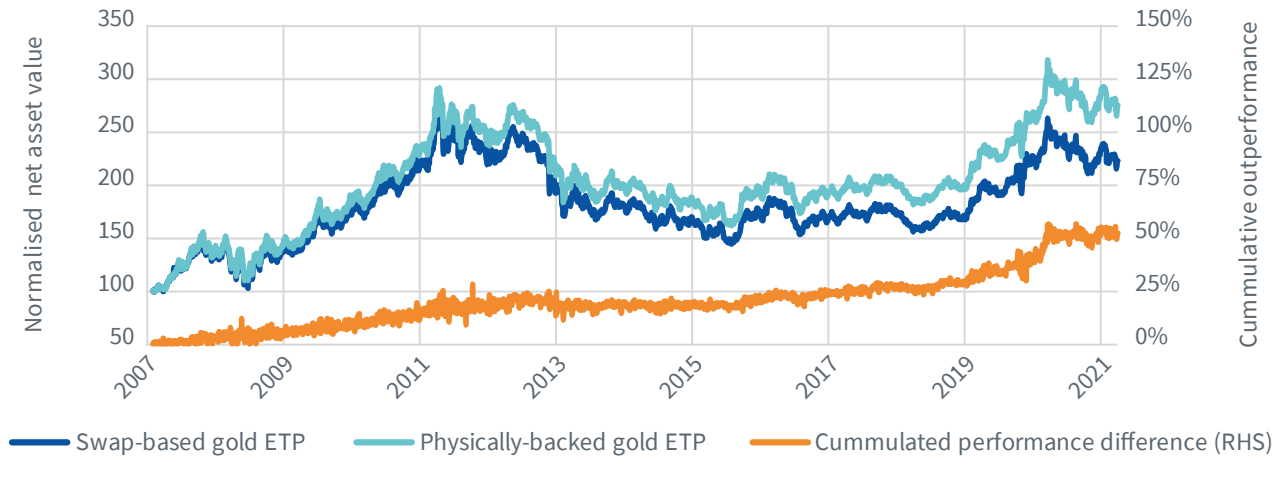
For gold specifically, this cost has historically represented 1% per year on average compared to owning gold bullion. Physically backed ETPs have many advantages: limited operational burden, reduced tracking difference, cheap and liquid.

Gold ETP and futures contracts Comparison		
	Physically-backed ETP	Futures contracts
Legal structure	Listed debt instrument	Listed derivative contract
Funding requirement	100%	Margin of 5 to 10%
Tracking error	Effectively zero	Depends on market condition and supply and demand dynamics in the future markets
Trading	On-exchange or Over the Counter (OTC)	On-exchange or Over the Counter (OTC)
Transaction costs	Commission and bid-offer spread on entry and exit	Commission and bid-offer spread on entry and exit as well as on roll every two months
Holding costs	Known in advance Total Expense Ratio (TER)	Unkown in advance Depends on market condition and supply and demand dynamics in the futures markets
Operational constraints	Similar to equity shares	Margin monitoring and rolling of contracts six times a year

Source: WisdomTree. September 2021.

With low fees and very liquid trading, physically-backed precious metals ETPs very often outperform investments in futures.

Figure 28: A physically-backed gold ETP has outperformed a swap based gold ETP consistently



Source: WisdomTree, Bloomberg. 20th June 2007 to 31st August 2021. Daily in USD. WisdomTree Physical gold is used for the physically backed-gold ETP, and the performance is corrected of 39bps TER per annum. WisdomTree Gold is used for the swap-based gold ETP, and the performance is corrected of 49bps TER per annum. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #13: For the vast majority of investors futures contracts are the better choice to gain exposure to commodities except for precious metals, where direct investments appear better.

Implementation

When it comes to the implementation of an investment in physical commodities and physical precious metals, in particular, investors have two main choices:

1. **Own a vault or rent space in a vault to store gold or silver bars:** This solution is only available to extremely large investors with substantial, strategic investments. Even then, the cost of storage and the cost of insurance can be high. Furthermore, organising safe movement and delivery of large chunks of gold or silver is extremely difficult.

2. **Invest in a physically-backed exchange-traded product (ETP):** Securities are backed by physical bars of the relevant metal and usually held by the custodian within a secure vault and regularly inspected by an independent entity. Exchange-traded commodities ("ETCs") are operationally very easy to use. They are listed on exchange and trade like shares during market hours. So, from an operational point of view, they behave like stocks. Overall it is a simple structure with a transparent fee. In Europe, single commodities can not be wrapped in the UCITS structure, so there aren't any physically-backed gold or silver UCITS exhcnaged traded funds ("ETF") due to the current regulatory framework.

2. Commodity futures contracts and indices

The easiest way to gain access to commodities is through futures markets. Commodity futures contracts are traded on exchange and use the same infrastructure as equity and bond futures that many investors can already access. Furthermore, by rolling their exposure regularly, investors can avoid physical delivery of the commodity forever.

Investors usually invest in a fully collateralised basket of futures contracts like the Bloomberg commodity Index (BCOM) or the S&P GSCI Index when investing in broad commodities. Fully collateralised means that an amount equivalent to the notional investment in the different futures is invested in short-term bonds and is paying out cash like returns (usually 1 or 3 months T-bills returns). Those indices tend to invest as close as possible to the front part of the curve to maximise liquidity, leaving some space for more sophisticated commodity investment strategies that would invest in futures contracts further along the curve.

Implementation

When it comes to the implementation of an investment in future based commodities indices, investors have a large panel of choices:

+ **Direct future investment:** This seems like the most logical approach. However, it can become operationally cumbersome when it comes to broad commodity exposure. The BCOM, for example, invests in 23 commodities across multiple exchanges, across numerous timezones (LME, COMEX, ICE, NYME...). Replicating this index means trading 23 different futures contracts for subscriptions/redemptions, rolling 23 commodity futures contracts every two months, and managing daily margin across multiple exchanges and multiple timezones. While entirely doable for commodity-focused managers, it usually represents a high operational burden for a multi-asset manager. Also, this is an unfunded approach, and investors will have to find ways to invest their cash while matching the implied funding rate they pay through their future investment, which can be difficult to do.

+ **Direct swap investment:** This approach has the advantage of gaining an unfunded exposure to broad commodities in one line. Financially, the performance is identical to investing in futures contracts as the counterpart manages all of the operational burdens of broad commodity futures contracts investment. It is, however, only available for large investors with an advanced operational setup. It requires, for example:

  » to be able to trade derivatives,

  » having an ISDA setup with a commodity house,

  » having a system to manage collateral movements daily to minimise counterparty risk.

  Also, it ties the investor to one bank and its offering. While not an issue for benchmark exposures like BCOM or S&P GSCI, it can prove disadvantageous for enhanced commodities. The bank the investor has an ISDA with may not offer the most suited enhanced strategy for the investors' needs.

+ **Exchange-traded funds and notes:** This approach also has the advantage of gaining funded exposure to broad commodities in one line. ETFs, deliver a performance that is identical to the performance of a portfolio of futures contracts plus a return on cash, usually in line with US short term treasury bills. Most ETFs use one or multiple fully collateralised swaps to get the exposure, and the issuer is responsible for the operations like the daily collateralisation. ETFs are operationally very easy to use. They are listed on exchange and trade like shares during market hours. So, from an operational point of view, they behave like stocks. Overall it is a simple structure with a transparent fee. Broad commodities can be wrapped as a UCITS ETFs in Europe, and both benchmark approaches and enhanced approaches can be found in the market under that format. It is also possible to find sector variations such as ex-Agriculture indices or low tracking error products that, for example, would invest precious metal physically.

+ **Mutual funds**: Another investment vehicle delivering a funded exposure to broad commodities. Strategies vary widely from index funds that track benchmark indices to long-short strategies like Commodity Trading Advisors (“CTA”).

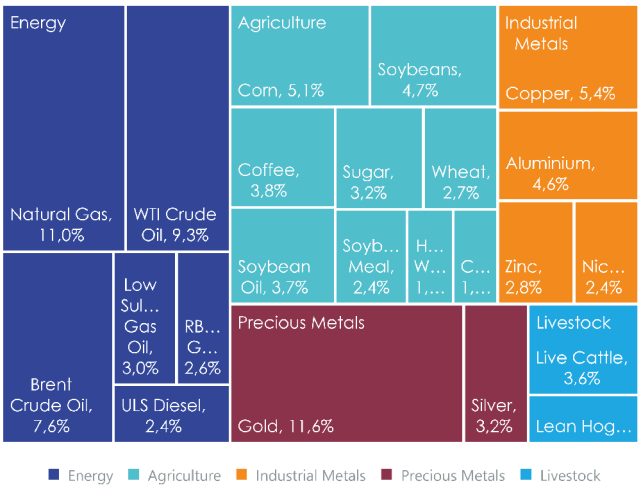
Finding #14: ETFs can provide cost-efficient, transparent and operationally easy access to broad commodities.

Bloomberg commodity index (BCOM)

Widely seen as the industry benchmark, the Bloomberg commodity (BCOM) total return index offers investors access to 23 commodities spread across energy, industrial metals, precious metals and agriculture. Commodities and weights within this index were chosen by the Bloomberg Committee on the basis of liquidity and economic significance . The weight between the different commodities are rebalanced once a year in January, after that the weight will change depending on relative performance. Even though futures are rolled every two months, the weights of each commodities are rebalanced only annually even if caps are breached. This wide variety of commodities offers strong diversification benefits. Various caps make the index structurally compatible with European Union's UCITS 35/20 requirements.

Commodity selection	Based on liquidity measure
Weighting	2/3 Liquidity and 1/3 production measures.
# commodities	23
Launch date	01/07/98
Roll period	5th to 10th business day of the month
Roll frequency	Every 2 months
Rebalancing	Annually
Average futures maturity	Less than 2 months

Bloomberg commodity Index target weights



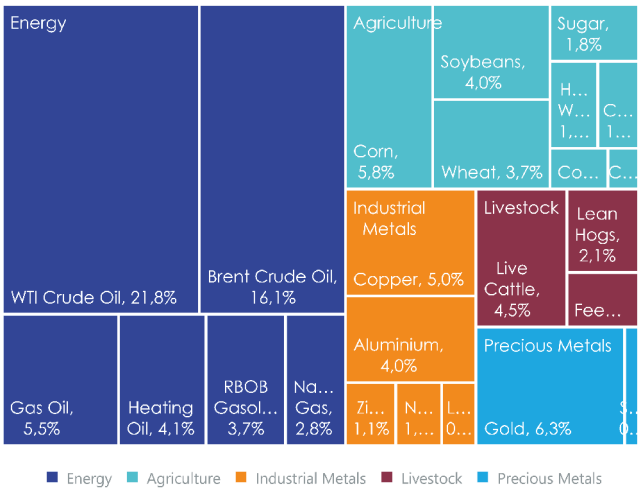
Source: WisdomTree, Bloomberg. As of 31st August 2021.

S&P GSCI index (GSCI)

The S&P GSCI was the first major investable commodity index. Today, it has become one of the most widely recognized benchmarks that is broad-based and production weighted to represent the global commodity market beta. It offers investors access to 24 commodities spread across energy, industrial metals, precious metals and agriculture. The weight between the different commodities are rebalanced once a year in January, after that the weight will change depending on relative performance. Even though futures are rolled every two months, the weights of each commodities are rebalanced only annually even if caps are breached. Overall, the S&P GSCI tends to be more energy heavy than the BCOM. This wide variety of commodities offers strong diversification benefits. The S&P GSCI light energy index is compatible with European Union's UCITS 35/20 requirements. The S&P GSCI is not.

Commodity selection	Based on liquidity measures
Weighting	World production weighted over previous five years.
# commodities	24
Launch date	01/11/91
Roll period	5th to 9th business day of the month
Roll frequency	Every month
Rebalancing	Annually
Average futures maturity	Less than 2 months

S&P GSCI Index target weights



Source: WisdomTree, S&P. As of 8th January 2021.

3. Commodity-linked equities

Commodity-linked stocks are often used as an easy-access alternative to commodity investments. However, academics have shown that they do not provide any direct exposure to commodities. (Bhardwaj, et al., 2005) used the Standard Industrial Classification (SIC) codes to identify US-listed, commodity-linked stocks over 41 years. They found that those stocks correlated more to the S&P 500 (57%) than to commodities indices (40%). An investment into commodity-linked stocks provides exposure mainly to the management, the business lines and the practices of those companies. In many cases, those companies hedge part of their commodity exposure, i.e. they pay out the commodity risk premium to futures contract holders.

Looking at gold miners over the last 18 years or so, it is quite clear that their performance has not matched the performance of gold itself. Figure 29 uses the MSCI ACWI select gold miners IMI net TR index as a proxy for gold miners, and the index has returned only 3.3% on average per year versus 9% for gold as priced by the LBMA. This is despite the fact that MSCI goes through a pretty heavy screening process to select only companies "engaged in gold mining or that derive a majority of their revenues from gold mining and that do not hedge their exposure to underlying gold prices". The volatility and max drawdown are also almost twice higher than those of gold. While gold exhibits equity-like volatility of 17.5%, Gold miners exhibit a whopping volatility of 37.7%.

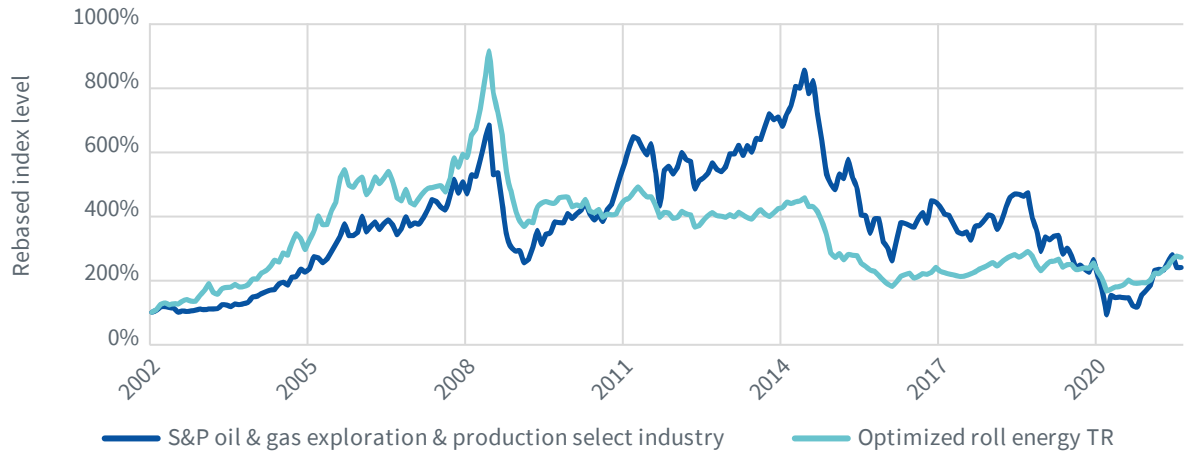
Figure 29: Comparing gold miners to a direct investment in gold

	MSCI ACWI select gold miners IMI	Gold spot
Annualised returns	2.9%	8.9%
Annualised volatility	37.7%	17.5%
Max drawdown	-80.3%	-41.5%

Source: WisdomTree, Bloomberg, MSCI. From 28th November 2003 to 31st August 2021. Gold Spot is proxied by the performance of the LBMA Gold PM. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Similarly, we observe in Figure 30 that the companies in the oil & gas exploration & production industry, as defined by GICS, have historically exhibited very high volatility and drawdown. Investors in those companies would have suffered 36% volatility and a 90% max drawdown over the last 20 years. In comparison, an investment into a basket of commodity futures contracts in the energy sectors (crude oil, natural gas, gasoline..) would have exhibited 22% of volatility and 81.8% drawdown instead. The overall performance of both investments over the period is pretty similar, though.

Figure 30: Comparing oil& gas exploration and producers to energy commodity futures



	S&P oil & gas exploration & production select industry	Optimized roll energy TR
Annualised returns	4.6%	5.2%
Annualised volatility	36.1%	21.9%
Max drawdown	-89.2%	-81.8%

Source: WisdomTree, Bloomberg, MSCI. From 30th January 2002 to 31st August 2021. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Looking back further, we use the Kenneth French data library to source long-term data for commodity-linked industries in the US to test the hypothesis that commodity-linked equities can be used as a substitute to commodity futures contracts in a strategic asset allocation. To do so, Figure 31 tests those equities against all of the characteristics that make commodities such an interesting investment proposition. The analysis focuses on precious metals miners, petroleum and gas exploration and production, coal producers and non-metallic and industrial metal mining. Quantitatively, we observe that, across all indicators, commodity-linked equities fail that test. They behave like high beta equities and not like commodities:

a. Similar long-term performance. Two sectors performed worse than broad commodities over the period. Two sectors performed better than commodities but worse than equities.

b. Significantly higher risk across metrics. Commodity-linked equities have exhibited up to twice the volatility of broad commodities. They also suffered from significantly increased drawdown. Looking at the worst 1% or 5% monthly performances (the Value at Risk), it was up to two or three times higher than the S&P 500, while broad commodities had smaller VaR than equities.

c. Little diversification versus equities. Commodity-linked equities exhibited a very low correlation to commodities themselves, in the 30%. Most of the sectors considered exhibited correlation in the 50 or 60s with equities when commodities were only correlated at 12% with equities over the period.

d. No business cycle diversification. While broad commodities have lost on average only 0.6% (real returns) in the months when equities have lost more than 5%, commodity-linked industries performed inline or worse than equities highlighting their similarities to equities more than commodities. Commodity-linked equities also exhibit equity-like behaviour across the business cycle, suffering in early recession and flying in late recession periods. On the contrary, commodities can provide some diversification in early recession periods.

Overall, commodity-linked equities behaved historically like high beta equities. While they could be an interesting way to invest in equities, it is hard to imagine how they can replace an investment in commodities or how they could bring diversification properties anywhere close to what commodities can bring to a portfolio.

Figure 31: the US-listed commodity-linked equities versus commodities over the very long term

	Broad commodity	US equities	Precious metal miners	Non-metallic and industrial metal mining	Coal producers	Petroleum and gas exploration and production
Annualised performance	8.0%	10.6%	6.2%	10.7%	5.3%	9.8%
Annualized volatility	15.9%	15.4%	36.1%	25.6%	35.9%	20.3%
Skew	0.9	-0.5	0.8	-0.3	0.1	0.1
Kurtosis	7.1	2.0	4.8	1.7	2.2	4.3
1 month VaR 99%	-10.3%	-11.0%	-22.4%	-16.2%	-29.2%	-12.9%
1 month VaR 95%	-6.2%	-6.8%	-15.4%	-10.5%	-14.5%	-8.6%
Correlation with broad commodities	100%	12%	36%	38%	29%	34%
Correlation with US equities	12%	100%	25%	66%	49%	66%
Average real returns in months where US equities <-5%	-0.6%	-8.1%	-2.2%	-8.2%	-9.5%	-7.8%
Average monthly returns in early recession	0.5%	-1.6%	-1.4%	-2.7%	-2.8%	-1.2%
Average monthly returns in late recession	0.2%	2.1%	4.2%	2.1%	3.7%	1.4%
Average monthly returns in early recovery	0.4%	1.2%	0.5%	1.2%	0.7%	1.4%
Average monthly returns in late recovery	1.2%	0.7%	1.1%	1.7%	1.2%	1.0%

Source: WisdomTree, Bloomberg, S&P, Kenneth French Data Library. From January 1960 to August 2021. Calculations are based on monthly returns in USD. Broad commodities (Bloomberg commodity total return index) and US equities (S&P 500 gross total return index) data started in Jan 1960. Non-metallic and industrial metal mining, Petroleum and Natural gas and Coal are US equities sub-industries where monthly returns are sourced from the Kenneth French Data Library from June 1926. Precious metals data started in June 1963. Annualised performance is calculated on the longest common period, i.e. from June 1963. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #15: While useful tactically, commodity-linked equities behave more like high beta equities than commodities. They do not act as a replacement for a strategic commodity allocation.

Investing in commodities, a summary		
	Advantages	Disadvantages
Precious metals physical holdings	Physical exposure, Best performance historically for precious metals, Great diversifier and Inflation Hedge	Only for large investors with access to vaults, High cost (storage, insurance), Physical movements of gold bars constrain liquidity
Physically backed precious metal exchange traded products (ETP)	Physical exposure, Best performance historically for precious metals, Great diversifier and Inflation Hedge Transparent, liquid and low-cost structure, Listed Instrument	Not UCITS (but in many cases, UCITS can invest in the ETP)
Physically-backed broad commodity	-	Virtually impossible to do across all commodities
Future-based broad commodity	Great diversifier and Inflation Hedge Positive, Risk Premium	Derivative, Operationally complex (roll across 20+ futures and daily margin management)
Swap-based broad commodity	Great diversifier and Inflation Hedge Positive, Risk Premium, Can deliver first or second-generation exposures	Derivative, Needs legal framework (ISDA) Counterparty risk, Operationally complex (manage daily collateral), Linked to one counterparty only
Broad commodity ETF	Great diversifier and Inflation Hedge Positive, Risk Premium Transparent, liquid and low-cost structure, Listed Instrument, Can deliver first or second-generation exposures, Can be UCITS	Funded Instrument
Broad commodity Fund	Great diversifier and Inflation Hedge Positive, Risk Premium, Long short exposure, Can be UCITS	Higher Fees
Commodity-linked equities	Easy to understand, Familiar asset class, Can pay dividends	Not a commodity exposure, Poor diversifier, Not hedging inflation, No Commodity, Risk Premium, Funded Instrument

Source: WisdomTree. October 2021.

B. How to improve on commodity benchmarks?

Broadly speaking, futures-based commodity indices can be split into two big families:

+ Benchmarks or first-generation indices, like the BCOM or the S&P GSCI.
+ Second-generation indices that aim to improve returns and lower risk through dynamic futures contract selection.

1. First and second-generation commodity indices

First-generation indices have usually been modelled on equities indices. The weight of the different commodities is fixed at regular intervals (very often once a year) and then left to drift. But what sets them apart is the way the rolling is performed. Those indices have been built to stay as close as possible to the uninvestable spot, so they invest very close to the front month of the curve, usually in the first one or two futures contracts. Consequently, they roll very frequently, every month or two. The average maturity of the futures in those indices is usually less than two months. S&P GSCI and the BCOM indices are two of the oldest examples in that generation. What tends to differentiate two first-generation indices is mainly the different weights of each commodity. The S&P GSCI, for example, is heavier on energy commodities and so tends to outperform BCOM when energy does well and underperform when it does not.

Second-generation indices (or enhanced indices) have been created more recently, starting in the early 2000s. First-generation indices are known to be sub-optimal because they rebalance infrequently and fail to consider the term structure of each future curve. Those new indices are meant to address some of those known issues. Their methodologies tend to differ in two ways:

- Different weights of the commodities.
- Investment in futures contracts that have longer maturity in a dynamic way to use the term structure to create outperformance.

Academics have shown that by rolling front or second months futures contracts, first-generation indices tend to exhibit higher volatility due to their higher exposure to the spot price see (Daal, et al., 2006) and (Samuelson, 1965). They also can suffer from high negative roll yields when the curve is in contango. By investing further up the curve, enhanced commodity indices aim and often succeed in reducing this volatility and the average roll yield.

2. How do enhanced commodity indices work?

For each commodity, enhanced commodity indices choose futures contracts on the curve depending on varying criteria with the aim to improve performance and reduce risk. Taking the example of the Optimised Roll Commodity Index (EBCI), let's have a look at how this can work.

As discussed in more detail in the introduction of this paper, the excess return performance of commodity futures contracts can be explained by two components: the spot return and the roll return. The roll return is the yield generated due to the rolling of one futures contract to the next contract, hence ensuring a continual exposure to futures prices and avoiding physical delivery and contract expiry. The roll return is mainly impacted by the shape of the futures curve and how it changes over time. Enhanced commodity indices in general and the EBCI, in particular, adopt a highly dynamic approach, looking at the liquidity each month on each commodity's futures curve to determine which maturities are liquid enough to be investable. It then selects the most optimal contract on the futures curve to minimise this drag when the curve is upward sloping (contango) and maximises the benefit when downward sloping (backwardation). By doing this monthly, the approach can respond quickly to changes in the shapes of futures curves.

The index, similarly to the BCOM, rebalances yearly in January. It also uses the same target weight as the BCOM for each commodity based on liquidity (2/3) and production (1/3). Similarly to the BCOM, the index holds one contract at a time for each commodity, except during the roll period. Because rolls are done over multiple days, for that period, the index holds two contracts (the "old" one and the "new" one). EBCI actively selects a specific maturity every month to improve the realised roll yield. For each commodity, the exact contract selection is made as follows:

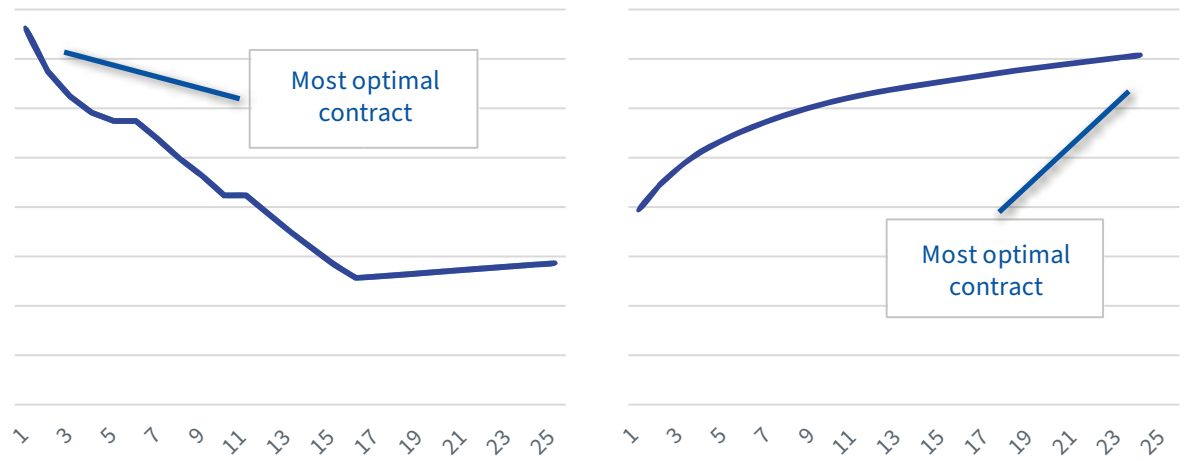
- Define which contracts have at least $100m average daily open interest to ensure the liquidity of the strategy.
- Calculate the monthly implied roll yield for each of those contracts.
- Select the contract with the highest positive implied roll yield or smaller negative implied roll yield.

To minimise transaction costs, if the futures contract the index is already invested in is among the best in terms of implied roll yield (but not the best), then the index may not change the contract. The strategy does not optimize for gold and silver as those curves tend to be almost flat (even if slightly in contango).

Overall, the Dynamic Roll algorithm aims:

- to minimise negative roll yield in contango and picks further-out futures contracts.
- to maximise positive roll yield in backwardation by selecting close to the front futures contracts.

Figure 32: Commodity futures curve and roll yield (Contango left, backwardation right)

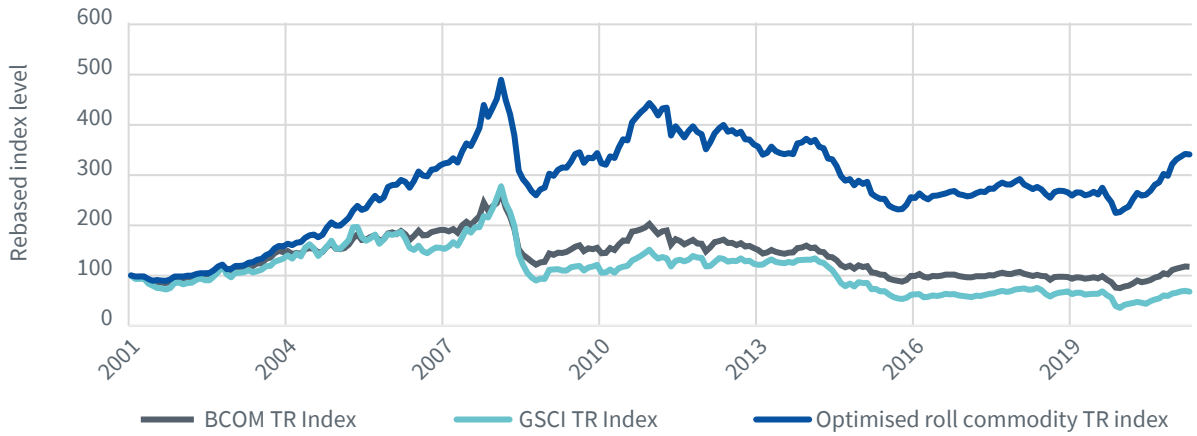


Source: WisdomTree, for illustrative purposes only.

Over long periods, this "optimised roll yield" approach can improve the index return. It also tends to reduce volatility because choosing futures contracts further along the curve means the strategy is less exposed to spot price movements, enhancing the risk-return profile over the long term. This is inline with (Rallis, et al., 2010), who found that a maturity enhanced S&P GSCI outperformed by 5% on an annualised basis over the studied periods. Similarly, maturity enhanced BCOM indices outperformed by 3% and 4.3% on an annualised basis.

Looking at our own example, the Optimised Roll Commodity Index significantly outperformed both the BCOM Index and the S&P GSCI Index. With a 6.3% annualised returns between 31st May 2001 and 31st August 2021, it outperformed the BCOM index by 5.5% on average every year and the S&P GSCI index by 8.1% on average every year. The index also exhibited reduced volatility of 13.7%, 2.3% less than the BCOM and almost 10% less than the S&P GSCI.

Figure 33: Performance comparison – Enhanced commodities versus commodity benchmarks



	BCOM TR Index	GSCI TR Index	Optimised roll commodity TR index
Annualised returns	0.8%	-1.9%	6.2%
Annualised volatility	15.9%	23.4%	13.7%

Source: WisdomTree, BNP, Bloomberg, S&P. May 2001 to August 2021. Calculations are based on monthly returns in USD. You can not invest directly in an index. **Historical performance is not an indication of future performance and any investments may go down in value.**

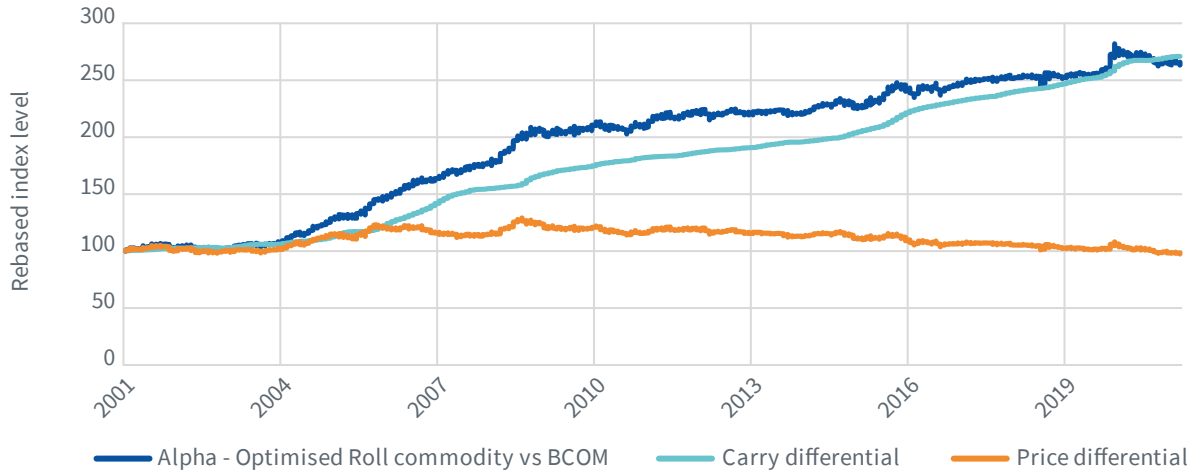
Looking further at the drivers of such an outperformance, it is possible to decompose the differential in performance between the Optimised Roll Commodity Index and the BCOM index into two distinct parts:

+ The carry differential i.e. the difference in performance driven by the different roll yields in the futures contract each index is invested in.

+ The price differential i.e. the difference in performance driven by the varying sensitivity to spot prices of the futures contracts each index is invested in.

As illustrated in Figure 34, the carry differential is the main driver of the outperformance, while the price differential has little impact. In other words, the main source of outperformance of the optimised roll index is the mechanism that minimizes the roll yield by going further out on the curve.

Figure 34: Explaining the alpha of Optimised Roll Commodity Index versus the Bloomberg commodity index



Source: WisdomTree, BNP. From 15 May 2001 to 27 July 2021. You can not invest directly in an index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Finding #16: Enhanced commodity strategies outperform commodity benchmarks consistently while reducing volatility.

3. Enhanced commodities exhibit the same statistical behaviour as commodity benchmarks

Second-generation commodity indices can improve performance and reduce volatility but by doing so, do they dilute their "commodity exposure"? For a strategic investment, the diversification properties of commodities are also key.

(Rallis, et al., 2010) illustrates that maturity enhanced S&P GSCI and maturity enhanced BCOM remain highly correlated to the benchmark commodity indices and maintain their inflation hedging properties. The Optimised Roll Commodity Index, for example, exhibit a 97.2% correlation on monthly returns with the BCOM index and 85.4% with the S&P GSCI Index. Since it shares similar commodity weights with the BCOM, it is logical that the correlation is higher. Also, it highlights that the mechanism to go further up the curve, while making a huge difference on the return and the volatility, does not significantly impact the behaviour of the index.

In light of this high correlation between enhanced and benchmark commodities, it is somewhat unsurprising that the correlation of enhanced commodities with other asset classes is low. Like first-generation benchmarks, enhanced commodities exhibit low to negative correlation with equities and bonds. Again, the exception is emerging market equities whose economies tend to remain more industrials and therefore more linked to the price of commodities. Figure 35 also demonstrates that enhanced commodities remain highly negatively correlated to the US dollar.

Figure 35: Correlation of enhanced broad commodities with other assets

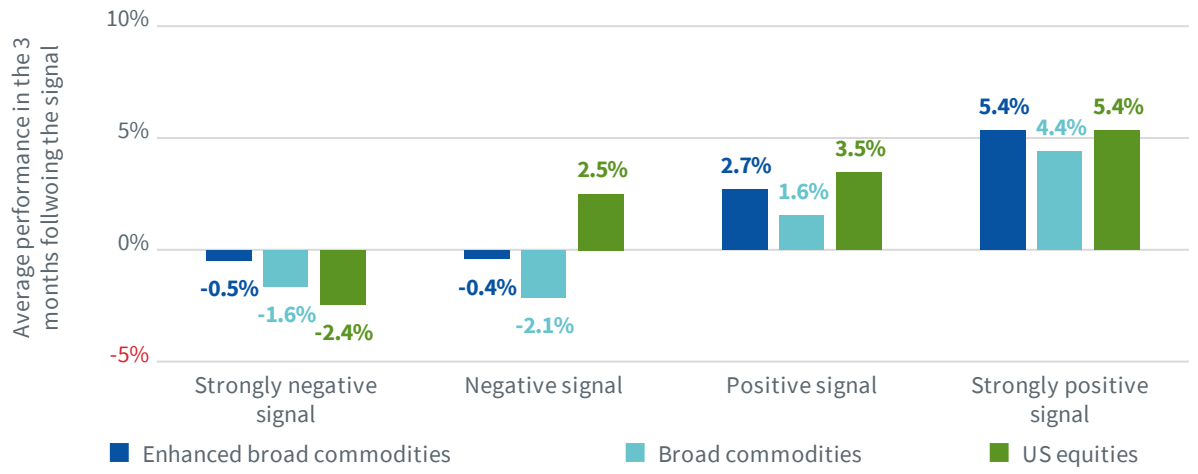
	BCOM TR Index	US equities	EM equities	US treasuries	US corporate bonds	US high yield bonds	US Dollar index
Enhanced broad commodities	97%	42%	60%	-15%	25%	45%	-56%

Source: WisdomTree, Bloomberg, MSCI, S&P. May 2001 to August 2021. Calculations are based on monthly returns in USD. Enhanced Broad commodities stands for the EBCI, Optimised Roll Commodity total return index. US Equities stands for S&P 500 gross total return index). Global equities stand for MSCI world gross total return index. EM equities stand for MSCI emerging market total return index. US treasuries stand for Bloomberg US treasury total return unhedged USD index. US corporate bonds stand for Bloomberg US corporate total return unhedged USD index. US high yield bonds stand for Bloomberg US corporate high yield total return unhedged USD index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Figure 36 highlights the cyclicality of enhanced commodities. Using the Organisation for Economic Co-operation and Development ("OECD") Composite Leading indicator ("CLI"), all the months, in the period considered, are distributed across four groups depending on the moves of the CLI. The CLI has been designed to provide early signals of turning points in the business cycle and therefore tends to decrease a few months before the economy starts to slow down or increase before the economy restarts. Months where the CLI move is strongly negative are grouped and represent months that could lead to a recession. Months where the CLI move is strongly positive are grouped and represent months that could lead to a strong economic expansion. Figure 36 exhibits the average performance of each asset in the quarter following the signals. It allows assessing the performance of the different assets in different parts of the business cycle.

The results are clear. Equities are the most cyclical asset. Their performance exhibit the highest sensitivity to the value of the CLI. They exhibit large losses when the signal is negative and large gains when it is positive. Broad commodities and enhanced commodities behave cyclically but less so than equities. Thanks to their improved performance, the performance of enhanced commodities in periods where the CLI is negative is significantly improved to the point that it is barely negative.

Figure 36: Average performance in the three months following the CLI signal



Source: WisdomTree, Bloomberg, S&P. June 2001 to August 2021. Calculations are based on monthly returns in USD. Enhanced Broad commodities stands for the EBCI, Optimised roll broad commodity total return index. US Equities stands for S&P 500 gross total return index). Broad commodities stand for the Bloomberg commodity total return index. **Historical performance is not an indication of future performance and any investments may go down in value.**

As expected, the beta to inflation of enhanced commodities is very close to that of broad commodities. The beta to unexpected inflation is identical. Overall, enhanced commodities, therefore, exhibit the same inflation hedging capabilities as commodity benchmarks.

Figure 37: Beta to Inflation			
	Beta to US CPI	Beta to expected inflation	Beta to unexpected inflation
Broad commodities	5.1	1.2	3.7
Enhanced broad commodities	4.6	3.4	3.7

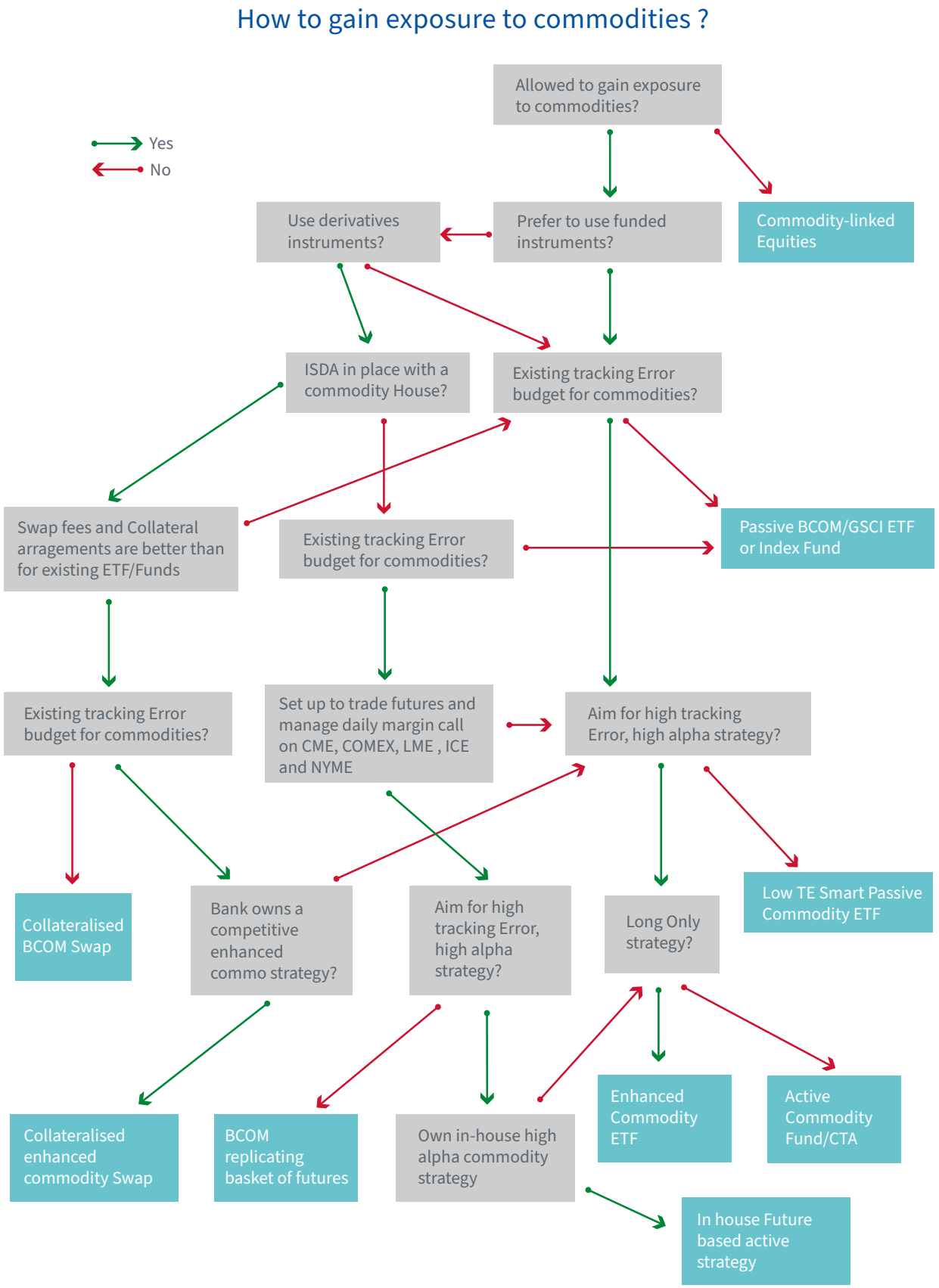
Source: WisdomTree, Bloomberg, S&P. June 2001 to August 2021. Calculations are based on monthly returns in USD. Enhanced Broad commodities stands for the EBCI, Optimised roll broad commodity total return index. US Equities stands for S&P 500 gross total return index). Broad commodities stand for the Bloomberg commodity total return index. **Historical performance is not an indication of future performance and any investments may go down in value.**

In other words, enhanced broad commodities:

- improve on the long term performance of broad commodity benchmarks.
- reduce the volatility.
- are highly correlated to commodity benchmarks.
- provide diversification from equities.
- are a cyclical asset with a twist.
- act as an inflation hedge, including against unexpected inflation.
- are negatively correlated to US dollars.

Finding #17: Enhanced commodity strategies exhibit the same properties as commodity benchmarks (Inflation hedge, diversifier...).

Figure 38: Investing in commodities – the decision Tree



ISDA: International Swaps and Derivatives Association; **BCOM**: The Bloomberg Commodity Index; **GSCI**: Goldman Sachs Commodity Index; **CME**, **COMEX**, London Metal Exchange (**LME**), International Exchange (**ICE**), **NYME** (New York Mercantile Exchange): Exchange companies; **Swap**: A swap is a derivative contract through which two parties exchange the cash flows or liabilities from two different financial instruments; **TE**: Tracking error.

The Case for Investing in Broad Commodities

IV. Commodities, a staple of a robust strategic asset allocation

Broad commodities can add much value to an investor's portfolio and:

- add to the long term performance thanks to their risk premium,
- provide diversification from equities and bonds,
- provide diversifying performance in early recession and late expansion,
- act as an inflation hedge, including against unexpected inflation,
- benefit from US dollar weaknesses when other assets won't.

However, should investors extend 5% of their portfolio to commodities, or should they invest 20%? This last chapter aims to combine all of our findings and look at the best way to utilise commodities and fit them into investors' portfolios.

A. Learning from the past

Over the years, many academics have wondered if commodities were a sound strategic investment and would add value to a strategic asset allocation. In most cases, their analyses concluded that portfolio performance is enhanced and portfolio efficiency is improved by adding a broad commodities exposure. This is the case, for example of (Bodie, 1983), (Ankrim & Hensel, 1993), (Greer, 1994), (Satyanarayan & Varangis, 1996), (Anson, 1998), (Jensen, et al., 2000), (Idzorek, 2006), (Idzorek, 2007). More recently, (Connover, et al., 2010) also have shown that adding a commodity exposure is beneficial regardless of an investor's equity style. Studies show that exposure to commodities does improve pure equity portfolios as well as already diversified portfolios.

(Idzorek, 2006) note that "it is widely agreed upon that strategic asset allocation is the most important decision in the investment process. For diversified portfolios, it is the dominant determinant of performance." Based on data from 1970 to 2004, he found that "Including commodities in the opportunity set resulted in a superior historical efficient frontier, which included large allocations to commodities. Over the common standard deviation range, the average improvement in historical returns at each of the risk levels was approximately 133 basis points."

Misconception #10

"Commodities don't add value to strategic asset allocation."

Since commodities and equities share similar risk premiums and volatility levels, it is easy to assume that they are two sides of the same coin. This is in no way the case.

Commodities have been and still are strong diversifiers, and they provide inflation hedging.

Many academics have demonstrated over the years that broad commodity investments improve the risk-return profile of classic equity/bond portfolios. See (Bodie, 1983), (Ankrim & Hensel, 1993), (Greer, 1994), (Satyanarayan & Varangis, 1996), (Anson, 1998), (Jensen, et al., 2000), (Idzorek, 2006) or (Idzorek, 2007).

In this paper, we use mean-variance analysis to assess the impact of investing in commodities on portfolios. We find that both historically and looking forward, broad commodities improve the efficient frontier. We also note that this is the case for USD-based, EUR-based and GBP-based investors.

Academics have demonstrated over and over that commodities improve the risk-return profile of portfolios.

1. The best portfolio for the last 50 years

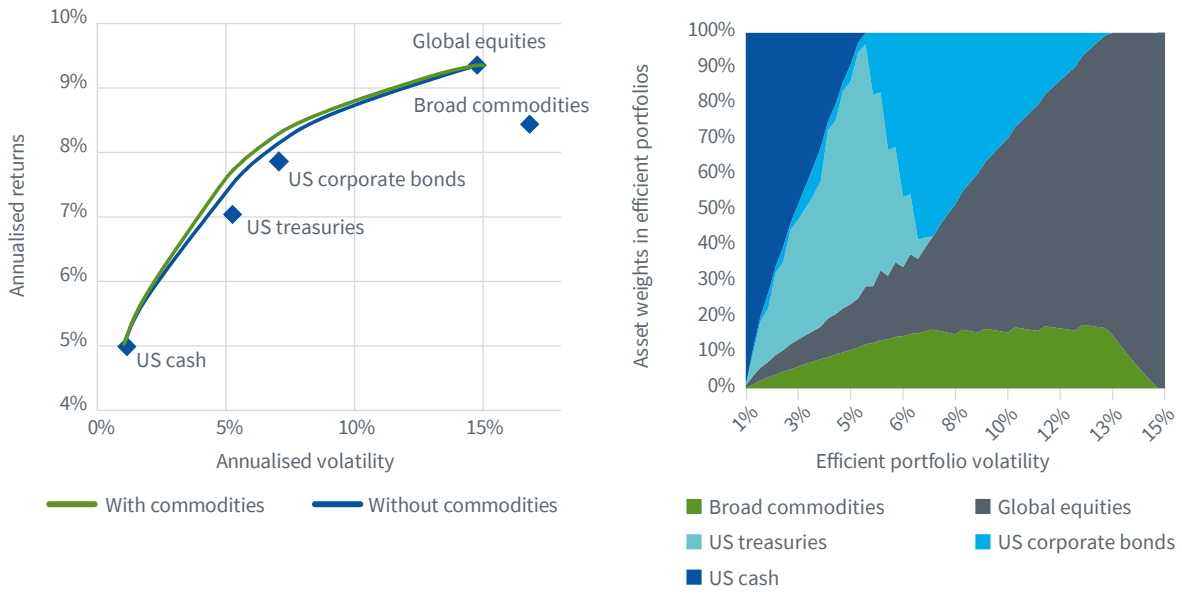
Harry Markowitz's modern portfolio theory, or mean-variance analysis, as introduced in (Markowitz, 1952) and which earned him the Nobel Memorial Prize in economic sciences, is a great tool to assess and compare different strategic asset allocations. Mean-variance optimisations require three inputs:

- A vector composed of the expected returns for each asset considered.
- A vector comprising the expected volatility for each asset considered.
- A matrix of correlations between all the different assets.

Based on those three inputs, it is then possible to construct the efficient frontier, representing a collection of portfolios that maximises the expected returns for each level of volatility. Using historical returns, volatility and correlation, instead of expected/future statistics, the efficient frontier represents the strategic asset allocation that would have performed the best in the past period considered. It allows assessing the impact of adding or not a new asset to the universe of investment by comparing the historical efficient frontier of the initial set of investments with the historical efficient frontier resulting from the new set of investments, the one including the tested asset.

In Figure 39, we initially consider four assets: US cash, US treasuries, US corporate bonds and global equities. Then add broad commodities to that universe. We then use the historical statistics calculated from Dec 1969 to Aug 2021, based on the data series described in Figure 40 to calculate the two efficient frontiers. We observe that for most levels of volatility, adding broad commodities would have improved the efficient frontier. It is not the case only for very low levels of volatility, where cash is the widely dominant asset and very high levels of volatility, where equities are the only asset. On average, for a given level of volatility, the return of the efficient portfolio is improved by 10bps. At its maximum, the return is improved by 22bps. Looking at the portfolio allocation of the different efficient portfolios, it is possible to assess the optimal allocation to broad commodities historically. Of course, it varies depending on the investor's risk appetite, but in most cases, this weight oscillates between 10% and 20% of the portfolio.

Figure 39: Comparing efficient frontiers for investors allowed to invest in commodities or not



Source: WisdomTree, Bloomberg. From 31st December 1969 to 31st August 2021. In US dollars. Data definitions are laid out in detail in Figure 40. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Figure 40: Data series used in the historical mean-variance optimisation analysis		
Global equities	60% MSCI EAFE gross Total return + 40% S&P 500 gross total return	From December 1969
US treasuries	Bloomberg Barclays US Treasury total return	From January 1973
	50% Ibbotson® SBBI® US Intermediate-term (5-Year) Government Bonds (Total Return) + 50% Ibbotson® SBBI® US Long-term (20-Year) Government Bonds (Total Return)	From December 1969 to Jan 1973
US corporates	Bloomberg Barclays US Corporate total return	From January 1973
	Ibbotson® SBBI® US Long-term (20-Year) Corporate Bonds (Total Return)	From December 1969 to Jan 1973
Cash	ICE BofA US 3-Month Treasury Bill	From December 1977
	Fed Fund rate	From December 1969 to December 1977
Broad commodities	Bloomberg Commodity total return	From December 1969
Commodity-linked equities	Equal weight of 4 sub-industries precious metals miners, petroleum and gas exploration and production, coal mining and non-metallic and industrial metal mining. As found in K. French Data library.	From December 1969

Source: WisdomTree, August 2021.

Finding #18: Historically, most efficient portfolios would have invested 10 to 20% in broad commodities.

Misconception #11

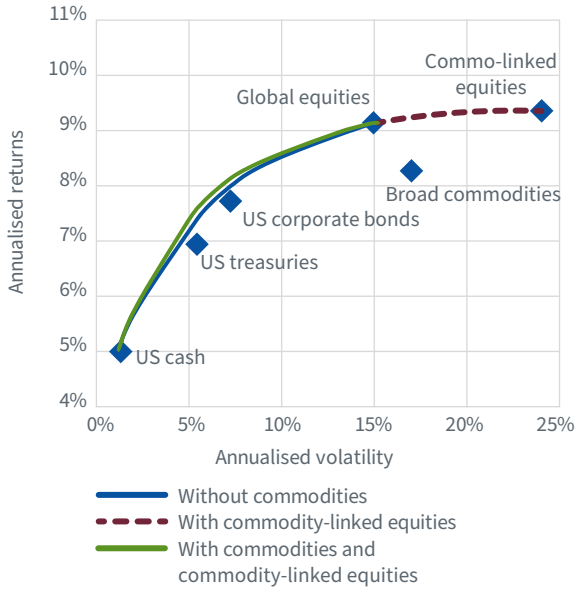
"Commodity-linked equity can replace commodity futures contracts in a portfolio."

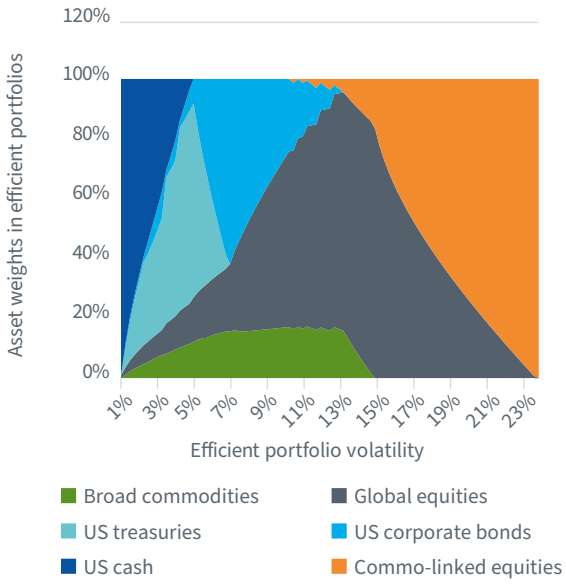
Many investors wonder if commodity-linked equities, such as the shares in miners, or oil producers, can be used as a proxy for an investment in broad commodities. We then use the historical statistics calculated from Dec 1969 to Aug 2021 based on the data series described in Figure 40 to calculate three efficient frontiers. The first efficient frontier is built around four assets: US cash, US treasuries, US corporate bonds, global equities. The second one includes commodity-linked equities as a potential diversifier on top of the first four assets. The third one includes equities, bonds, broad commodities and commodity-linked equities.

It is clear in the left-hand graph that the efficient frontier with or without commodity-linked equities are, in fact, identical for volatility levels below 15%. Commodity-linked equities have had zero diversification effect on the portfolio. In light of earlier results in this paper, it is not surprising. Commodities-linked equities are equities at the end of the day. They display a high correlation to equities and do not display any of commodities investment' statistical advantages.

In a mean-variance optimisation where investors can invest in both broad commodities and commodity-linked equities, like in the right-hand graph, the efficient portfolios do not invest in commodity-linked equities for any level of volatility under 13%. Below 13%, the efficient allocation is, in fact, identical to the one in Figure 39, i.e. to the case where the investor is not allowed to invest in commodity-linked equities, with 10% to 20% in broad commodity and 0% in commodity-linked equities. Above 13% of volatility, the optimiser invests in commodity-linked equities but as a replacement of equities, not broad commodities.

Commodity linked equities have not improved the efficient frontier historically





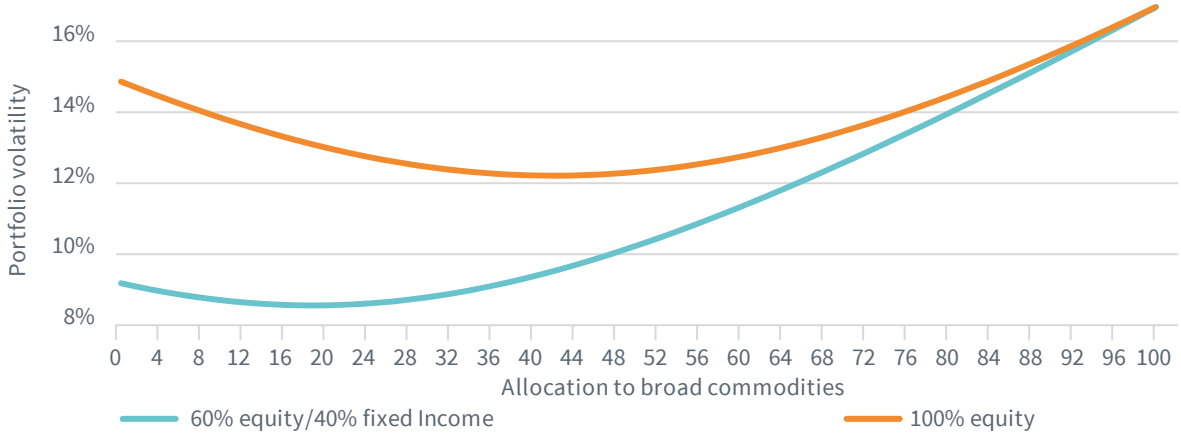
Source: WisdomTree, Bloomberg. From 31st December 1969 to 31st August 2021. In US dollars. Data definitions are laid out in detail in Figure 40. You cannot invest in an Index. Historical performance is not an indication of future performance and any investments may go down in value.

2. A risk manager's perspective

Broad commodities are a diversifier. Their correlation to equities and bonds has historically been low. But what does that mean for a portfolio? Figure 41 looks at the impact of a broad commodity investment on the volatility of two existing portfolios: 100% equities and 60% equities/40% fixed income. For both portfolios, we show that the historical volatility (from 1973) increases as the proportion of broad commodities increases. We observe that the volatility of both portfolios is reduced up to a certain amount of commodities.

For the 60% equities/40% fixed income portfolio, the minimum amount of volatility (8.5%) is achieved when the weight of broad commodities is 19% (equities are then 48% and bonds are at 33%). The volatility of that new portfolio is decreased by a full percentage point. For the 100% equity portfolio, the minimum volatility point is achieved for an investment of 42% in commodities. The volatility is then 12.2% versus 15% for the equity alone.

Figure 41: Volatility reduction of portfolio investing in broad commodities



Source: WisdomTree, Bloomberg, S&P. January 1973 to August 2021. Calculations are based on monthly returns in USD. MSCI World gross total return index is used for equities. Bloomberg US treasury total return unhedged USD index is used for Fixed Income. Broad commodities stand for the Bloomberg commodity total return index. **Historical performance is not an indication of future performance and any investments may go down in value.**

FINDING #19 Creating a broad commodity sleeve in a portfolio could reduce the overall volatility of the portfolio significantly.

B. Looking ahead, where do commodities fit in a portfolio

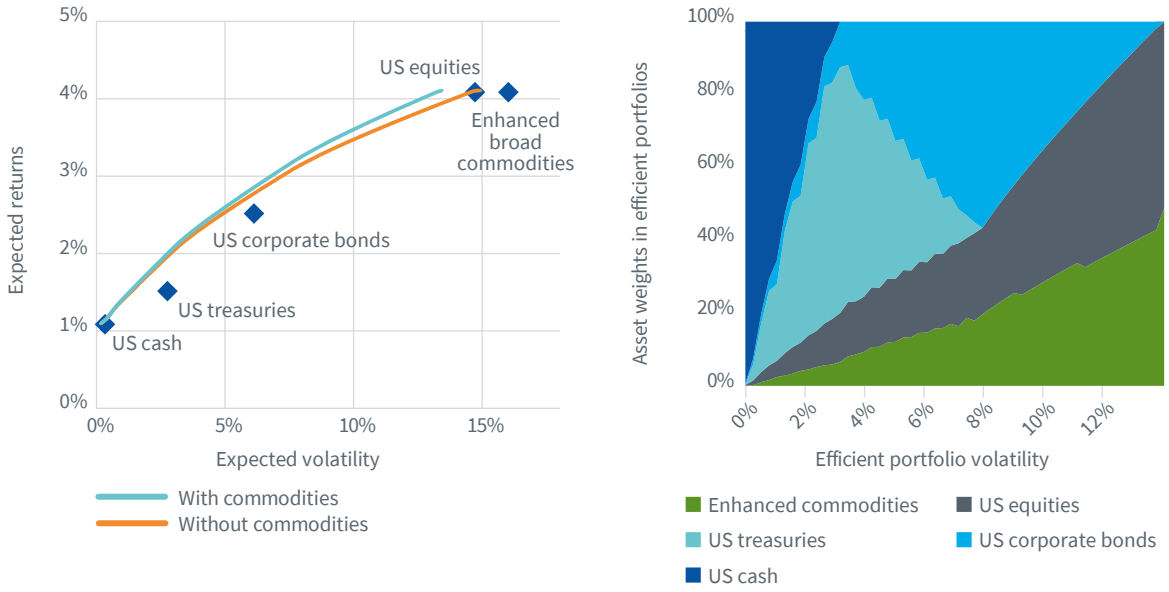
While mean-variance analysis is a very strong tool to understand the past, it can also be used to prepare for the future. Forward-looking efficient frontiers are derived from forward-looking capital market assumptions. For the sake of the following analyses, we use J.P. Morgan Asset Management Long-Term Capital Market Assumptions 2021. Those assumptions aim to give estimates for returns, volatility, and correlation for the next ten years.

1. The case of a US dollar investor

In Figure 42, we consider a typical example portfolio for a USD based investor, composed of 4 assets: US cash, US treasury, US corporate bonds and US equities. Using Long Term Capital Market Assumptions, it is possible to create the expected efficient frontier for the next 10 years. To assess the impact of commodities on the portfolio, we then add enhanced commodities to the universe of investable assets. Enhanced commodities' long term expected returns are derived from those of broad commodities by adding 1.8% per annum of outperformance. As a comparison, historically, the EBCI optimised roll commodity total return index has outperformed the Bloomberg commodity index by more than 1.8% in 90% of the three-year rolling periods since inception in 2001.

Clearly, the forward-looking, efficient frontier of the five asset portfolios, including commodities, has been improved markedly. On average, the annualised expected returns is higher by 10bps, and at the highest point, the return is higher by 17bps. Changing perspective, the highest return portfolio is expected to return 4.1% over the period in both frontiers. Without commodities, the expected volatility is 15% but only 13.5% if commodities are introduced in the portfolio. Looking at the portfolio allocation of the different efficient portfolio exampless, it is possible to assess the optimal allocation to commodities under the above assumptions. Depending on the portfolio's volatility, the optimal allocation to commodities varies from 0% to 45%. For a volatility of 8%, typical of a 60/40 portfolio, the optimal allocation to enhanced commodities is 20%.

Figure 42: Looking-forward efficient frontier for USD-based investors.

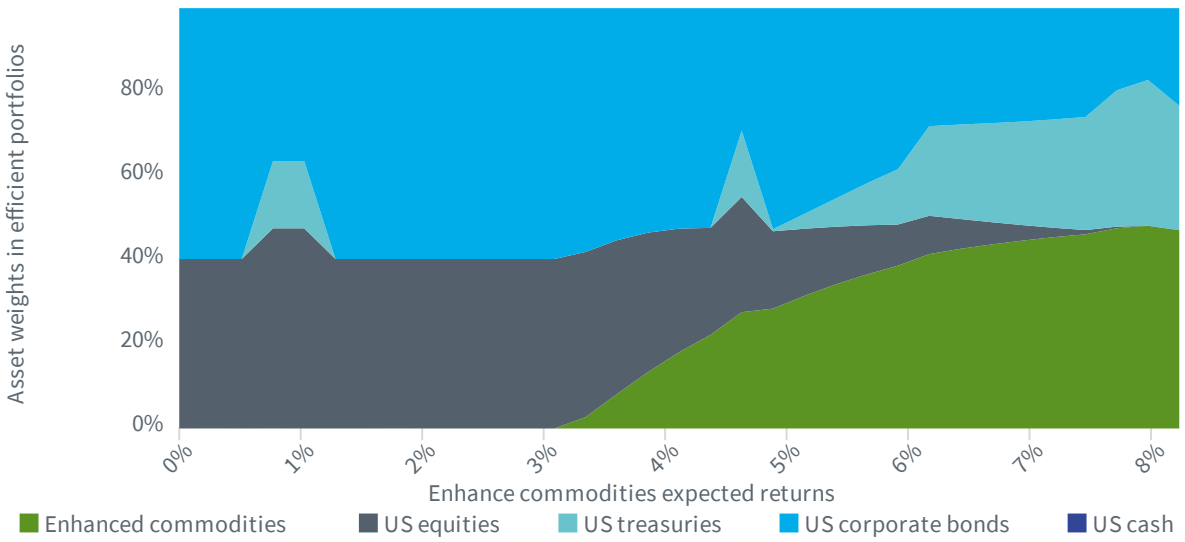


Source: WisdomTree, Bloomberg. 31st August 2021. In US dollars. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

The above results are, of course, directly dependant on the assumptions used. In this case, the long term capital market assumptions are that enhanced commodities and US equities will both return 4.1% per annum over the next ten years. Considering a portfolio with 8% volatility, typical of a 60/40 portfolio, the commodities' optimal weight in Figure 42 is 21%.

In Figure 43, we test the sensitivity of that optimal weight to the commodities' expected return by changing that input in our mean-variance analysis and looking at the composition of the efficient portfolio with an 8% volatility. We observe that the portfolio is invested in commodities as long as the expected return for enhanced commodities is above 2.8%. Then the weight of commodities in the efficient portfolio increases in line with the expected return to a maximum of 48% when the return expectations get high. 6% expected commodity returns would translate into 42% invested in commodities, everything else remaining equal.

Figure 43: Sensitivity of commodities' weight in the efficient frontier to their expected returns



Source: WisdomTree, Bloomberg. 31st August 2021. In US dollars. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

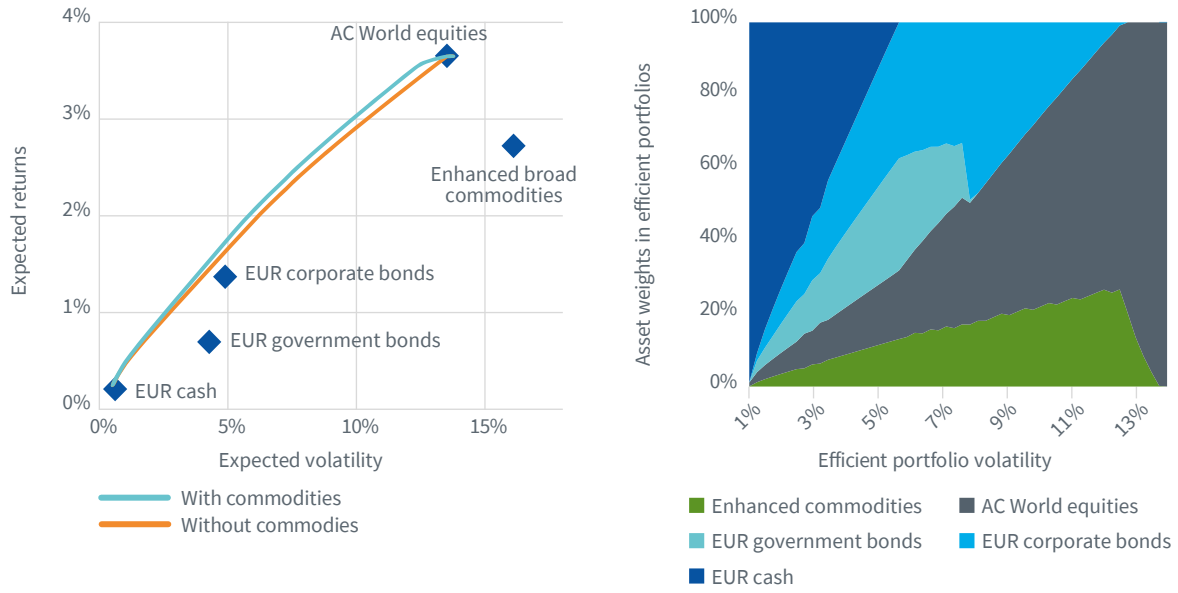
2. The case of a euro investor

In Figure 44, we consider a typical example portfolio for a EUR based investor, composed of 4 assets: EUR cash, EUR government bonds, EUR corporate bonds and World equities. Similarly to before, using Long Term Capital Market Assumptions, it is possible to create the expected efficient frontier for the next ten years and compare it to the efficient frontier that includes enhanced commodities.

The forward-looking, efficient frontier of the five asset portfolios, including commodities, has been improved markedly. On average, the annualised expected returns is higher by 9bps, and at the highest point, the return is higher by 14bps. According to the analysis, the portfolio's volatility with commodities is expected to be lower for any given level of expected returns.

Looking at the portfolio allocation of the different efficient portfolio examples, it is possible to assess the optimal allocation to commodities under the above assumptions. Depending on the portfolio's volatility, the optimal allocation to commodities varies from 0% to 25%. For a volatility of 8%, typical of a 60/40 portfolio, the optimal allocation to enhanced commodities is 18%. Overall the results are pretty similar to those found for a USD-based investor.

Figure 44: Looking-forward efficient frontier for Euro-based investors.



Source: WisdomTree, Bloomberg. 31st August 2021. In US dollars. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

For commodity investors whose home currency is not the US dollar, the next question after the size of the allocation is if the exposure should be currency hedged or not. In most cases, the hedging decision is linked to the investor view on the trajectory of the US dollar. Taking the above as a quick example, using J.P. Morgan Asset Management Long Term Capital Market Assumptions, expectations are for enhanced commodities to return 4.1% on average per year over the next ten years or so in US dollars. In euro unhedged, the expected returns fall to 2.7%. 1.4% less than in USD because markets expect the US dollar to continue to weaken versus the euro. If the decision to currency-hedged the exposure is taken, then the return expectations go back up to 3.3%. That is because the investor would not suffer from the weakening of the US dollars, but currency-hedging has a cost (linked to the differential in interest rate in both currencies), here estimated at -0.8%. So assuming that correlations and risks remain similar for the hedged and unhedged commodity exposure, our mean-variance optimisation would favour a hedged exposure versus an unhedged exposure.

At the end of the day, the hedging decision is based on two main factors: is the US dollar expected to strengthen or weaken over the investment period versus the investor's home currency, and how much does it cost to hedge the currency risk.

3. The case of a British pound investor

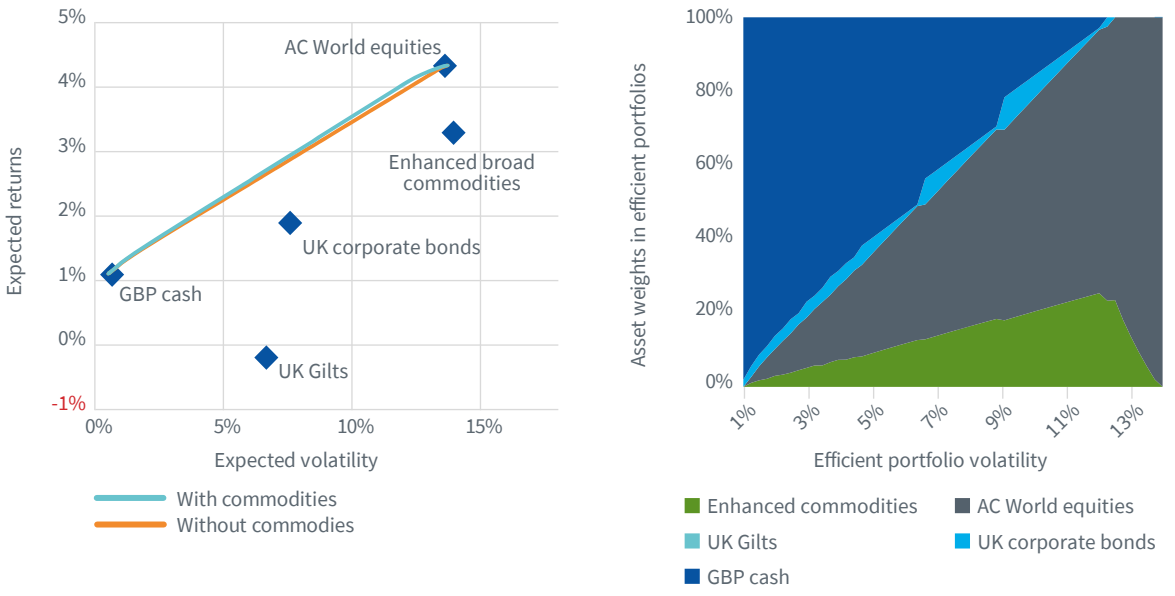
Figure 45 considers a typical example portfolio for a GBP-based investor, composed of 4 assets: GBP cash, UK gilts, UK corporate bonds, and World equities. Similarly to before, Using Long Term Capital Market Assumptions, it is possible to create the expected efficient frontier for the next ten years and compare it to the efficient frontier that includes enhanced commodities. The forward-looking, efficient frontier of the five asset portfolios, including commodities, has been improved. On average, the annualised expected returns is higher by 5bps, and at the highest point, the return is higher by 10bps.

Looking at the portfolio allocation of the different efficient portfolio examples, it is possible to assess the optimal allocation to commodities under the above assumptions. Depending on the portfolio's volatility, the optimal allocation to commodities varies from 0% to 25%. For a volatility of 8%, typical of a 60/40 portfolio, the optimal allocation to enhanced commodities is 17%. According to the analysis, the portfolio's volatility with commodities is expected to be lower for any given level of expected returns.

Overall the results are pretty similar to those found for a USD-based or a EUR-based investor from the commodity angle. The efficient portfolios themselves are quite different due to the low return expectations and high duration of UK Gilts, which leads to a large portion of cash in the portfolio.

In British pound unhedged, the expected returns fall to 1.5%. 2.6% less than in USD because markets expect the US dollar to continue to weaken versus the British pound. If the decision to currency-hedged the exposure is taken, then the return expectations go back up to 4%. That is because the investor would not suffer from the weakening of the US dollars, but currency-hedging has a cost (linked to the differential in interest rate in both currencies), here estimated at -0.1%. So assuming that correlations and risks remain similar for the hedged and unhedged commodity exposure, our mean-variance optimisation would favour a hedged exposure versus an unhedged exposure.

Figure 45: Looking-forward efficient frontier for GBP-based investors.



Source: WisdomTree, Bloomberg. 31st August 2021. In British pounds. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Figure 46: Asset allocation in looking-forward efficient portfolioexamples with expected volatility of 8%

	USD-based investor	EUR-based investor	GBP-based investor
Expected annualised volatility	8.0%	8.0%	8.0%
Expected annualised return	3.2%	2.6%	3.0%
Cash	0.0%	0.0%	32.7%
Government bonds	0.0%	0.0%	0.0%
Corporate bonds	53.5%	44.2%	2.1%
Equities	25.4%	37.8%	48.0%
Enhanced commodities	21.2%	18.1%	17.2%

Source: WisdomTree, Bloomberg. 31st August 2021. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

FINDING #20 Looking forward to the next ten years, we believe broad commodities are likely to improve portfolios, and their optimal allocation varies between 5% and 25% depending on the targeted risk.

C. What about gold, then?

Most of this paper is about broad commodity as an asset class. Looking at every single commodity separately in any meaningful level of detail would require another 50 pages of analysis. However, gold holds a special place in most investors' portfolios. It is usually considered an asset on its own because it is recognised as a store of value. It is usually already part of strategic asset allocation. So it stands to reason to wonder if holding gold strategically in a portfolio would change the optimal weight of broad commodities to be held in a portfolio.

1. A defensive commodity with its own place in strategic asset allocation

Gold, as a commodity, tends to stand out. There are large above-ground stocks that can easily be mobilised. As a result of gold's liquidity, it often acts more like a currency than a commodity. But unlike most fiat currencies, its supply cannot be increased at the click of a few buttons following a monetary policy meeting. As such, it has a 'super-haven' status. This makes gold historically an excellent hedge against geopolitical and financial market turbulence. The expectation is that investors will flock to that safe-haven asset, and its price will rise in such a period. So gold is a defensive asset when broad commodities are cyclical. (Baur & McDermott, 2010) demonstrated that gold is a safe haven and has historically provided a hedge against adverse conditions in many developed markets.

Misconception #12

"Gold can replace broad commodities in a portfolio."

While being a commodity, gold's investment characteristics differ largely from those of broad commodities. Gold is a safe-haven asset, very defensive in crisis periods. Broad commodities represents a strategy more cyclical in nature and considered to be a risky asset in portfolios. Therefore, their role in a portfolio is very different:

Commodities act as a return enhancer and risk diversifier.

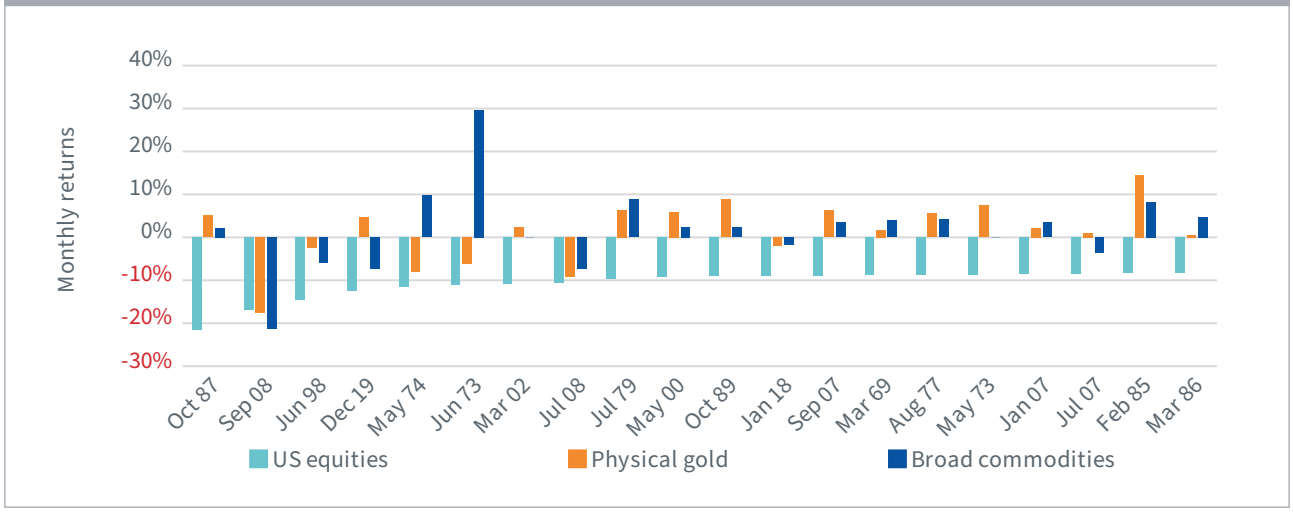
Gold acts as a kind of insurance against downside risk even if its "insurance premium" is negative, i.e. gold is not a drag on performance.

A mean-variance analysis, as described in IV.C.2 shows that an optimizer does not choose between broad commodities and Gold but, in fact, combine them. An optimal portfolio allocated up to 8% into Gold and up to 35% into broad commodities.

Historically, efficient portfolios allocate to gold and broad commodities to improve their overall risk-return profile.

Figure 47 illustrates the performance of physical gold in the worst 20 months for the S&P 500 since 1969. We observe that gold has offered very strong differentiation to an investor. Taking the example of the worst month for equity in the last 60 years or so, US equities lost -21.5% in October 1987. During that same month, gold gained 5.0%. This would have provided incredible help to any investor during that month. In fact, gold has outperformed equities in 19 out of those 20 months. In 14 months, gold has even performed positively as it did in October 1987. Interestingly enough, the performance of gold and broad commodities looks quite differentiated as well.

Figure 47: Gold performance in the worst 20 months for the S&P 500 since 1967



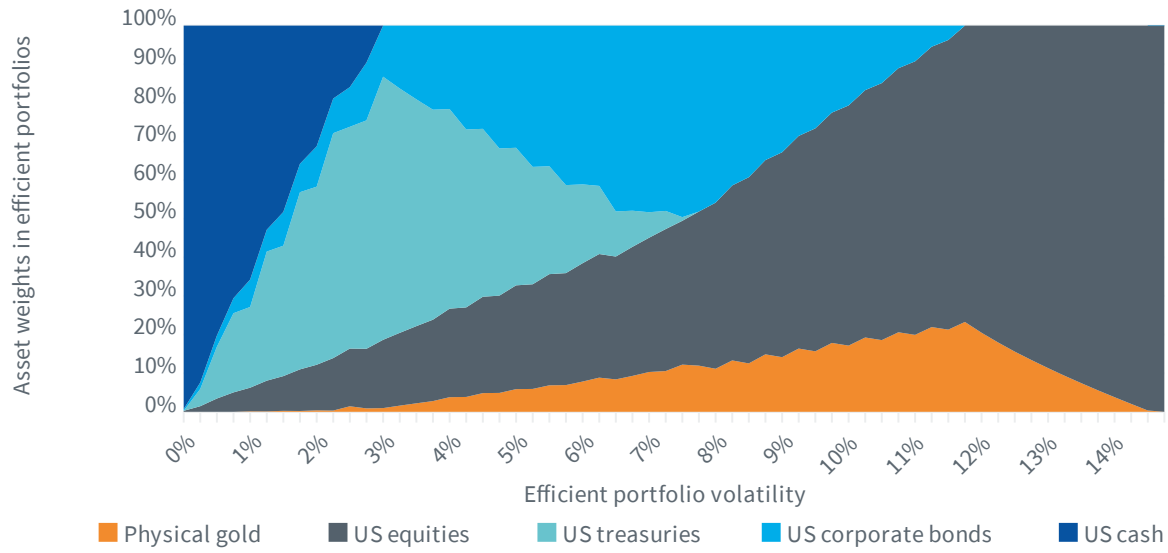
Source: WisdomTree, Bloomberg, S&P. March 1967 to August 2021. Calculations are based on monthly returns in USD. Physical gold is the LBMA Gold Price PM), US Equities is the S&P 500 gross total return index, and Broad commodities is the Bloomberg commodity total return index. **Historical performance is not an indication of future performance and any investments may go down in value.**

Gold is also a very strong inflation hedge. The fact that gold rises with inflation means that it is not just a "doomsday" asset – i.e. it doesn't just perform when cyclical assets are faltering. Strong economic activity that generates inflation often goes hand-in-hand with gold price gains. Therefore, gold does not have to be a drag on a portfolio in the "good times". In fact, introducing gold into a portfolio can help during "bad times" but isn't costly in "good times". Overall, gold acts as a kind of insurance against equity market drawdowns. However, what makes gold truly special is that contrary to most insurance, it is not a drag on performance. It tends to act as an insurance but with a premium paid to you.

These results have been proven repeatedly. (Jaffe, 1989), (Chua, et al., 1990), (Hiller, et al., 2006), (Connover, et al., 2009), (Dempster & Artigas, 2010) all demonstrated that adding a strategic investment in gold would enhance the portfolio's performance by lowering risk and increasing portfolio returns. In a recent paper (Debru & Shah, 2020) published by WisdomTree, we show that adding 10% of gold strategically in a 60/40 portfolio would have maximised the Sharpe ratio for the period 1973-2020.

Coming back to the forward-looking, efficient portfolios for USD-based investors, we consider a typical portfolio for a USD based investor, composed of 4 assets: US cash, US treasury, US corporate bonds and US equities and add gold to that universe. Figure 48 clearly shows that gold is part of the efficient portfolio for most volatility levels and adds to the strategic asset allocation. Gold's allocation rose as high as 23% for 12% target volatility portfolios.

Figure 48: Allocation of efficient portfolios with gold



Source: WisdomTree, Bloomberg. 31st August 2021. In US dollars. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

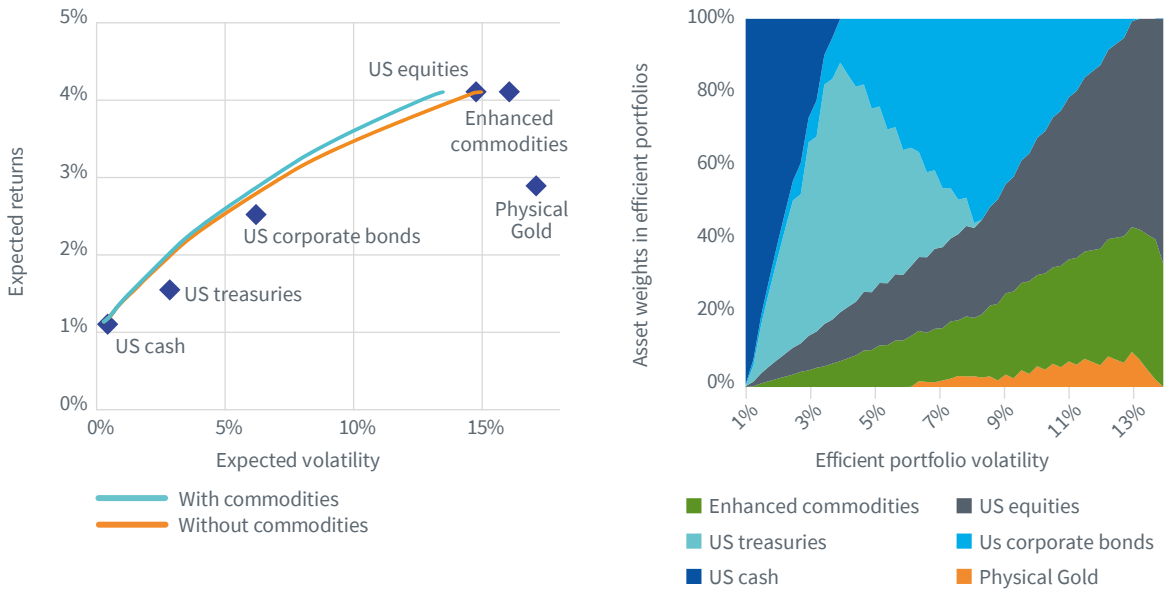
2. Combining gold and broad commodities in portfolios

The above analyses point to the advantages of including gold in a strategic asset allocation and of having broad commodities in a strategic asset allocation. In Figure 49, we aim to look at the combination of both. To do so, we run a forward-looking mean-variance analysis using six assets: US cash, US treasury, US corporate bonds, US equities, enhanced commodities and gold. It is clear that the addition of both assets improves the efficient frontier. For a given level of volatility, the expected returns are improved by 10 bps on average.

Looking at the allocation, the most efficient portfolios are invested in both gold and broad commodities. Both assets clearly add to the portfolio in different ways. Broad commodity allocation ranges from 0% to 35%, depending on the level of volatility targeted. Gold gets between 0% and 8% also depending on volatility. In a typical 8% volatility portfolio, the allocation to gold is 3%, and the allocation to enhanced commodities is 19%. Compared to Figure 42, this means that the allocation to broad commodities has reduced by only 1% and that 3% have been added to Gold. So the overall allocation to commodities is higher.

While Figure 48 and Figure 49 have been run from the point of view of a USD-based investor. It is expected that the results would be very similar for other home currencies.

Figure 49: Looking-forward efficient frontier with gold and broad commodities



Source: WisdomTree, Bloomberg. 31st August 2021. In US dollars. You cannot invest in an Index. **Historical performance is not an indication of future performance and any investments may go down in value.**

FINDING #21: Most efficient portfolios typically allocate to gold and broad commodities to improve their overall risk-return profile.

Conclusion

Asset allocation is the most important decision that long-term investors can make, which is 100% in their control. This allocation will drive the returns investors can earn and the volatility and risk they may encounter. Adding the right assets in this strategic allocation can improve both returns and risk over the long term. We hope that this paper will have inspired you to look at commodities with a new eye.

In those last lines, we wanted to leave you a few parting thoughts:

- Harvesting, drilling or mining commodities is a capital intensive, multi-year endeavour. Being able to hedge revenues and protect return on investments is key to make many of those operations viable. This is why the commodity producers are willing to pay a "premium" to commodities futures buyers delivering an above-inflation payout.

- Broad commodities are, in many cases, the fuel of economic growth. The economic expansion goes hand in hand with an increased demand for basic commodities, leading to an increase in price in such commodities. Their relationship with inflation is not indirect, coming from investors' expectations of the future like for equities or bonds, but direct. This is why broad commodities indices are such a strong hedge against expected but also unexpected inflation.

- Thanks to their unique risk profile, broad commodities would have historically improved the returns and risk for investors. Looking forward, quantitative analysis indicates that they could still prove very valuable for strategic investments.

- To leverage a commodity investment to its maximum potential, implementation is key. Broad commodity indices based on futures contracts are demonstrably the most efficient way to harness key commodity characteristics. In contrast, other investments like commodity-linked equities, for example, have proven sub-optimal at best, failing to deliver on most of those key characteristics. For investors with tracking error budgets in their commodity sleeve, second-generation or enhanced commodities strategies have proven over the last 20 years that they can improve returns and remain true to typical commodity behaviour at the same time.

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