Michael Stafford
Econ 450
Dr. Condie
4/15/2024

Commodities

Commodities are the asset class associated with raw materials. Some examples include food, livestock, oil, gasoline, gold, and silver. Commodities have been traded since the 1800s [1] and can be a useful component of an investor's portfolio.

Commodities are considered a "real asset", meaning that the underlying value of a commodity is tangible; in this case, the underlying asset is the raw material that the commodity represents. For example, the underlying value of a corn future is the price of corn. As such, commodities are closely associated with tangible products; purchasing a corn future means agreeing to purchase corn at a later time.

Trading Commodities: Spot and Futures Markets

Commodities are traded in two main ways: in the spot market and in futures exchanges. The spot market refers to buying and selling the good for its current price, called the "spot price". This can be done through actually receiving and delivering the commodity, or through ETFs or commodity stocks [2].

More commonly, commodities are traded on futures exchanges; the Chicago Board of Trade being the foremost example [3]. Investors who trade with commodities usually do so by buying and selling futures. A future is an agreement to buy or sell a product on a future date at a pre-determined price. For example, if you purchase a corn future (referred to as "going long"), you are agreeing to buy a certain amount of corn at a future date for a price that is set when you enter into the contract. On the other hand, if you are selling a corn future (or "going short"), you are agreeing to deliver corn on that future date for that price. Unlike limit order markets, in a

futures exchange, every participant trades with the exchange and not directly with other participants.

Those who participate in futures exchanges can be separated into two categories: hedgers and speculators. Hedgers are those who have a natural position in the underlying asset. For example, a corn farmer (who will be selling corn once harvest season begins) and a cereal company (who will soon be purchasing corn) are two examples of hedgers on opposite sides of the market. These parties are called hedgers because they are seeking to hedge their risk. For example, if a corn farmer is growing crops that will be sold in a few months, the farmer does not know the price of corn when it will be sold. Since the farmer is risk-averse, he would like to lock in the price now. He can do so by shorting a futures contract for the same amount of corn as he will sell later. By the time the sale date arrives, if the price has gone up, the farmer will benefit from selling the corn at the higher price, but lose some money from his shorted futures contract. If the price has gone down, the farmer will lose some money from selling corn at the lower sale price, but gain from his shorted future contract.

This mitigates his risk; regardless of what happens to the price of corn, the farmer has a good idea of what his returns will be. Similarly, on the demand side, a cereal company may want to go long on a corn futures contract, agreeing to buy corn at a later date at a known price now, hedging against the possibility that the corn price will go up in the future.

The other type of trader in a futures exchange is a speculator. Speculators are those who do not intend to actually use the underlying value of the asset. In our example, they have no interest in receiving or delivering corn. They are simply looking to make a profit by predicting the price changes of the underlying asset. For example, if a speculator believes that the price of corn will increase, she would go long in a corn future, agreeing to purchase corn at a prespecified

price on a later date. If time passes and the price of corn does increase, she can offset her futures contract by going short in another futures contract. This means she agrees to sell corn in the future, but now since the price of corn has increased, the futures contract she sells is worth more than the one she bought previously. These two futures contracts offset (so she is no longer in the market) and she makes a profit on the difference between the two contracts. The majority of participants in a commodity exchange are speculators, so delivery of the underlying asset rarely occurs [3].

Why Trade with Commodities?

There are a few reasons why investors may be inclined to trade with commodities, both in the spot and futures markets. One important reason is the way that commodities react to inflation. Since commodities are based on raw materials, inflation increases the price of raw materials which in turn increases the price of the commodity. Financial assets, such as stocks and bonds, do not see a price increase with inflation, thereby becoming less valuable when inflation occurs. Therefore, if an investor is worried about inflation, commodities may be a way to hedge against it [1].

Additionally, commodities are often uncorrelated with the stock market. For investors that are looking to diversify their portfolio, commodities may be a good option to hedge risk. Commodities have low correlation with the stock market because their fluctuations in price are driven by different factors than those that drive the stock market. The price of commodities are often influenced by weather and geopolitical events throughout the world, whereas stocks and bonds are less affected by these events and more affected by financial events [1].

To test this claim that commodities have a low correlation with the stock market, I collected some data from Kaggle [4], which contains daily spot price returns data for Brent oil,

gold, natural gas, and US wheat, all of which are examples of commodities. Additionally, I collected data on the S&P 500 from the Yahoo Finance API [5] and calculated the correlation between the S&P 500 and each of the commodities. The S&P 500 is a conglomeration of 500 publicly traded companies, weighted by their market capitalization. For this paper, I will use the S&P 500 as a representation of the stock market as a whole, which is a common practice in the financial world [6]. The result of the correlation calculations are as follows:

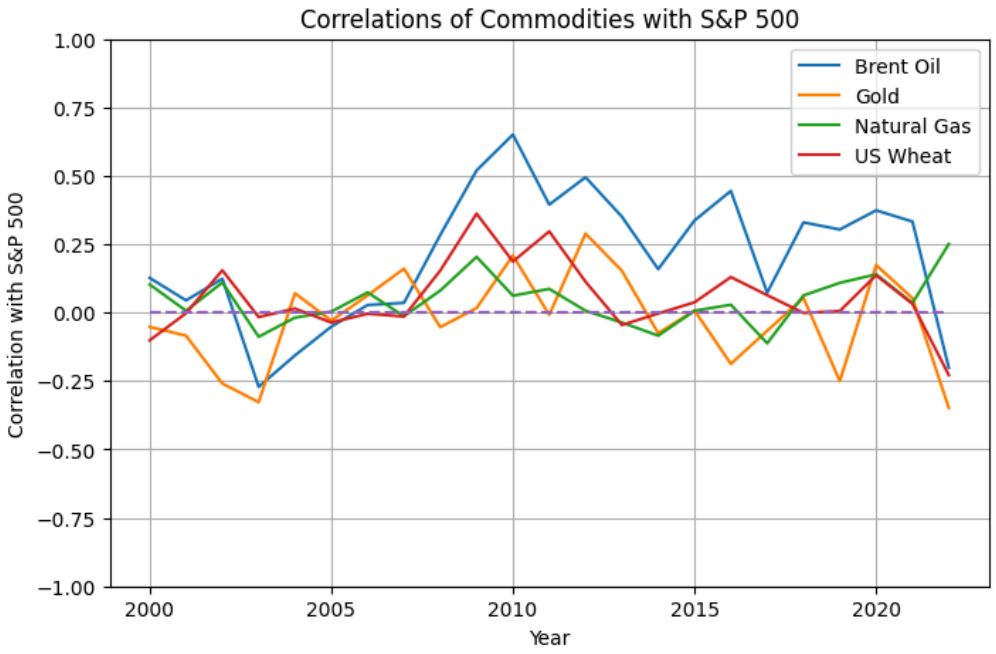

Figure 1 – The correlation of each commodity with the S&P 500. The correlations were calculated separately for each year. Throughout this paper, calculations are done yearly to improve the readability of each graph.

Recall that the correlation between two variables ranges between -1 (negatively correlated) and 1 (positively correlated). Brent oil seems to have a positive correlation with the S&P 500 over the years, but the other commodities' correlations hover around 0.

In summary, commodity exchanges (and futures exchanges in particular) are useful because they give hedgers an opportunity to reduce risk and speculators a chance to earn positive returns. In this environment, the hedgers are generally more risk-averse than the speculators

because the hedgers have less diversification. For example, a corn farmer's total wealth is very closely tied to corn futures (their livelihood depends on the price of corn), while a speculator may have only a portion of their portfolio in commodities. Therefore, speculators are typically willing to tolerate more risk than hedgers, although preferences can vary. Futures exchanges give hedgers an opportunity to offload risk to speculators [3].

Risk and Returns Analysis for Commodities

Using the same dataset from earlier, I proceed by examining the returns of four commodities compared with the returns of the S&P 500. The data was in terms of commodity price, so I calculated the average daily return by taking the daily closing price, dividing it by the previous day's closing price, and subtracting 1. Below is a graph that shows average daily returns by year. The results were binned by year to improve the graph's readability and observe more general trends for each commodity, as opposed to daily fluctuations.

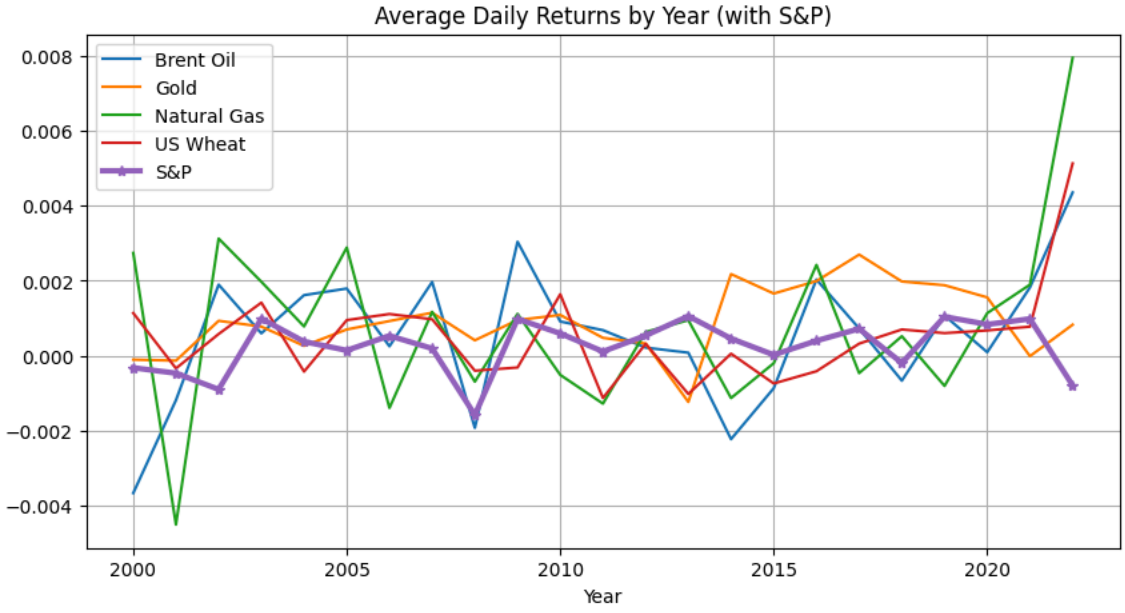

Figure 2 – Average daily returns for each asset, given yearly from 2000-2022. The S&P line was bolded for emphasis.

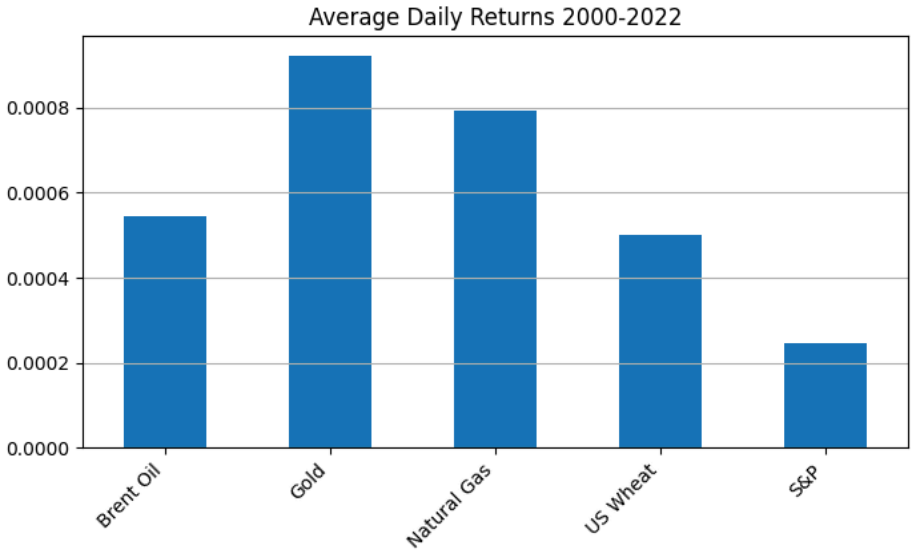

Figure 3 – Average daily returns for each asset aggregated over 2000-2022.

Each of these commodities outperformed the S&P 500 in terms of average daily returns in the 21st century. Gold had the strongest performance, especially in the years 2014-2020. Each commodity performed well in 2022 (the most recent data in this dataset), while the S&P 500 was down. This partially explains the gap in performance between the S&P 500 and the market.

However, investors are also concerned with the variance in asset returns. The graph below shows the variance of each commodity since 2000, along with the S&P 500.

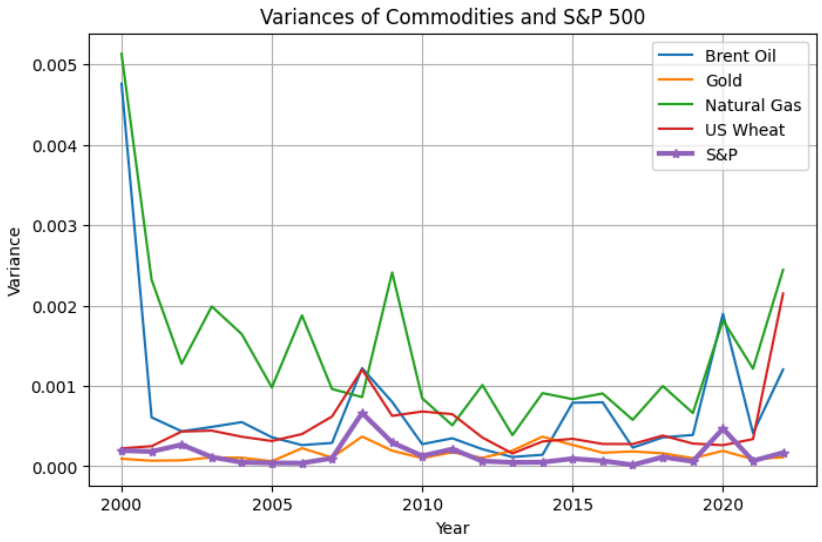

Figure 4 – The variance of each commodity, calculated yearly from 2000-2022.

As you can see, the variance of most of the commodities is higher than the S&P 500. The only comparable commodity to the S&P 500 in terms of variance is gold. This data makes sense; the S&P 500 is a conglomeration of various stocks and is likely better-diversified than a single commodity.

Earlier, we explored the correlation between commodities and the S&P 500, but even more useful is calculating the beta between the two. Recall that beta refers to the ratio between the covariance of a commodity and the S&P and the variance of the S&P. Beta is useful in understanding the CAPM framework for pricing assets; a higher beta means that the asset is risky compared to the market (and therefore a higher risk premium is expected), while a low beta means that the asset has a lower risk in relation to the market. Beta = 1 corresponds with a risk level exactly equal to the market's risk. The beta calculation for each commodity by year is as follows:

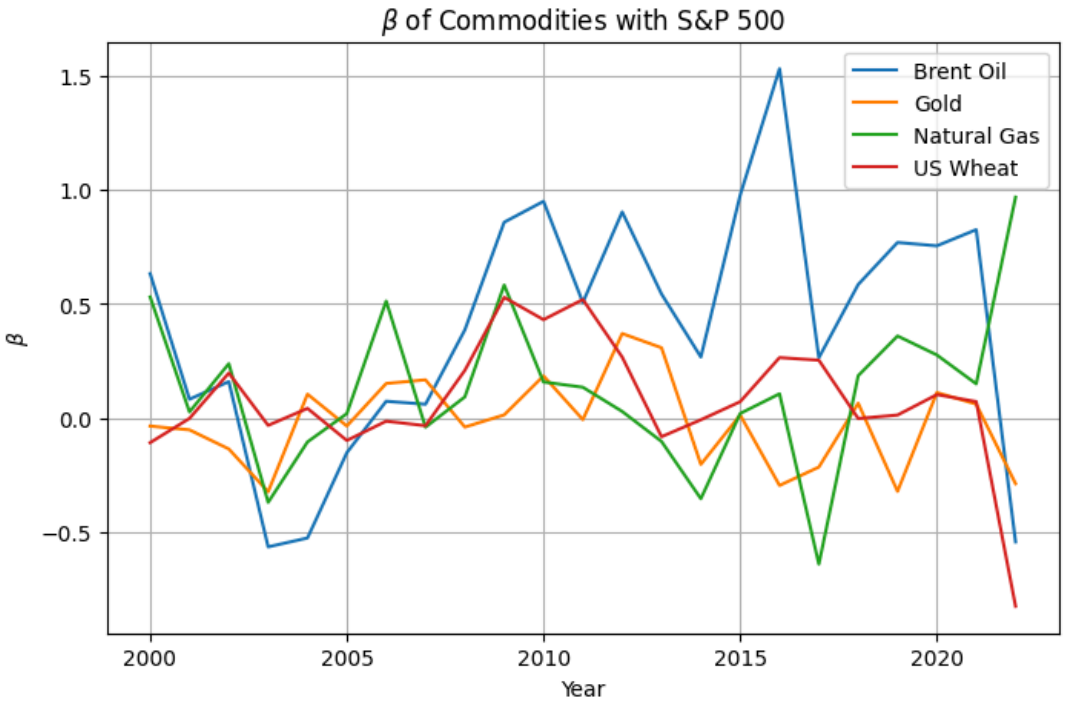

Figure 5 – The beta of each commodity, calculated yearly from 2000-2022.

As you can see, the beta level for most commodities is less than 1, further showing that these commodities are less correlated with the market.

Based on this data, commodities have provided higher daily returns than the market index, but also had a higher volatility. Therefore, investors may be enticed by high historical returns, but cautious of the high variance of commodities. Nevertheless, commodities can still be valuable for an investor with assets in the stock market because of their low correlation and beta values. Of course, much of the decision-making regarding where to invest depends on one's perception of market efficiency; namely, whether one believes that past returns/variance data has any bearing on future returns and variances.

Mispricing in Commodities

To examine potential mispricing opportunities for commodities, I calculated Jensen's alpha for each of the commodities in the previous dataset. Recall that Jensen's alpha measures the difference between the actual return of an asset and the return of investing in the market index at the same level of risk. A positive alpha value would imply that the asset has higher returns than the market relative to its risk level. A non-zero value of alpha implies mispricing; if you go long in this asset (or short if the alpha value is negative), you can get higher returns than what is expected based on your risk level.

To calculate Jensen's alpha for these commodities, I once again used the S&P 500 as the market index. I also used US treasury bills as a proxy for the risk-free rate, again using data from the Yahoo Finance API [5]. The results are summarized in the following graph:

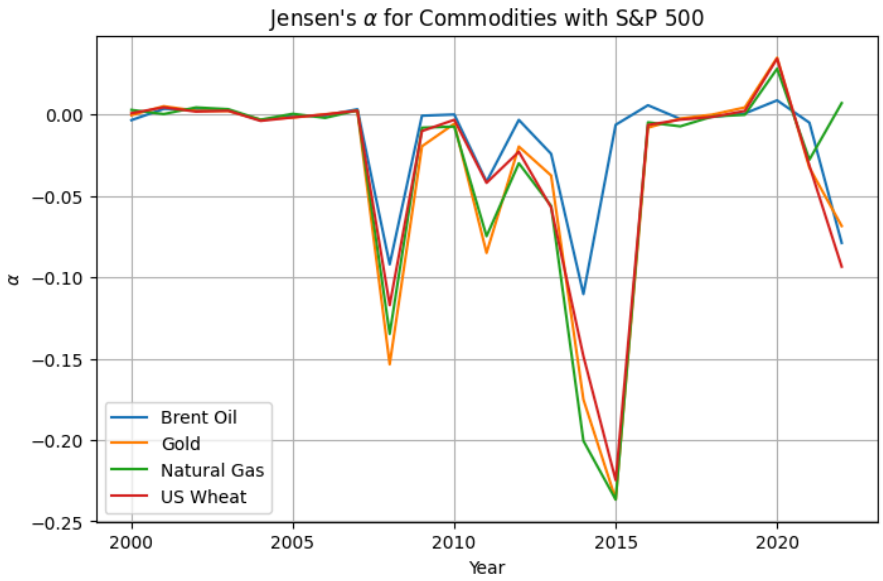

Figure 6 – Jensen's alpha each commodity, calculated yearly from 2000-2022.

As you can see, each of the commodities have a similar trend year-to-year. The values of alpha tend to hover around 0, with periodic dips in 2008, 2011, 2015, and 2022. This implies that most of the time, commodities perform as expected or underperform based their level of risk, compared to the market.

Finding mispricing in commodities can be difficult. Commodities are unique in that there is no real differentiation between producers of the product [7], meaning that the raw material is the same regardless of who it is purchased from. When someone purchases a commodity, they typically don't know (or care) who the seller is, because the product will be the same. Additionally, in futures markets, buyers are interacting with the futures exchange and not with the sellers, so differentiating between the sellers is practically impossible. This is a stark contrast between financial assets such as stocks and bonds, where the performance of the asset is closely dependent on the performance of the company that issues the asset. This opens the door for investors to research companies and take advantage of mispricing opportunities. That being said, finding mispricing in commodities is theoretically possible. Those who keep close tabs on the

causes of commodity price shifts, such as geopolitical events and weather patterns, could find mispricing opportunities by properly estimating the future of commodity prices.

Conclusion

Commodities can be a valuable contribution to an investor's portfolio. Their low correlation with the stock market and positive correlation with inflation make them useful in reducing portfolio risk. However, one tradeoff is that commodities are often more volatile than the market index. Commodities can be traded in the spot market, but are usually traded in the form of a futures contract on futures exchanges, giving hedgers an opportunity to alleviate risk by transferring it to speculators.

Sources Cited

[1] “Understanding Investing: Commodities,” PIMCO, URL: https://europe.pimco.com/en-eu/resources/education/understanding-commodities#:~:text=Commodities%20are%20a%20distinct%20asset,overall%20portfolio%20and%20boosting%20returns

[2] Rodeck, David & Curry, Benjamin. “A Basic Guide to Commodities” Forbes Advisor, URL: https://www.forbes.com/advisor/investing/commodities-trading/

[3] Editors of Encyclopaedia Britannica. “Commodity Exchange,” Brittanica Money, URL: https://www.britannica.com/money/commodity-exchange

[4] Kanawattanachai, Prasert. “Major commodity prices from 2000-2022”, Kaggle. URL: https://www.kaggle.com/datasets/prasertk/historical-commodity-prices-from-20002022

[5] Ranaroussi. “yfinance: Yahoo Finance market data downloader.” Version 0.2.37, GitHub, URL: https://github.com/ranaroussi/yfinance

[6] Kenton, Will. "S&P 500 Index: What It’s for and Why It’s Important in Investing." Investopedia, Dotdash Meredith Publishing Family, September 22, 2023, URL: https://www.investopedia.com/terms/s/sp500.asp

[7] Fernando, Jason. “What Are Commodities and Understanding Their Role in the Stock Market”, Investopedia, Dotdash Meredith Publishing Family, January 23, 2024, URL: https://www.investopedia.com/terms/c/commodity.asp