Commodity Portfolio Management

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Investing in the commodities markets has become increasingly popular over the last two decades. Several research articles have concluded that adding commodities to the classical portfolio construction, which usually consists of 60% of equities and 40% of bonds, helps to diversify portfolio risk while protecting investors against inflation-driven asset value erosions. The goal of the present research is to dig deeper into the structure of commodity markets and understand its evolution over time. The present paper will analyze liquid and exchange-traded (ICE and CME) commodity futures prices from three different sectors ranging from January 2010 to August 2019: energy (which can be further sub-divided into crude grades and petroleum products), agricultural, and metals (which can be further sub-divided into precious and base metals.) The aforementioned sectors contain the following sets of futures contracts:

- Energy: Brent Crude, West Texas Intermediate (WTI) Crude, European Low Sulphur Gasoil (diesel), New York Reformulated Blendstock for Oxygenate Blending (RBOB) Gasoline, and Dutch Title Transfer Facility (TTF) Natural Gas;

- Agricultural: U.S. Sugar Number 11 and White Sugar Europe; and

- Metals: Gold, Silver, Copper.

Managing a commodity portfolio is not particularly easy because commodities markets respond to idiosyncratic features, which cannot be found in equities, nor in the fixed income markets. In fact, their response to changes in the macroeconomic, financial and geopolitical landscapes might considerably differ from one commodity to another. In order to better address the aforementioned problems, the present research will examine four important aspects of commodity portfolio management: (1) commodity market returns; (2) commodity volatilities; (3) commodity seasonal volatility; and (4) trend and mean reversion.

Commodity Market Returns

In this section, the collective performance of a hypothetical portfolio will be examined. Specifically, the true object of study here is not to examine the return provided by a specific strategy but rather the cumulative portfolio returns yielded by the market itself over the course of the last 9.5 years. The returns can also be thought of as the portfolio performance of an investor with a passive investing strategy in a commodity basket.

Figure 1
Commodity Portfolio Aggregated Logarithmic Returns

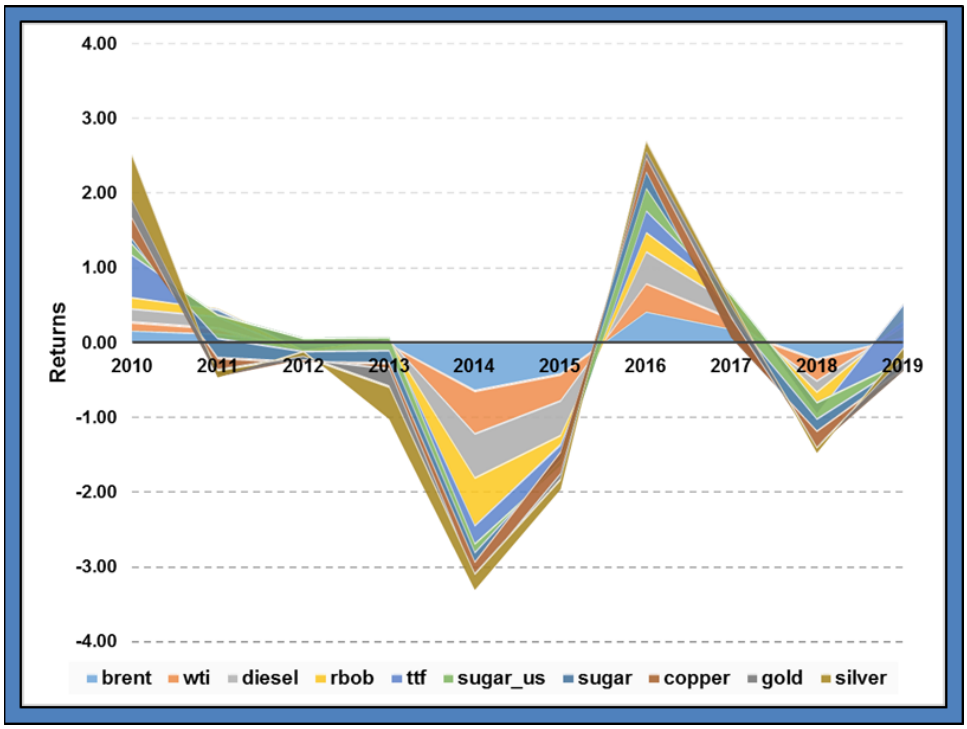
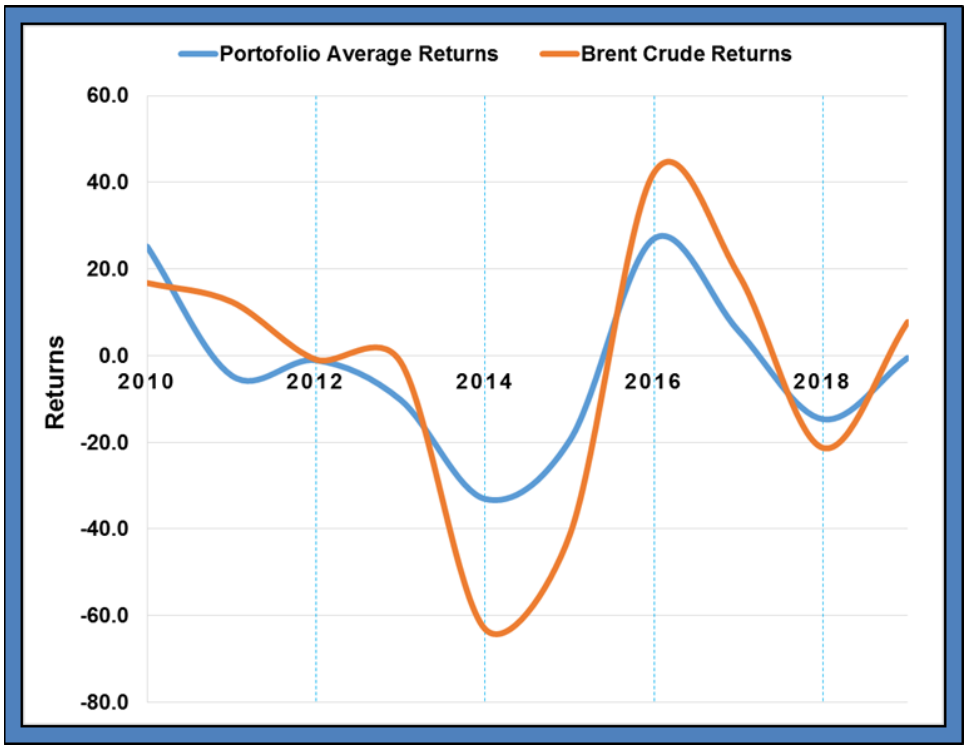


Figure 1 shows that the commodity market performance has been rather volatile over the last decade despite the steady performance of the S&P 500 index. The chart shows quite clearly that commodity market returns have been negatively affected by the Greek crisis of 2011-2012, moved sideways in 2013 but then dropped dramatically in 2014. Nevertheless, the aggressive plunge in commodity returns was arguably not due to global macroeconomic dynamics, but rather to the violent downtrend in crude oil prices caused by OPEC members who drastically increased their oil output to counterbalance the rise of American shale oil production and avoid losing market share. It is clear that the fluctuation of crude oil prices strongly impacts industrial production and the cost of transportation of all other commodities, so it is reasonable to expect that a large change in crude grade prices would trigger a domino effect on other commodities. Portfolio performance quickly improved in 2016 and slowed down in 2017 although it remained largely positive in 2017. Portfolio performance plunged again in 2018 and suffered an increase in volatility in the first half of 2019. Specifically, trade frictions between the U.S. and China and fears of a slowdown in global growth, fueled by the fact the economy is in its late business cycle, have contributed to an increase in selling pressure, which dragged commodity prices, but also equity indices, all the way down in Q4 2018. However, since January 2010, there have been commodity markets that have returned more positive yields than others. For example, the European low sulphur gasoil (diesel) market yielded positive returns for 6.5 years while both the European and American sugar markets returns were positive only for 3 years. Another market where returns remained positive for a long time is gold (more than 7 years) while silver managed to return above-zero yields only for 4.5 years. Overall, since January 2018 until now, we can say that gold futures, along with energy futures (Brent, WTI, Low

Sulphur Gasoil, New York RBOB and Dutch TTF Natural Gas), have largely outperformed all the other commodity markets under examination.

Figure 2
Average Commodity Portfolio Logarithmic Returns

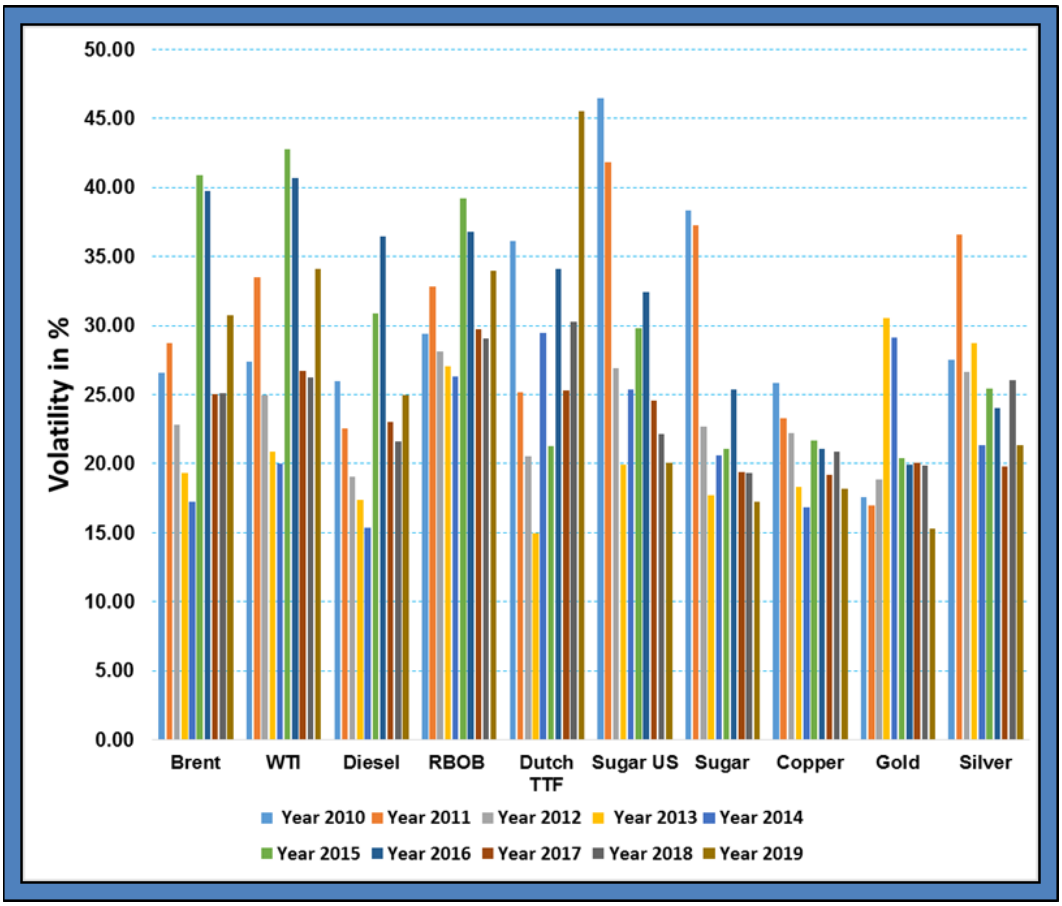


The average performance of the above-mentioned commodity portfolio and the impact that idiosyncratic and global fundamental shifts have had on it can be more visibly observed in Figure 2. Furthermore, in order to better highlight how important it still is to hold positions in crude grades, the returns of the Brent Crude market have been plotted: the Brent market is obviously more volatile, but its fluctuations are the most correlated to the chosen commodity portfolio. On the other hand, though, the sugar markets, and in particular the European one, have shown to be the least correlated to the portfolio under study, which automatically means they might be particularly good asset classes to further diversify commodity risk.

Commodity Volatilities

Commodity markets, in addition to being inflation-hedging "tools," are also known for being some of the most volatile asset classes. Volatility implies higher risk but also more opportunities.

Figure 3
Yearly Median Stochastic Volatility for Commodity



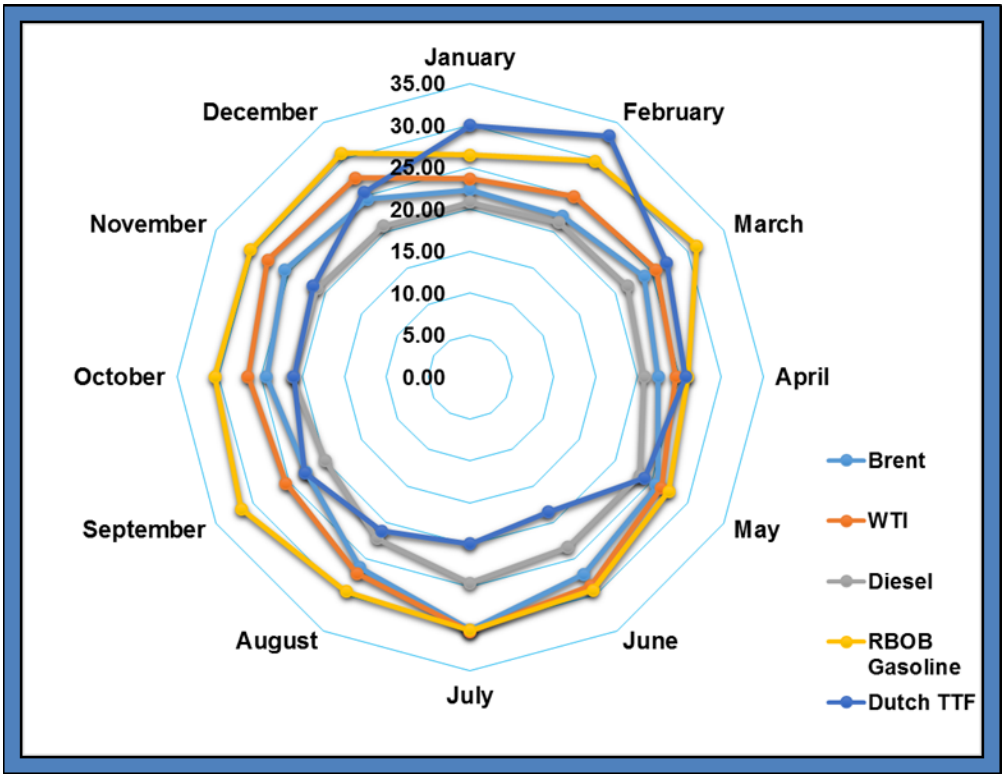
The first thing that it is worth noting is that the portfolio average stochastic volatility went down from 30.12% in 2010 to 21.48% in 2013. However, the trend reversed in 2014 and the rising volatility environment continued also in 2015 and 2016 when it reached its maximum of 31.06%. 2017 experienced a lower degree of market fluctuations (23.28%) while in 2018 and in the first half of 2019, stochastic volatility started to move back up, reaching 26.15%. Stochastic volatility peaked when commodity markets crashed while it softened when prices moved back up. On average, New York RBOB (31.25%) and WTI (29.72%) futures proved to be the most volatile markets while Copper (20.75%) and Gold (20.87%) futures were the least volatile among the selected portfolio components. However, it is U.S. Number 11 Sugar (46.49%) and Dutch TTF Natural Gas (45.54%) futures markets that experienced the highest peaks in volatility. Paradoxically, the Dutch TTF Natural Gas is also the market with the lowest stochastic volatility recorded (14.97%) along with Gold (15.32%) and European Low Sulphur Gasoil (15.35%) futures.

Commodity Seasonal Volatility

Volatility is one of the key indicators as far as portfolio management is concerned because it is one of the main metrics for asset class selection in factor investing. Nevertheless, commodity markets tend to

be particularly sensitive to seasonality given their idiosyncratic demand/supply dynamics and therefore price volatility fluctuations vary greatly from month to month. The commodity volatility seasonal study was conducted using stochastic volatility estimates calculated over 9 years' worth of futures prices ranging from January 2010 to December 2018. The findings will be examined by sector and the first one to be analyzed will be in the energies.

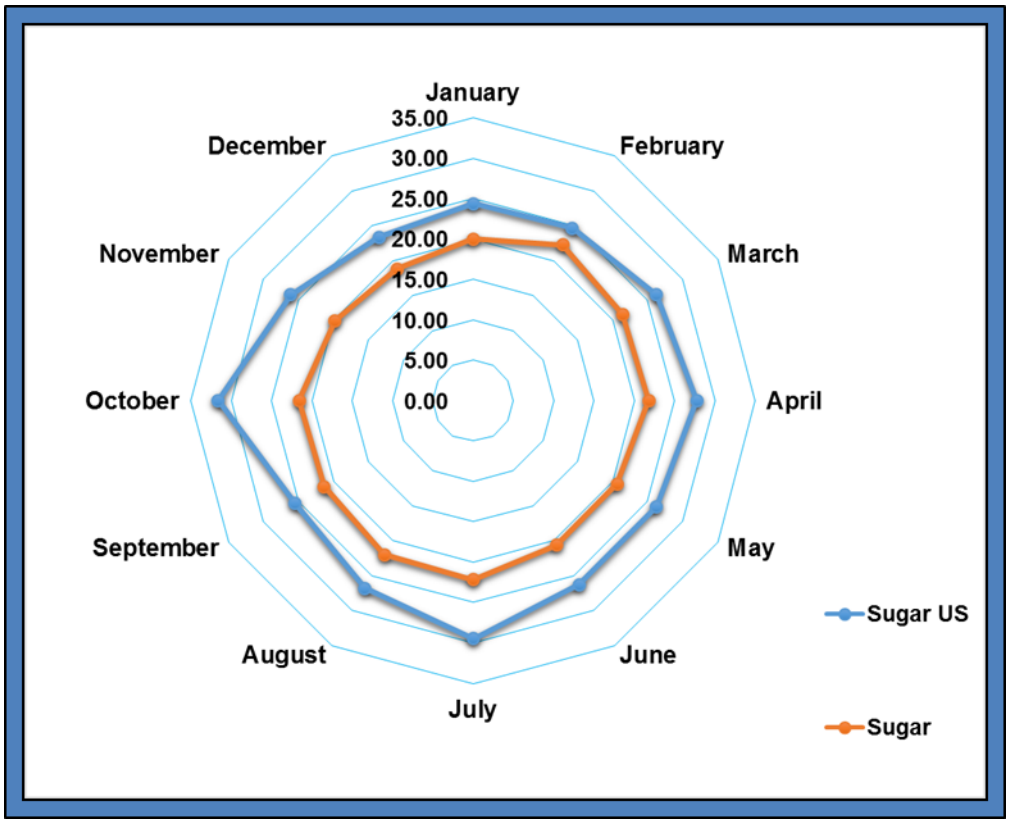
Figure 4
Seasonal Stochastic Volatility by Month - Energy



The seasonal volatility chart in Figure 4 shows that, over the course of the last 9 years, the most volatile month for Brent, WTI and Diesel was July while for RBOB it was September. On the other hand, the most volatile month for Dutch TTF Natural Gas is February due to its usage for heating. Conversely, the months with the lowest volatility for WTI and Brent are January and February respectively while for the Low Sulphur Gasoil market (diesel), the fluctuation rate touches the bottom in September. The month of September is crucial for petroleum products such as gasoline and diesel because it is when the switch between summer and winter grade fuel happens. Nevertheless, the grade switching causes volatility to peak in the RBOB Gasoline market and to bottom in the diesel one. This phenomenon is predominantly due to the fact that U.S. gasoline prices tend to drop as the driving season (summer) draws to a close, pushing up volatility, while European diesel prices tend to become more expensive during the winter time because of the particular additives, which get blended into the fuel to lower as much as possible its freezing point. Dutch TTF Natural Gas volatility, instead, tends to increase with a higher buying pressure, which is precisely why it peaks in February, while in June it tends to drop, as prices soften, and this explains the low volatility.

Let us now focus on the agricultural segment of the portfolio and in particular on the European and American sugar markets.

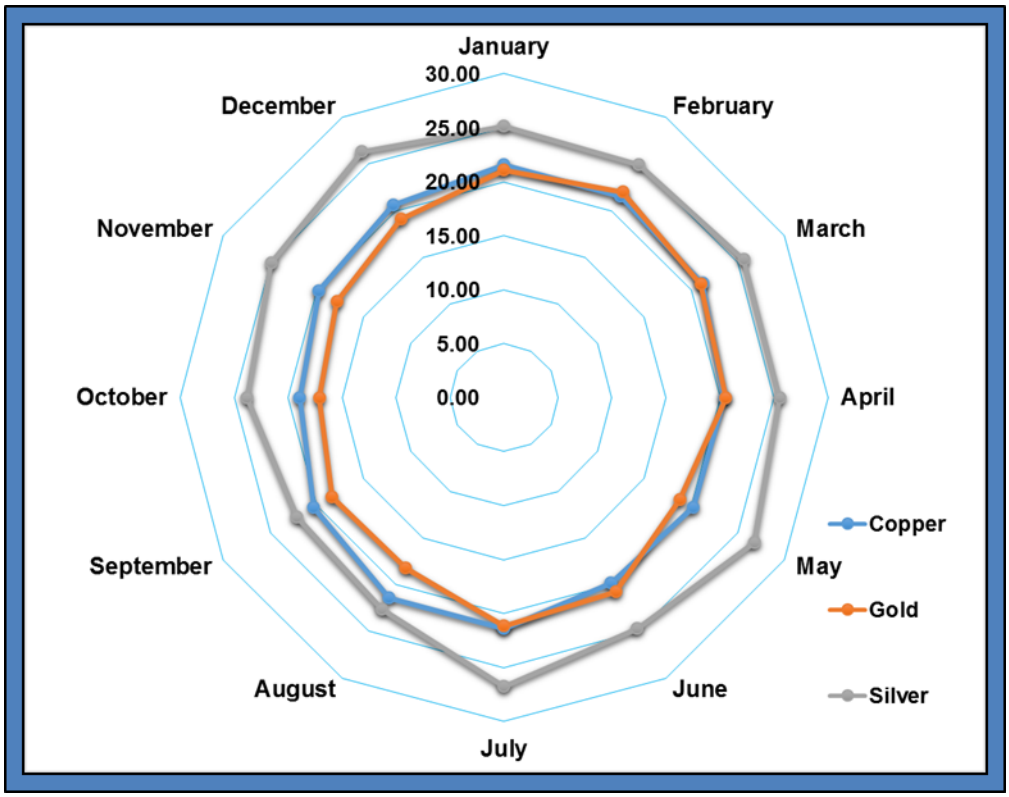
Figure 5
Seasonal Stochastic Volatility by Month – Agricultural



European and American sugar markets differ quite significantly as far as volatility is concerned. In fact, while volatility in the European White Sugar market peaks in the month of February, the fluctuation rate for American Sugar achieves its highest level in the month of October. Nevertheless, the lowest volatility point is reached in the month of December, as plants' sugar content tends to be at its highest within the last months of the year when it is harvested.

The last portfolio segment to analyze is the metals sector, which contains both precious metals like gold and silver, as well as copper, a base metal.

Figure 6
Seasonal Stochastic Volatility by Month – Metals (Precious and Base)



Stochastic volatility in the precious metal markets tends to reach its highest point in the month of February (Gold) and May (Silver) while the fluctuation rate in the copper market achieves its yearly high in the month of January. Nevertheless, volatility in all metal markets in the commodity portfolio tends to bottom in the second half of the year; in fact, September (Silver) and October (Gold and Copper) are their least volatile months.

Trend and Mean Reversion

The present research has so far examined commodity returns, commodity volatilities as well as their seasonality and these are all important variables that need to be taken into account when managing a commodity portfolio.

However, given the cyclical nature of the fundamentals which govern commodity markets, it is worthwhile to analyze the tendency of mean reversion which each commodity has experienced over the course of the last 9.5 years. In order to test this phenomenon, the present research uses the Hurst Exponent. The interpretation of the exponent is fairly straightforward:

- If the Hurst Exponent is lower than 0.5, the commodity is considered to be mean reverting;

- If the Hurst Exponent is equal to 0.5, the commodity is considered to be following a Geometric Brownian Motion, which means it follows a random walk; or

- If the Hurst Exponent is higher than 0.5, the commodity is considered to be trending.

The following table displays the aforementioned Hurst Exponents calculated for each commodity and for each year; the Hurst Exponents for 2019 have been calculated using a time series ranging from January to August 2019.

Table 1
Yearly Hurst Coefficient by Commodity

	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019
Brent	0.34	0.31	0.49	0.39	0.65	0.46	0.34	0.53	0.42	0.41
WTI	0.29	0.37	0.39	0.46	0.61	0.46	0.37	0.46	0.44	0.35
Diesel	0.29	0.28	0.49	0.43	0.58	0.42	0.32	0.50	0.38	0.33
RBOB	0.33	0.41	0.30	0.20	0.61	0.62	0.38	0.16	0.54	0.46
Dutch TTF	0.39	0.29	0.34	0.28	0.62	0.22	0.33	0.55	0.27	0.25
Sugar US	0.63	0.46	0.22	0.42	0.28	0.41	0.35	0.57	0.40	0.03
Sugar	0.55	0.38	0.23	0.18	0.34	0.31	0.36	0.49	0.26	0.02
Copper	0.47	0.26	0.38	0.38	0.31	0.39	0.29	0.41	0.27	0.39
Gold	0.24	0.30	0.44	0.42	0.20	0.07	0.47	0.14	0.40	0.48
Silver	0.53	0.39	0.52	0.51	0.42	0.18	0.49	0.28	0.29	0.49

The first thing worth noting is that all analyzed markets tend to have low Hurst Exponents, implying that a certain degree of mean reversion has been idiosyncratic to all commodities across the last 9 and a half years. The most mean-reverting commodity markets in our portfolio are Copper, Gold, European Sugar and Dutch TTF Natural Gas futures. On the other hand, the commodity markets with the highest propensity to trend for a long time are Silver, Brent and WTI futures.

Conclusion

The present research is far from exhaustive; however, it aims to provide a good understanding of some of the things that should be taken into account when managing a commodity portfolio. Furthermore, it

is crucial to point out that for commodities, metrics such as volatility and seasonality deserve to be addressed specifically and separately: an equity-style approach would ignore the strong idiosyncratic features characterizing each commodity, inevitably leading to inefficient portfolio construction and to a suboptimal allocation of resources.

Author Biography

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Mr. Vito Turitto joined the S&P Global Platts Commodity Risk Solutions team in 2015. Prior to joining Platts, he started his career in the City of London trading options on crude oil and other energy markets and went on to build HyperVolatility Ltd., a boutique quantitative investment consultancy. Mr. Turitto's field of expertise is in volatility trading, analysis and modeling. Mr. Turitto holds a B.A. in International Economics Relations from the University of Rome "La Sapienza" and received his Master of Science in International Finance and Investment from London South Bank University after completing a dissertation on forecasting volatility in the American crude oil market via stochastic volatility models.