

Cracking the Climate-Conscious Hard Commodities Code: Discovering Their True Value

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Catalogue

**Chapter I — When Traditional Key Inputs Meets Climate Transition:
The Sustainable Growth Rate Speaks Up**

**Chapter II — Climate-Driven Earnings Forecasts
The Interconnectedness**

Chapter III — Valuing Hard Commodities in Dynamic Climate

The Interconnectedness

What role does climate change play in reshaping the relationship between major hard commodities?

Methodology

❖ Data Selection

- Major Hard Commodities
 - **Pair 1:** Copper vs. Aluminum (Covered in both slides and quantitative analysis)
 - **Pair 2:** Crude Oil vs. Natural Gas (Quantitative analysis only, shown in Jupyter Notebook → [GitHub Link](#))
- Climate Change
 - Examined indirectly through two dimensions:
 - **People:** Economic indicators like CPI reflect consumer behavior and sentiment shaped by climate policies, such as changes in energy costs
 - **Technology:** Cryptocurrency and renewable energy both represent technological shifts, with Bitcoin emerging as a digital alternative to gold.
- Market Relevant Factors
 - Economic Indicators (Monthly Data)
 - Headline Consumer Price Index(CPI), Core CPI, Energy CPI, Energy Service CPI, Energy Commodities CPI, Personal Consumption Expenditure (PCE), Consumer Sentiment Index (CSI)
 - Digital Assets - Cryptocurrency (Daily Data)
 - Bitcoin & Ether
 - Defined Timeframes
 - Past Decade: December 2014 – November 2024
 - Five year: December 2019 – November 2024
 - COVID-19 Period: March 2020 – May 2023
 - Post-COVID Period: June 2023 – November 2024

❖ Data Source

- Yahoo Finance
- Federal Reserve Bank of St.Louis
- University of Michigan
- Apartment List

❖ Data Frequency Considerations

- Economic indicators (CPI, CSI, etc.) are reported on a *monthly* basis.
- Cryptocurrency data for Bitcoin and Ether is available on a *daily* basis
- The difference in data frequency will be accounted for in the analysis methodology.

❖ Analysis Methods

- Time Series Analysis
- Hypothesis Testing: Correlation (Pearson & Spearman rank)
- Correlation Analysis

❖ Limitation

- *Data Alignment:* Used global copper and aluminum prices instead of daily futures for consistency.
- *Sample Size:* Post-COVID analysis (<30 samples) may impact significance.
- *Market Differences:* Excluded some crypto spot data due to trading hour mismatches.
- *Data Integration:* Aligning cryptocurrency data with hard commodity trading calendars resulted in partial cryptocurrency data exclusion.

Key Findings

- Climate change policies significantly reshape the demand for hard commodities like copper and aluminum, vital to renewable energy and EV infrastructure. Copper's correlation with Energy Services CPI rose 64% post-COVID to 0.882, reflecting its growing role in power grids, while Energy Commodities CPI correlations weakened, highlighting sector-specific shifts.
- Rising commodity prices driven by climate-related demand show complex dynamics with CPI. While headline CPI correlated positively with copper (0.735) and aluminum (0.830) in the past decade, post-COVID shifts to weaker or negative correlations (copper: -0.391; aluminum: -0.562, significant) suggest inconsistencies influenced by factors like AI-driven stock performance.
- Historical correlations among hard commodities should be used cautiously in climate-driven forecasts. Recent policy shifts, such as major U.S. banks exiting climate finance groups, and changing dynamics where complementary relationships may evolve into substitution trends (e.g., copper and aluminum), require careful consideration.
- Cryptocurrencies like Bitcoin and Ether, traditionally seen as alternative investments, offer portfolio diversification benefits. However, the pursuit of negative correlations should be evaluated critically to assess the robustness and true value of such correlations.
- Bitcoin, unlike traditional gold, exhibits flat Month-over-Month trading volumes, highlighting a focus on short-term gains through derivatives, whereas gold experiences volume spikes during key rollover months due to futures trading cycles. Bitcoin's role as "digital gold" depends on portfolio composition and stable policy support, with evolving fiscal and climate policies set to shape its future trends.
- To achieve climate objectives, it's crucial to establish clear short-, medium-, and long-term targets, as each timeframe presents distinct correlations that can be leveraged to better align with investors' preferences and enhance diversification.

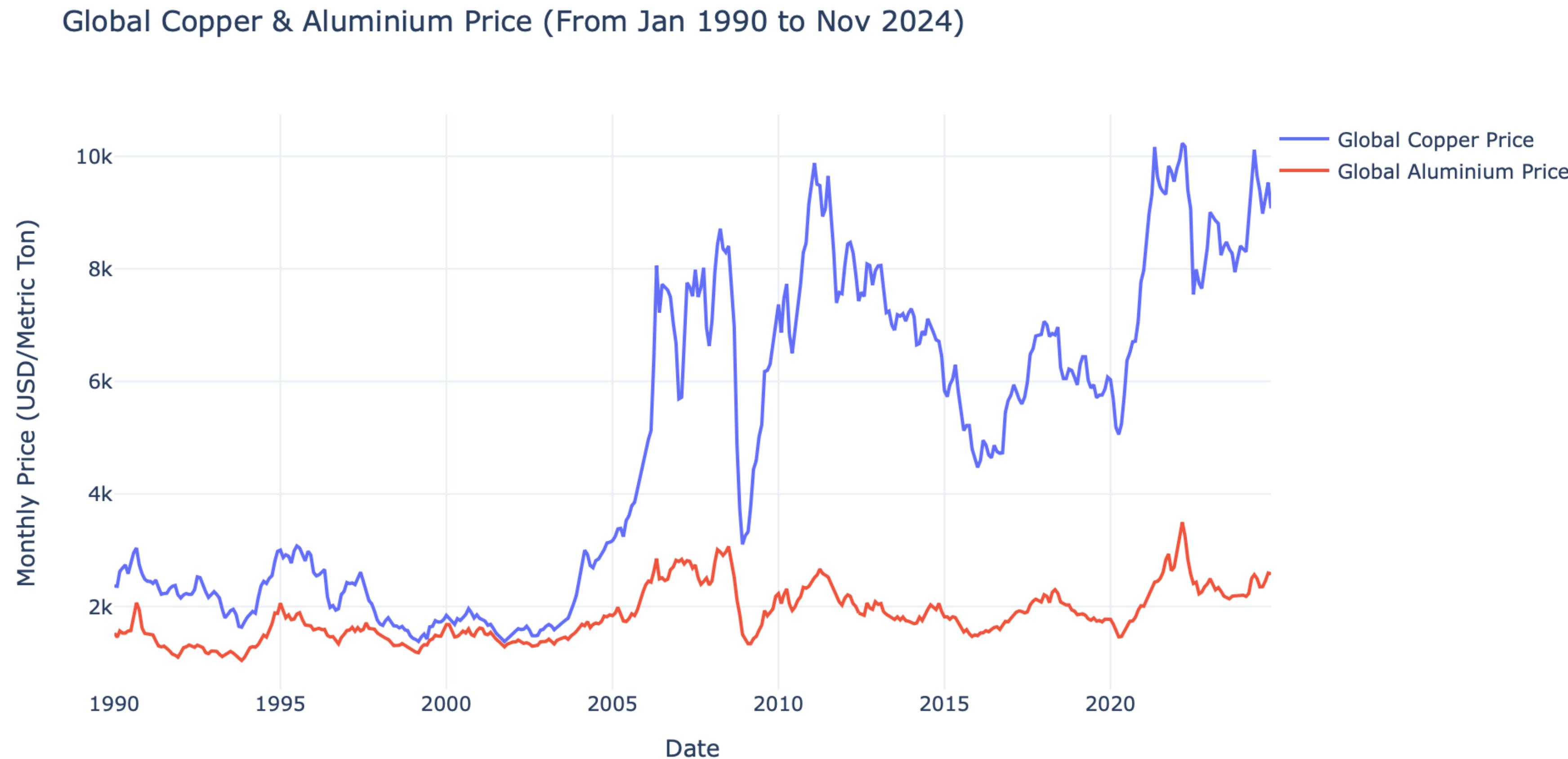
PART 1

Historical Correlation Trends

(Copper & Aluminum)

Historical Correlation: Copper & Aluminum

From January 1990 to November 2024, copper and aluminum showed a strong positive correlation (0.846), reflecting a complementary price relationship.



PART 2

Market Relevant Indicators
and
Hard Commodity Interconnections

Headline CPI

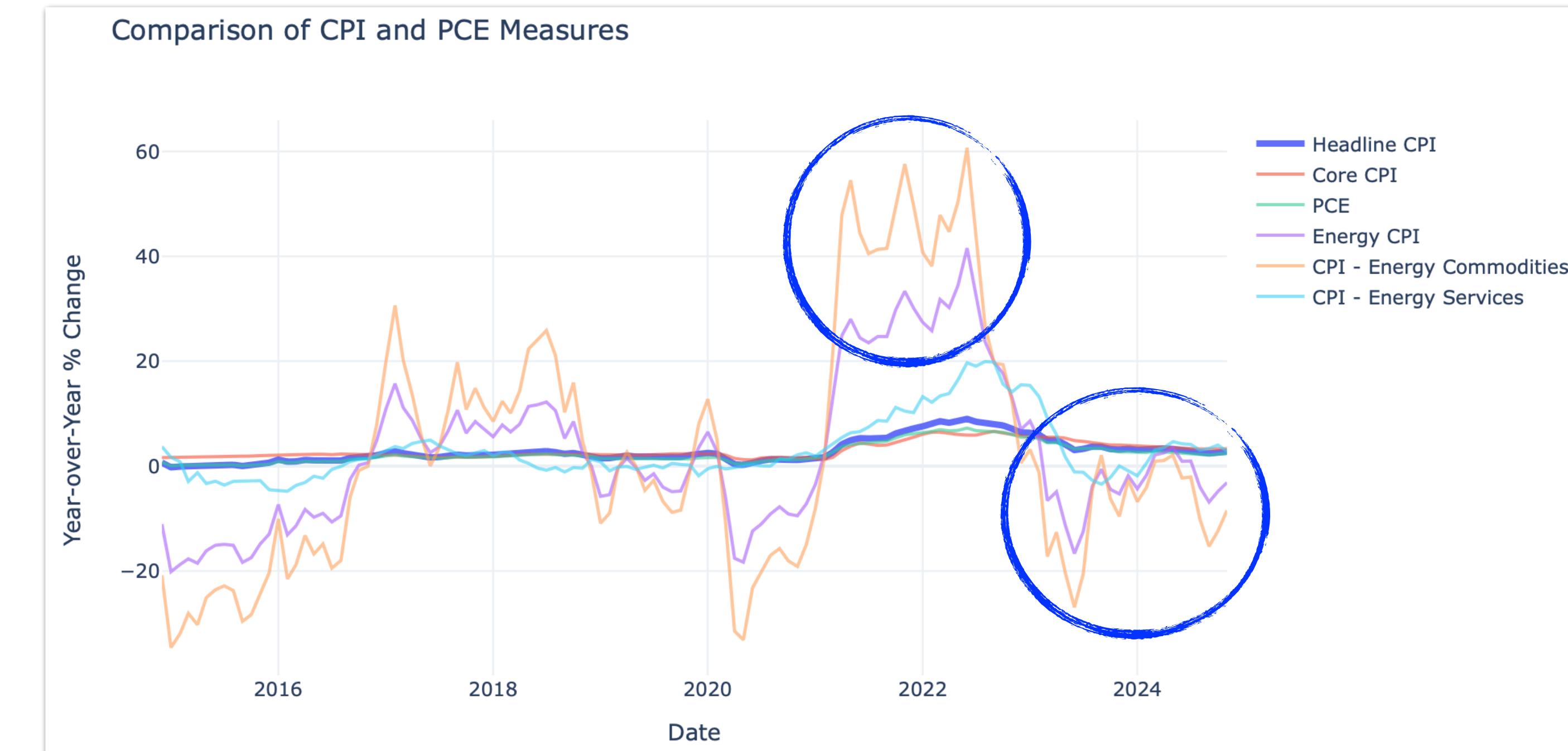
The relationship between hard commodities and CPI has significantly shifted in today's climate-driven world, marked by the rapid growth of renewable energy technologies and electric vehicles (EVs). These commodities, essential for green energy infrastructure and EV production, contribute to dynamic trends in the CPI while also being influenced by them.

Inflation, as reflected by the CPI, drives commodity prices in futures markets, influencing costs and market sentiment. In turn, the essential role of hard commodities in infrastructure and renewable technologies feeds back into consumer prices. Climate-related policies further complicate this dynamic, introducing additional factors—such as various market indicators—that influence the interconnectedness between hard commodities and economic conditions.

Factor 1: Headline CPI

Variability in CPI and PCE

- Over the past decade, headline CPI, core CPI, and PCE have followed similar trends, especially during the COVID-19 pandemic.
- Energy CPI is more volatile, with a variance of 198.655 compared to 5.252 for headline CPI.
- Energy Commodities CPI, accounting for 268.13% of the total Energy CPI variance, dropped by -1.279% in February 2023, fell to -26.925% in June 2023, and stayed negative through 2024 due to oversupply or weak demand.

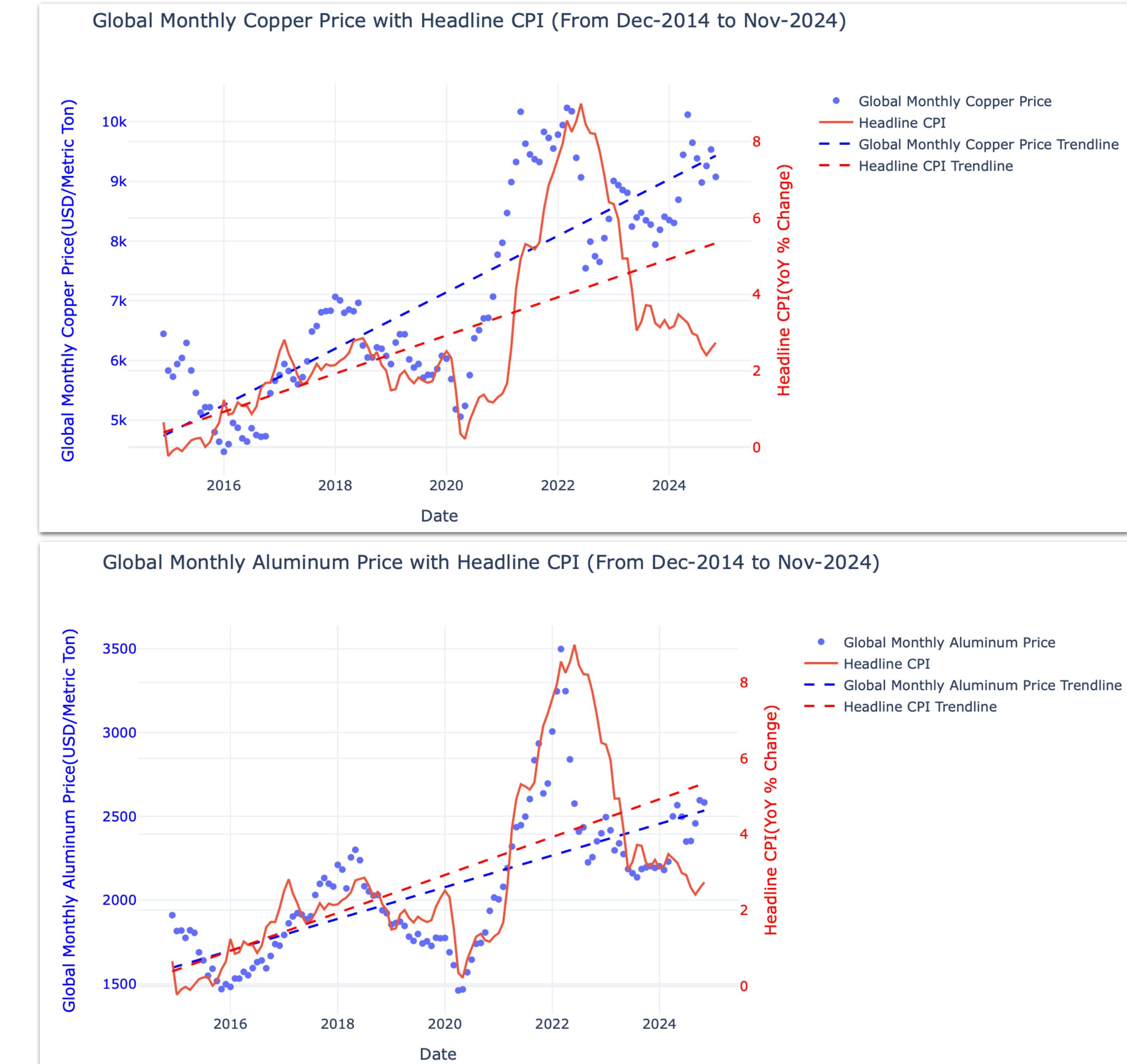


Variance and Standard Deviation of CPI Components						
	Headline CPI	Core CPI	Energy CPI	CPI - Energy Commodities	CPI - Energy Services	PCE
std	2.291812	1.517658	14.094853	23.079970	5.731737	1.900428
variance	5.252404	2.303286	198.664878	532.684993	32.852810	3.611627

Factor 1: Headline CPI

vs. Copper and Aluminum Prices

- Headline CPI shows strong positive correlations with copper (0.735) and aluminum (0.830), indicating that as commodity prices rise, CPI tends to follow. However, this relationship is complicated, as rising CPI usually reduces purchasing power, while higher commodity prices suggest increased demand. These contradictions highlight the complex dynamics between CPI and commodity prices, with factors like stock market performance and technological advancements also influencing the interconnections

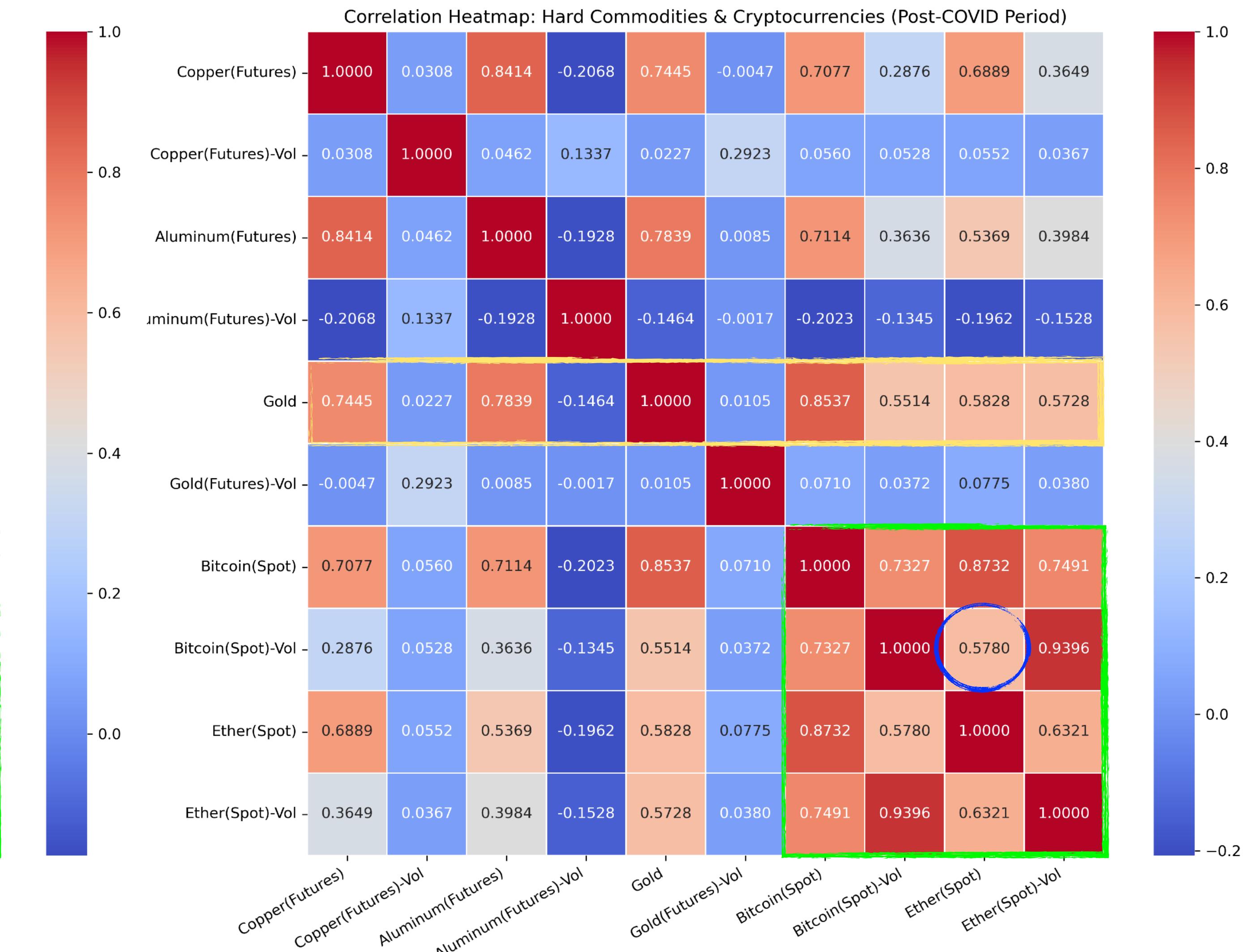
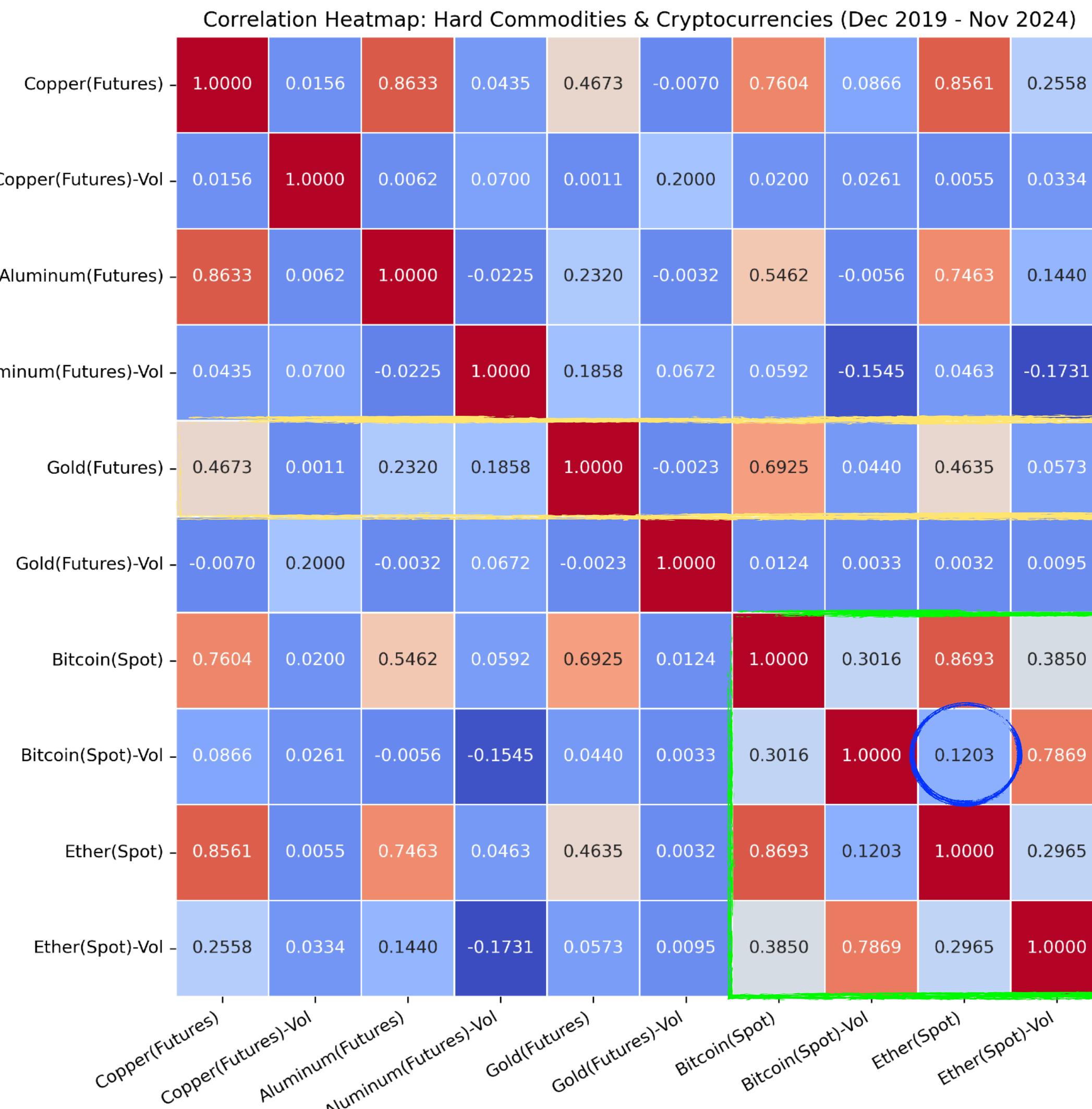


Cryptocurrency

Cryptocurrencies used to have frequent short-term fluctuations, occupy a unique position in contrast to traditional commodities. Bitcoin, often referred to as “digital gold,” differs from traditional gold in that its supply is driven by technological processes. Unlike copper mining in Chile, which relies on physical extraction, cryptocurrency supply depends on *miners* validating and securing blockchain transactions, aligning with the AI-driven era.

Factor 2: Cryptocurrency

Statistical significance does not always imply financial relevance, as demonstrated by the weak correlations between Ether prices and Bitcoin trading volume, despite large sample sizes.



PART 3

Fluctuations:

Analyzing Shifts in Market Dynamics

1. Contributions by Indicator Categories

Section Summary

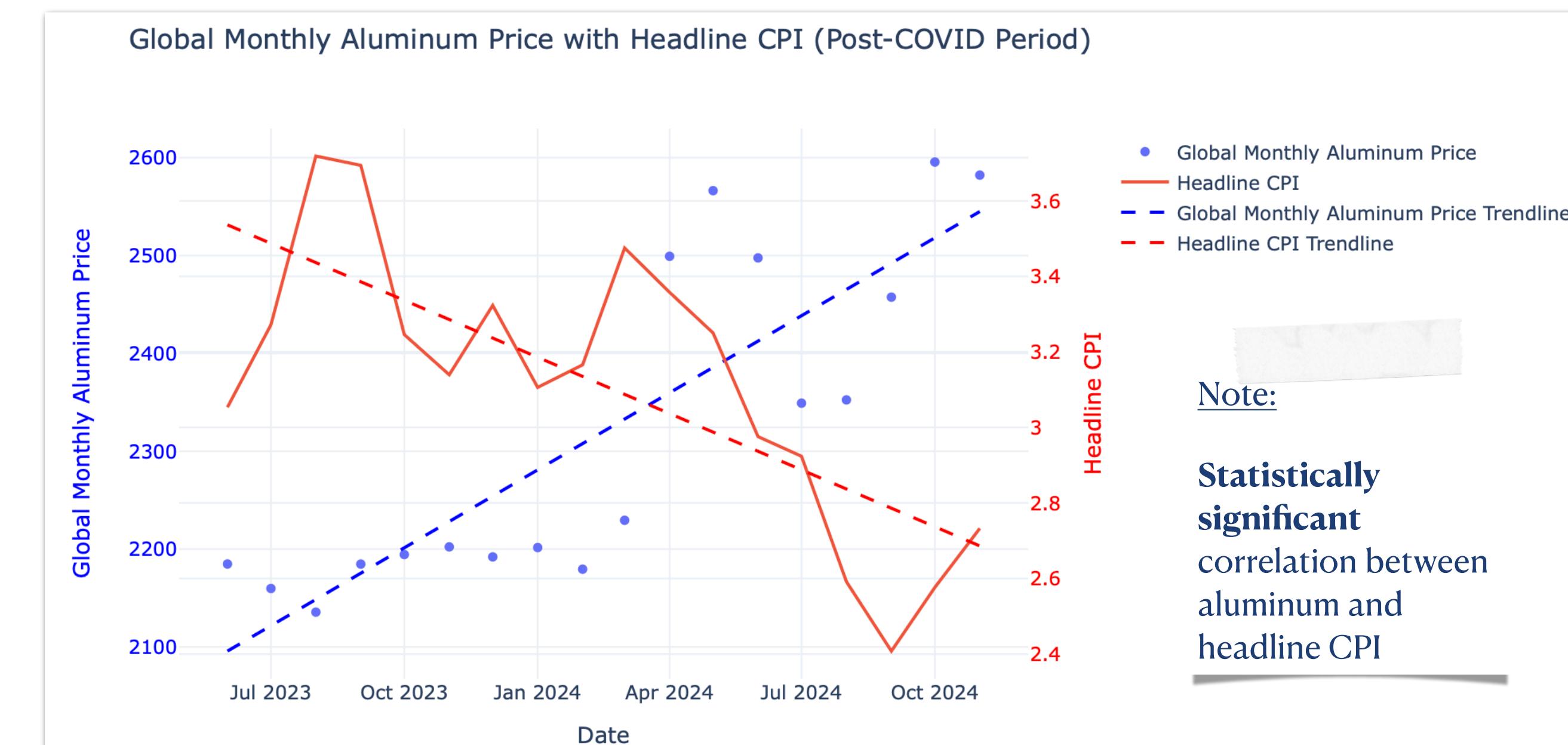
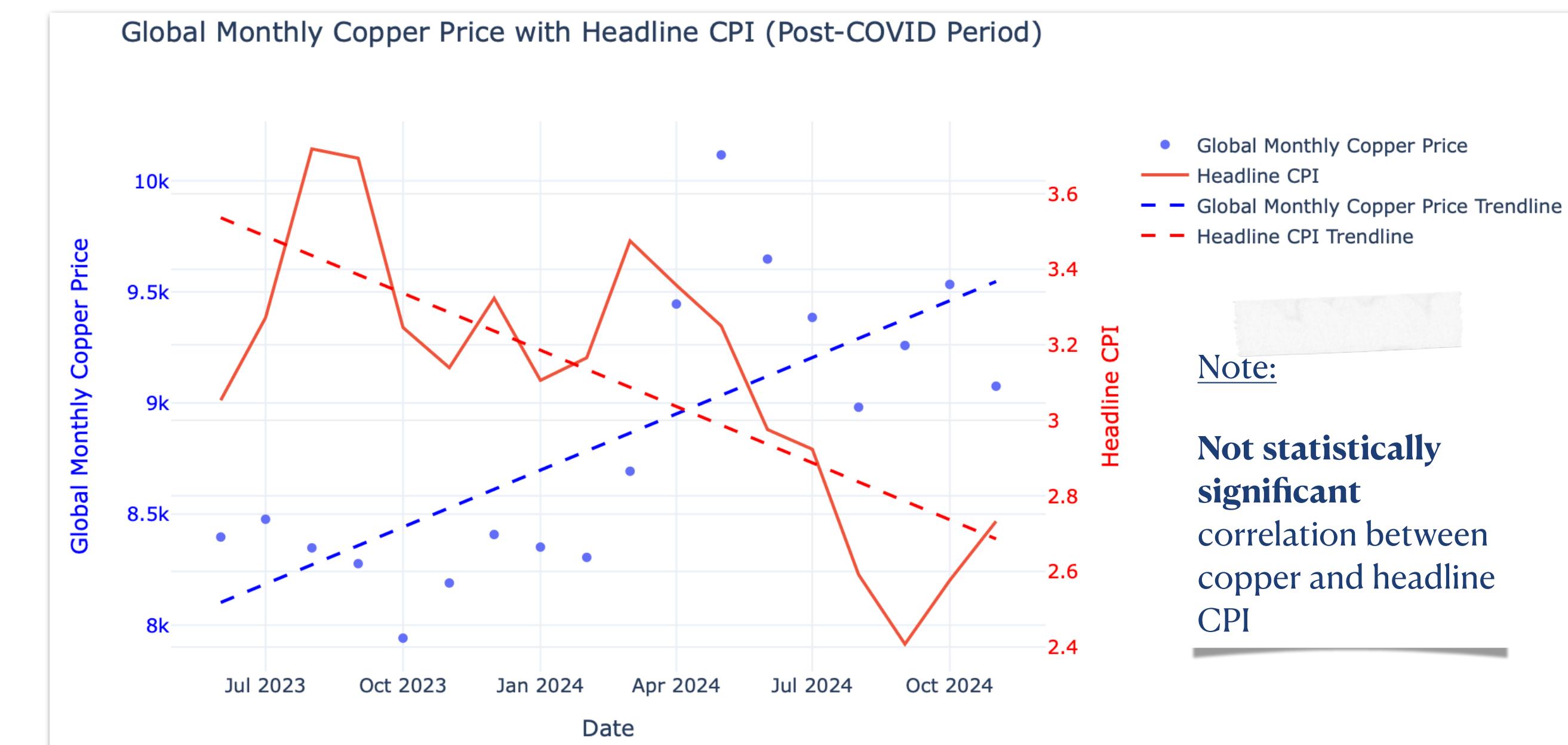
Different market indicators, such as CPI and cryptocurrencies, impact market fluctuations based on their categories and underlying drivers. For example, while Bitcoin and gold may show correlations during certain periods, their price movements are influenced by separate factors. Similarly, the relationship between CPI and commodity prices highlights the influence of non-inflationary elements in shaping market trends. The post-COVID surge in demand for copper aligns with the global shift toward green energy, emphasizing copper's importance in electricity infrastructure, including power grids for electric vehicles, as reinforced by COP28's focus on phasing out fossil fuels.

Economic Indicator: CPI

Headline and Core CPI

- The CPI-hard commodity correlation shifted post-COVID, reversing from a positive trend to rising commodity prices alongside falling CPI. (See graphs on the right side)
 - Note:** A small sample size (<30) may impact statistical significance.
- During the past decade and the COVID-19 period, headline CPI demonstrated stronger correlations with commodity prices. However, in the post-COVID period, core CPI exhibited a stronger negative correlation (See table at the bottom)

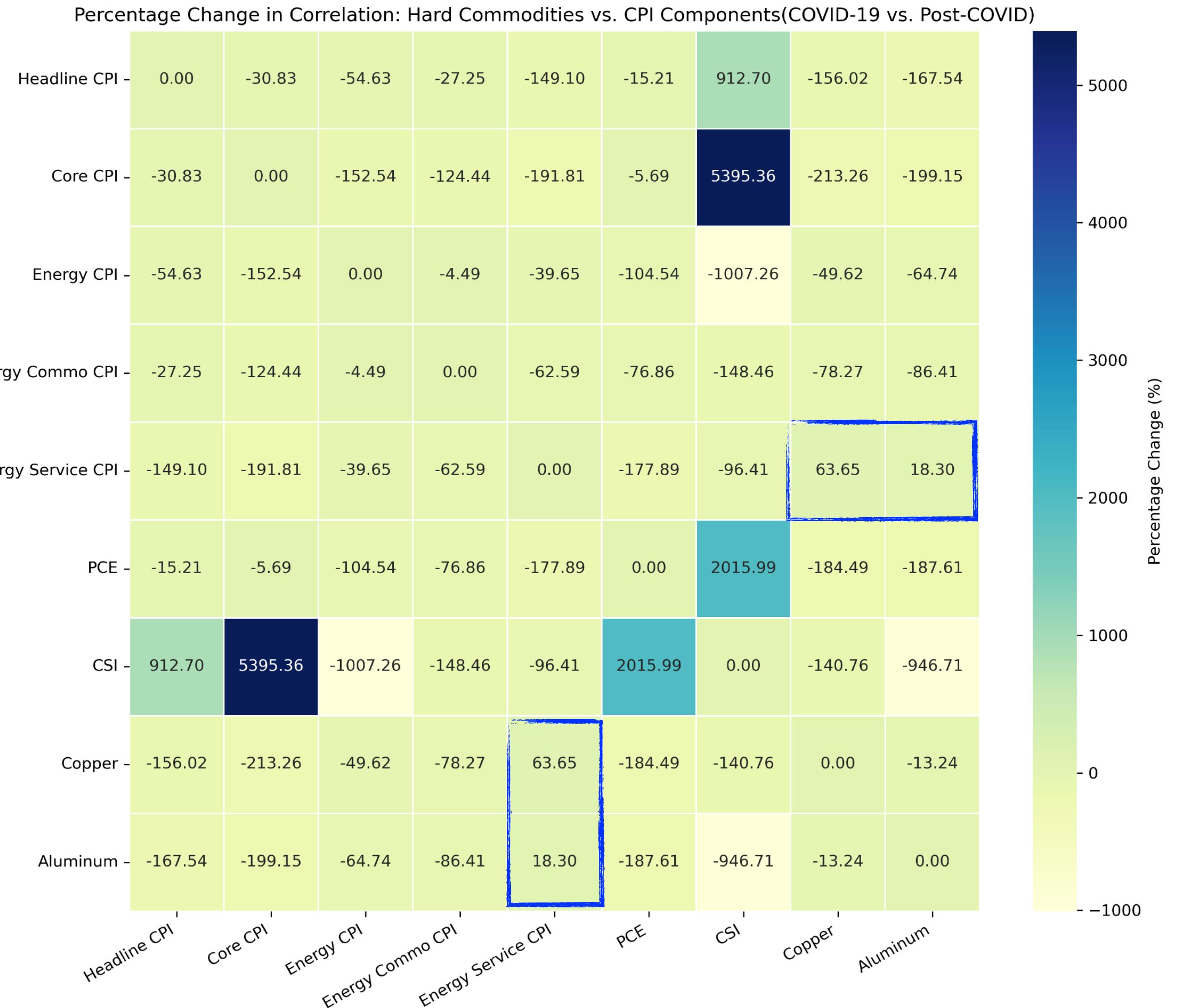
Period/ CPI	Post-COVID		COVID-19		Past Decade	
	Headline	Core	Headline	Core	Headline	Core
Copper	-0.391	-0.709	0.698	0.626	0.735	0.717
Aluminu	-0.562	-0.763	0.833	0.770	0.830	0.762



Economic Indicator: CPI

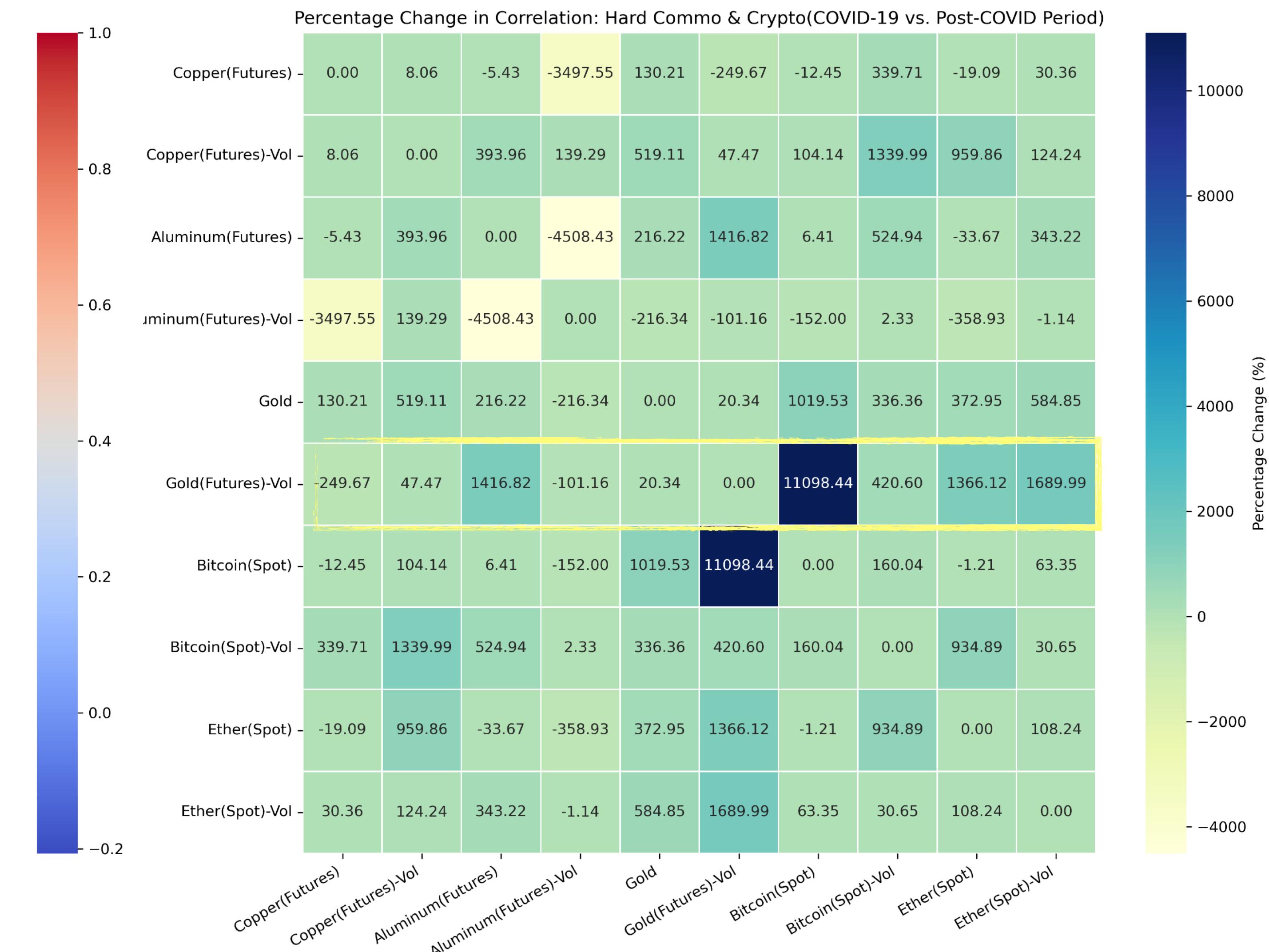
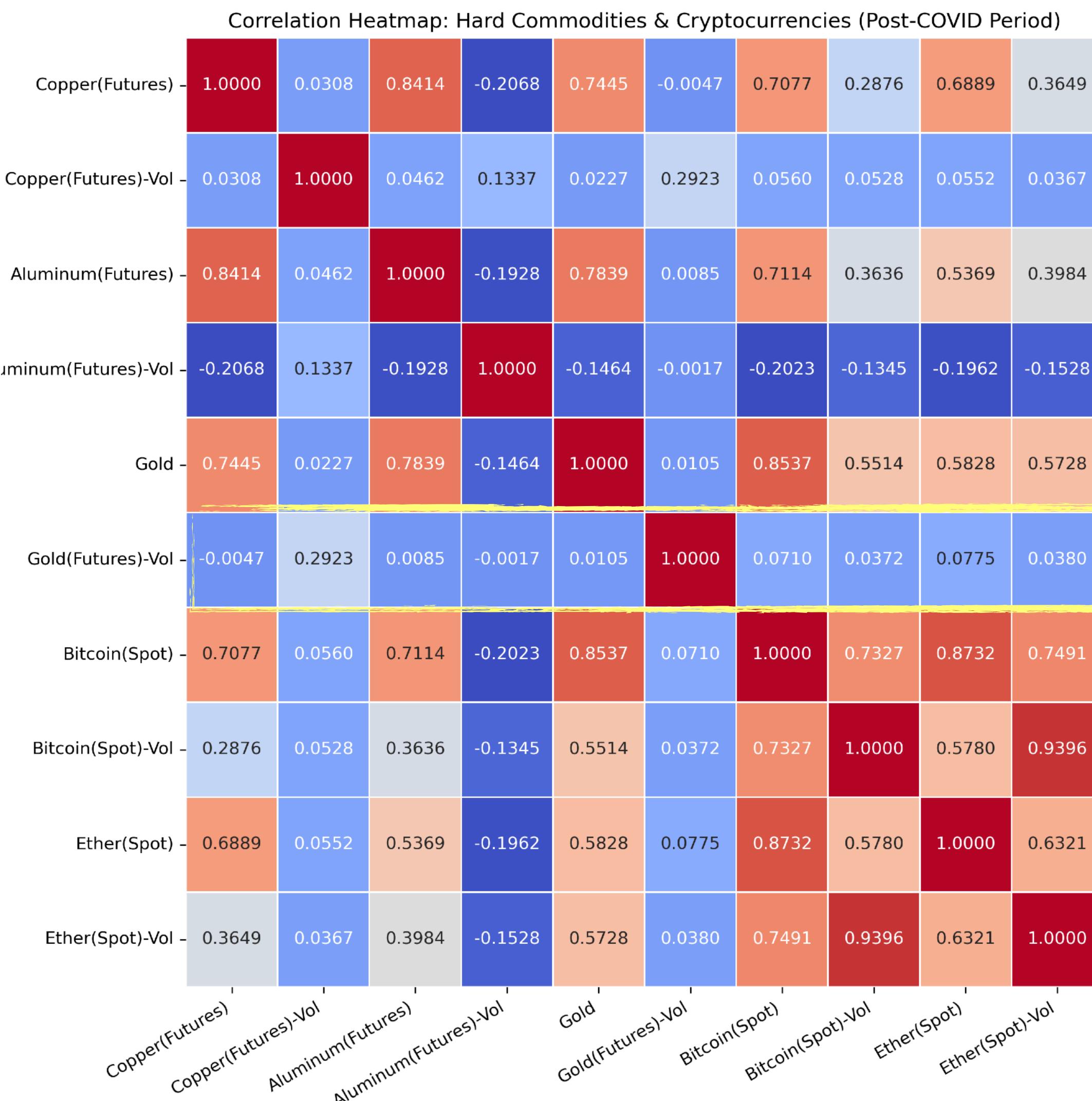
Energy CPI and Its Components: Energy Commodities and Energy Services

- During the post-COVID period,
 - Energy Services CPI's correlation with copper surged 64% to 0.882, while aluminum's rose 18% to 0.802.
 - Unlike Energy Commodities CPI, Energy Services CPI consistently maintained strong correlations with copper and aluminum.



Digital Assets: Cryptocurrency

Bitcoin and gold showed a strong post-COVID correlation (0.8537), but their price movements stem from distinct market drivers—gold from Chinese demand and Bitcoin from U.S. market sentiment shifts following the presidential election



2. Multiple Timeframe Analysis

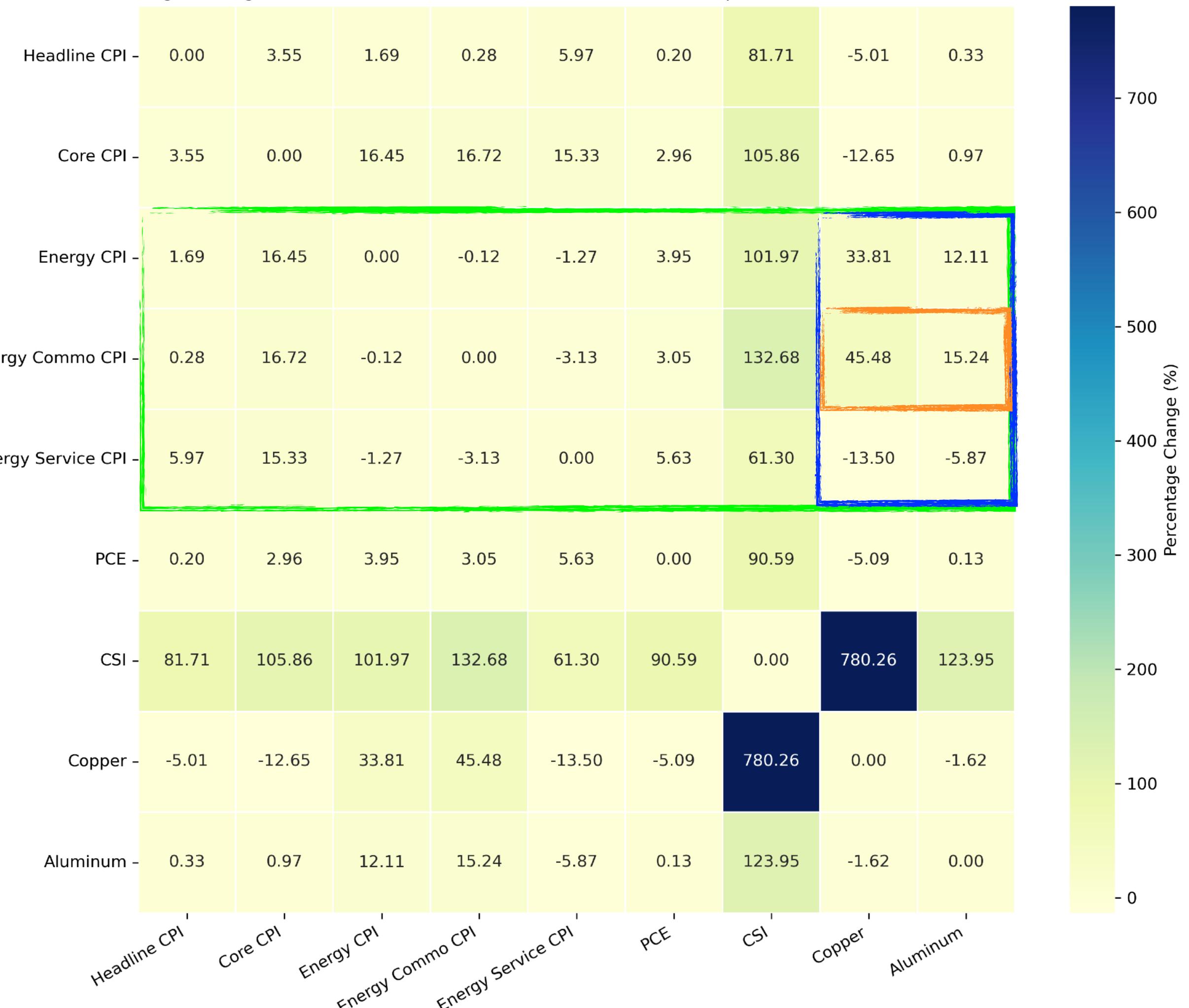
Section Summary

The evolving interconnections between hard commodities and market factors, driven by global energy transitions and post-pandemic shifts, have broad implications for economic indicators like CPI, reflecting their influence on consumer sentiment and market confidence. Correlation patterns among commodities like copper, aluminum, and cryptocurrencies shift across different timeframes. For example, the correlation between copper and aluminum increased from 0.846 over 34 years to 0.910 in the past decade. While shorter time horizons typically reduce noise, the correlation dropped during the COVID-19 period to 0.89 and further to 0.777 post-COVID. These fluctuations suggest that shorter timeframes may not always yield clearer trends, underscoring the need to align investment strategies with dynamic market conditions.

Economic Indicator: CPI

Post-COVID, Energy CPI and Energy Commodities CPI correlations with copper and aluminum dropped sharply, reversing the strong increases observed during COVID, while Energy Services CPI correlations strengthened.

Percentage Change in Correlation: Hard Commodities vs. CPI Components(Past Decade vs. COVID-19)

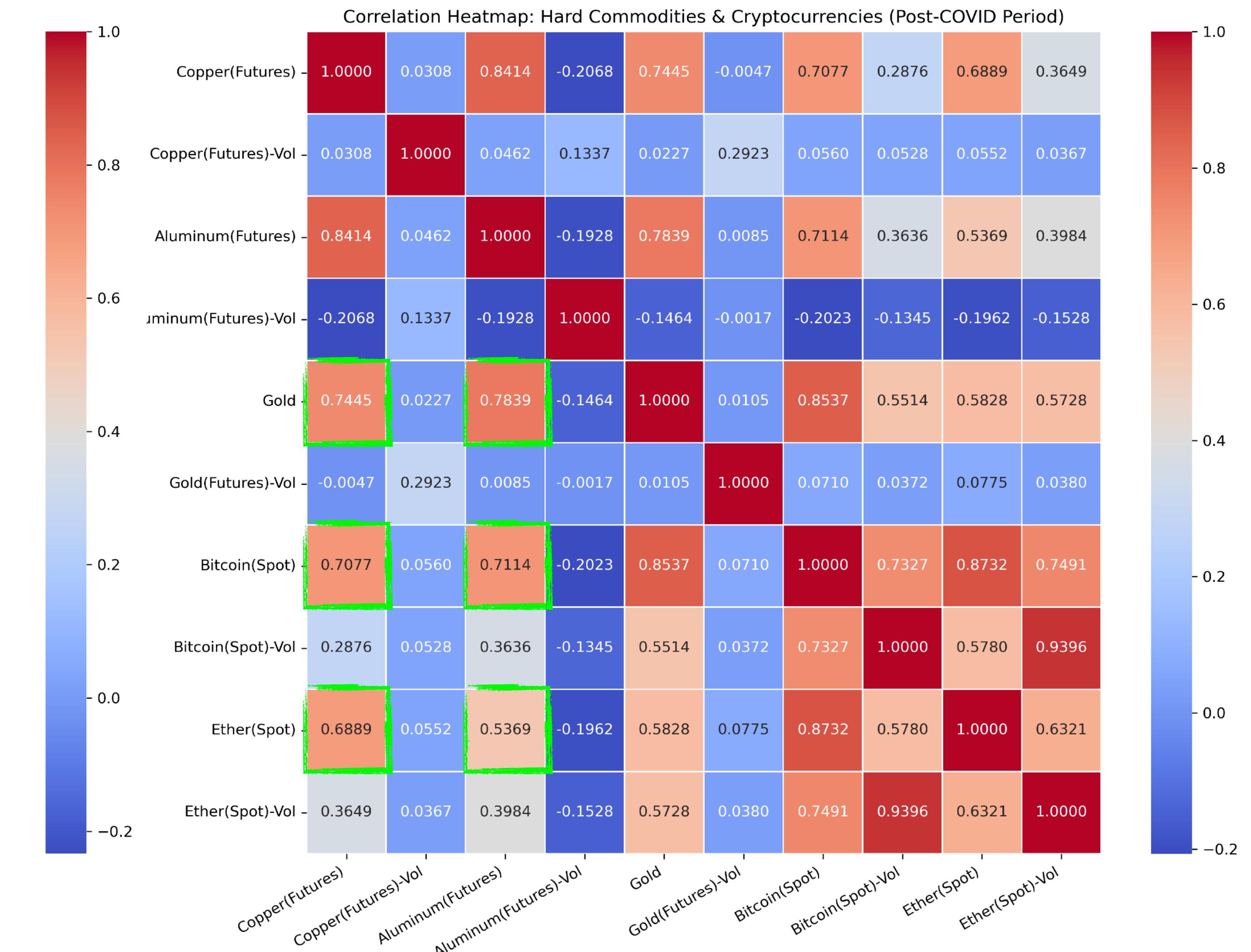
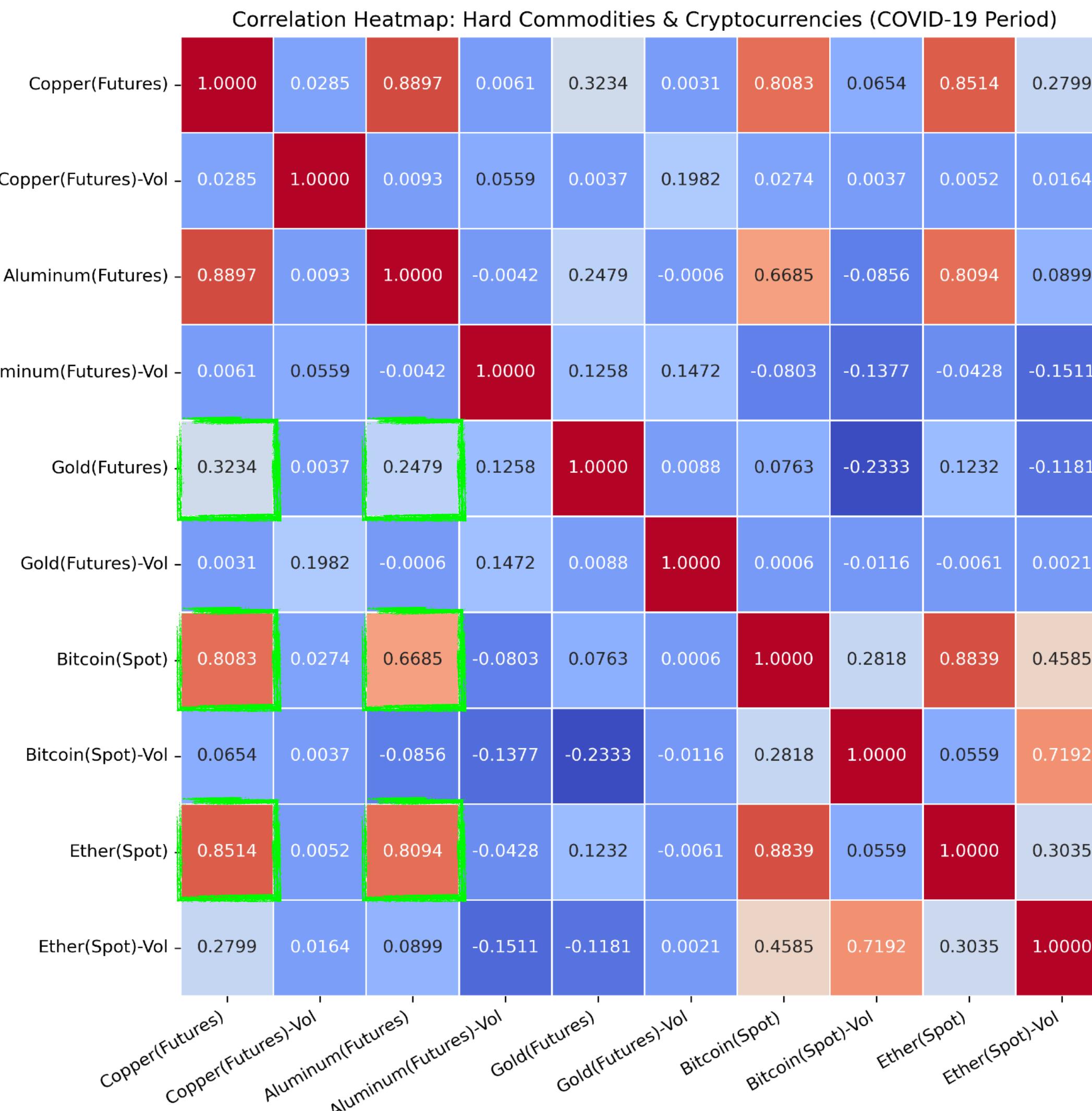


Percentage Change in Correlation: Hard Commodities vs. CPI Components(COVID-19 vs. Post-COVID)



Digital Assets: Cryptocurrency

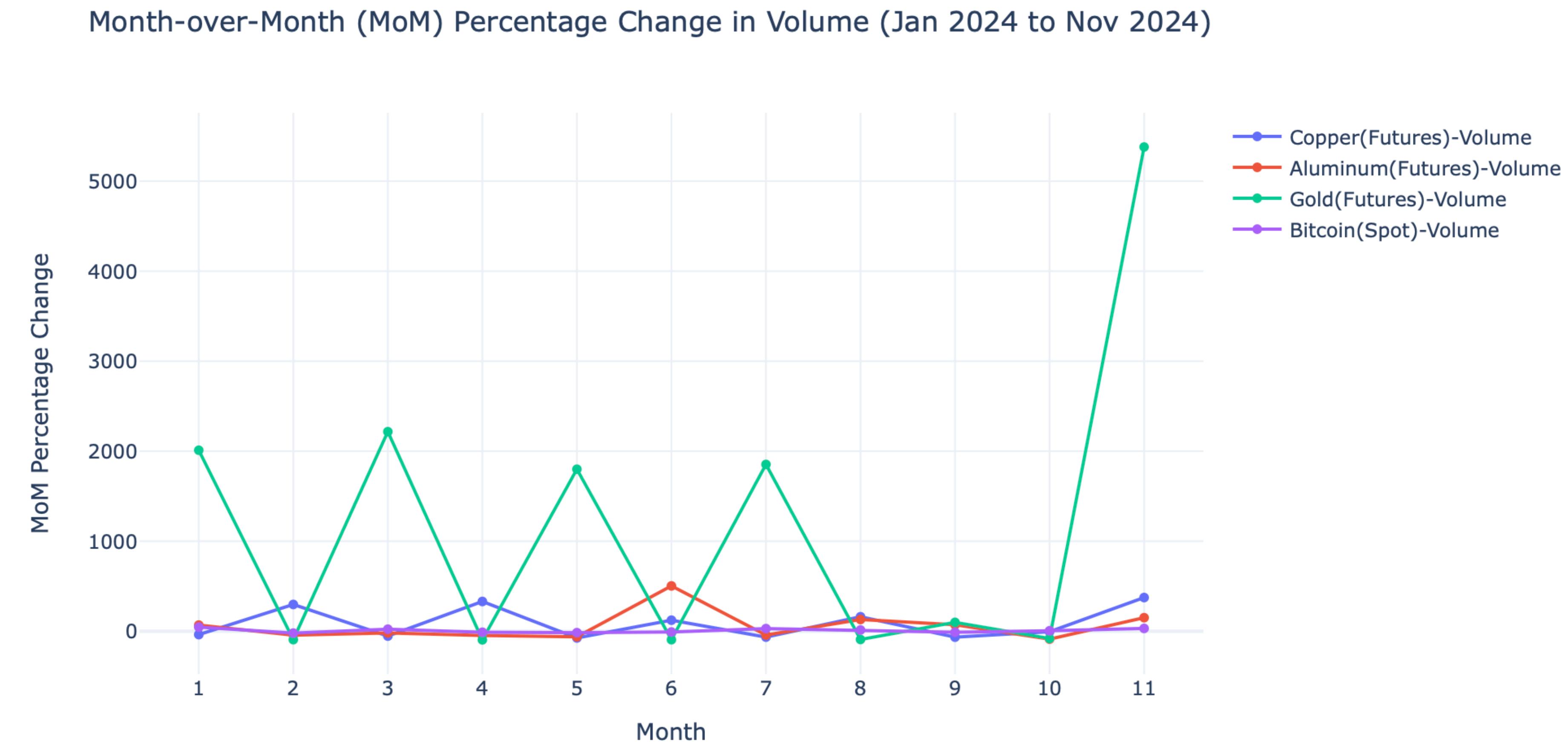
Shorter timeframes do not always lead to higher correlations, as external factors—such as the introduction of Ether—can drive short-term market fluctuations and disrupt expected patterns.



3. Seasonality in Market Trends

Seasonality: Gold vs. Bitcoin

Gold's trading volume follows seasonal futures rollover cycles, while Bitcoin remains relatively stable, indicating a short-term focus. Beyond traditional factors, fiscal policies and climate-driven regulations could further reshape hard commodity seasonality.



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THANK YOU