Macro Indicators in Motion:
Evaluating the Copper-Gold Ratio as a Predictor of Long-Term Interest Rates

Project Category:
Quantitative Analysis

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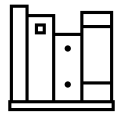
Introduction & Motivation

Copper-Gold Ratio (CGR)

- Not a standard economic indicator
  - Standard indicators are lagging, not leading
- Financial market participants acknowledge the CGR as informative of global economic health
  - CGR increases: Economic expansion
  - CGR decreases: Economic overheating
- Copper: Key industrial metal whose price is sensitive to economic growth
  - Machines, Electronics, Solar panels, Buildings, Cars, Cables
- Gold: A safe-haven asset
  - Scarce, Storage of wealth
  - Hedge against economic uncertainty, USD

10-Year Treasury Rates

- Treasury Rates reflect long-term investor sentiment on:
  - Inflation
  - Economic growth
  - Interest rate changes
- 10-Y Treasury Yield
  - Widely accepted benchmark for long-term rates
  - Reference for mortgage rates (e.g. 30-Year fixed-rate mortgage)
  - Reference for corporate bonds



Current lack of economic literature

- Lack of academic knowledge on the CGR as an indicator for US Treasury Yields (or for the macroeconomic outlook)
- Parnes (2024):
  - Studies static predictive strength of CGR on 10-Y Treasury Rates
  - No analysis of time evolution of relationship across different market regimes
  - Indirect interpretation of relative entropy metric
- Baumeister et al. (2022):
  - Studies indicators of global energy demand
  - Only mentions CGR as measure of market sentiment on global economic growth

Fails to analyse how the time-varying predictive power of the CGR for Treasury Yields can deliver interpretable outputs for practitioners

Value of predicting the 10-Year Treasury Rates

- For Policymakers
  - More accurate & informed monetary policy decision-making
  - Planning/Managing budget deficits & public debt
- For Investors & Consumers
  - Optimise portfolio & risk management
  - More informed decision-making on mortgage loans & investing in corporate bonds

Research Objective

Investigate whether the CGR can be systematically used to predict US 10Y Treasury Rates, given different periods of correlation regimes

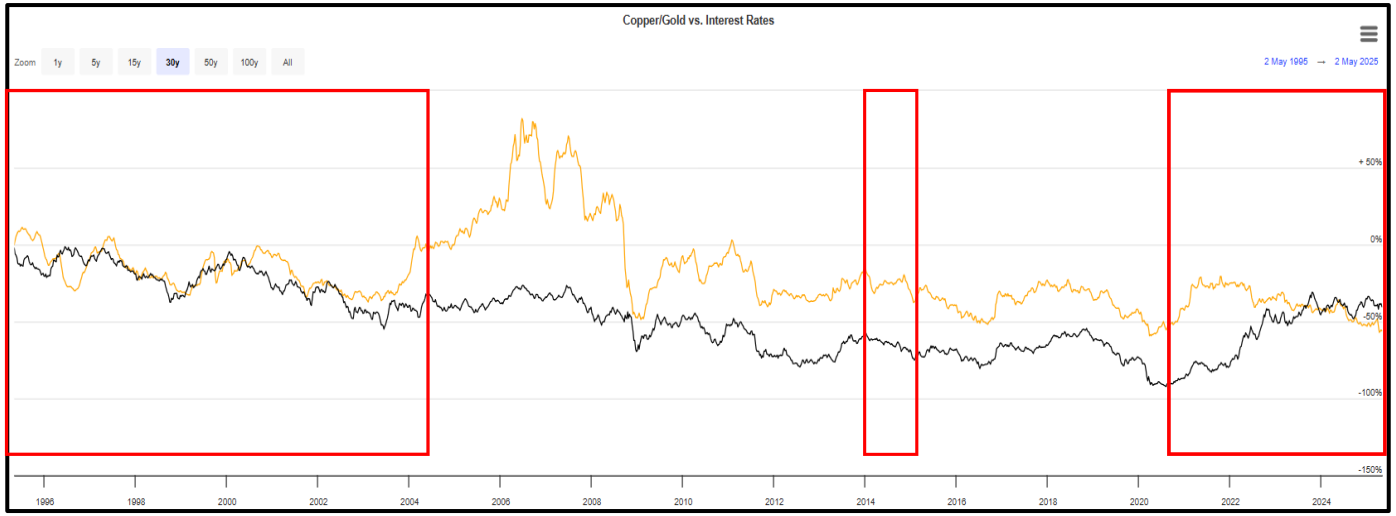
Considerations

1. Time-varying co-movement between CGR & 10Y Treasury Rates

2. Varying central bank rate regimes

3. Volatility clustering at different periods

4. Intuitive and visual model outputs



Analysis

1. Dynamic Conditional Correlation (DCC) GARCH

Identifies periods within rate & volatility fluctuations which the CGR is most correlated with 10Y Treasury Yields

- Formulates **correlation regimes** for predictive modelling
- Adaptable to different market conditions (Volatility Clustering, Monetary Policy Regimes)

2. Rolling Window Regression

Evaluates if CGR and its conditional correlation can be systematically used to predict future changes in 10Y Treasury Rates

- Simple, visual method
- Demonstrate whether (& when) correlation is persistent or episodic

Outputs

1. Rate and Volatility-Conditional Correlations

- Time-series plots for:
  - Conditional Volatility for Univariate GARCH of CGR & 10Y returns
  - Conditional Correlation between CGR & 10Y returns

3. Predictive Evaluation Metrics

- Quantify CGR's predictive power
- Metrics:
  - Root Mean Squared Error (RMSE)
  - % correct direction predictions

2. Conditional Correlation (DCC) as an input for multivariate model prediction

$$\Delta Y_{10Y,t} = \alpha + \beta_1 \cdot CGR_{t-1} + \beta_2 \cdot \rho_{t-1} + \beta_3 \cdot CGR_{t-1} \cdot \rho_{t-1} + \beta_4 \cdot FFR_{t-1} + \epsilon_t$$

- ρ_{t-1} is the lagged DCC correlation
- Also regress on FFR/VIX as controls for confounding effects

Limitations & Scope Management

Datasets

Date Range: 2000-01-01 to 2025-01-01

Monthly Copper & Gold Spot Market Prices

- Spot prices reflect real-time sentiment of economy
- Futures are influenced by:
  - Contango/Backwardation
  - Trading flows (instead of macro-drivers)

Monthly 10Y Treasury Yields

Monthly VIX Values

Fed Funds Rates

Scope of Analysis

Not seeking to build a full predictive model;
Focus on analysing CGR's predictive merit across time & market regimes (through "correlation regimes")

Clear econometric intuition;
Obtain interpretable dynamic coefficients, aligning with policymaker & investor interests

Project Timeline

Week of	Activity
26th May (Mon)	Literature Review & Research Framework Finalisation
2nd Jun (Mon)	Data Collection & Preprocessing
9th Jun (Mon)	Visualise Time Series & Stationarity Testing
16th Jun (Mon)	DCC-GARCH Modelling & Parameter Tuning
23rd Jun (Mon)	Regime Identification & Interpretation
30th Jun (Mon)	Predictive Modelling & Output Calculations
7th Jul (Mon)	Robustness Checks
14th Jul (Mon)	Practical Relevance Checks
21st Jul (Mon)	Generation of Figures, Charts, Tables
28th Jul (Mon)	Report Writing
4th Aug (Mon)	Buffer
11th Aug (Mon)	Submission Week (Deadline: 13th Aug)