

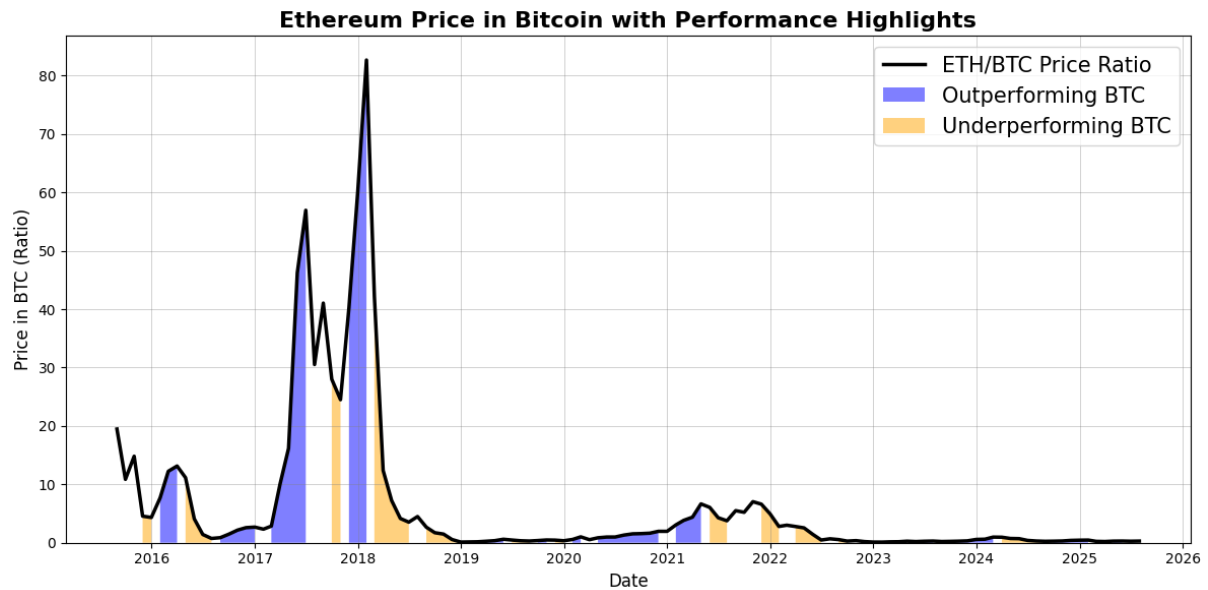
Comparative Analysis of Bitcoin and Ethereum: Inflation Hedging, Macroeconomic Correlation, and Market Dynamics

1. Introduction

The emergence of cryptocurrencies as alternative investment assets has sparked considerable debate regarding their potential role as hedges against traditional economic uncertainties. Bitcoin (BTC) and Ethereum (ETH), representing the two largest cryptocurrencies by market capitalization, exhibit distinct characteristics that merit comprehensive comparative analysis. While Bitcoin was conceived as a digital store of value and medium of exchange, Ethereum serves as a platform for decentralized applications and smart contracts, creating fundamentally different value propositions and market behaviors.

The relevance of studying these cryptocurrencies' relationships with macroeconomic variables has intensified amid global inflationary pressures, currency volatility, and unprecedented monetary policy interventions. Traditional financial theory suggests that effective inflation hedges should maintain purchasing power during periods of currency debasement, yet cryptocurrencies' relatively short historical performance and high volatility complicate this assessment. Understanding whether Bitcoin and Ethereum can serve as reliable inflation hedges requires rigorous analysis of their correlations with macroeconomic indicators across various economic cycles.

Furthermore, the behavioral aspects of cryptocurrency markets, particularly the role of investor sentiment and speculative dynamics, distinguish them from traditional asset classes. The integration of social sentiment data, such as Google search trends, provides unprecedented insights into how public interest correlates with price movements, potentially revealing whether these markets are driven more by fundamental economic factors or speculative behavior.



2. Data & Methodology

This comprehensive analysis utilized multiple datasets spanning from 2015 to 2025 from Kaggle, encompassing:

2.1 Data Sources

- **Price Data:** Daily OHLCV (Open, High, Low, Close, Volume) data for Bitcoin and Ethereum, including market capitalization and circulating supply metrics
- **Macroeconomic Indicators:**
 - Annual Inflation Rates:** from six countries (United Arab Emirates, Switzerland, China, United Kingdom, Lebanon, United States)
 - Exchange Rate Data:** Currency exchange rates relative to USD for multiple countries
 - Labor Market Data:** Unemployment rates across seven major economies
- **Sentiment Data:** Google Trends search volume data for Bitcoin and Ethereum queries
- **Event Data:** Major cryptocurrency market events including halving events, regulatory developments, and market crashes

2.2 Analytical Methodologies

- **Correlation Analysis:** Pearson and Spearman correlation coefficients to assess linear and non-linear relationships

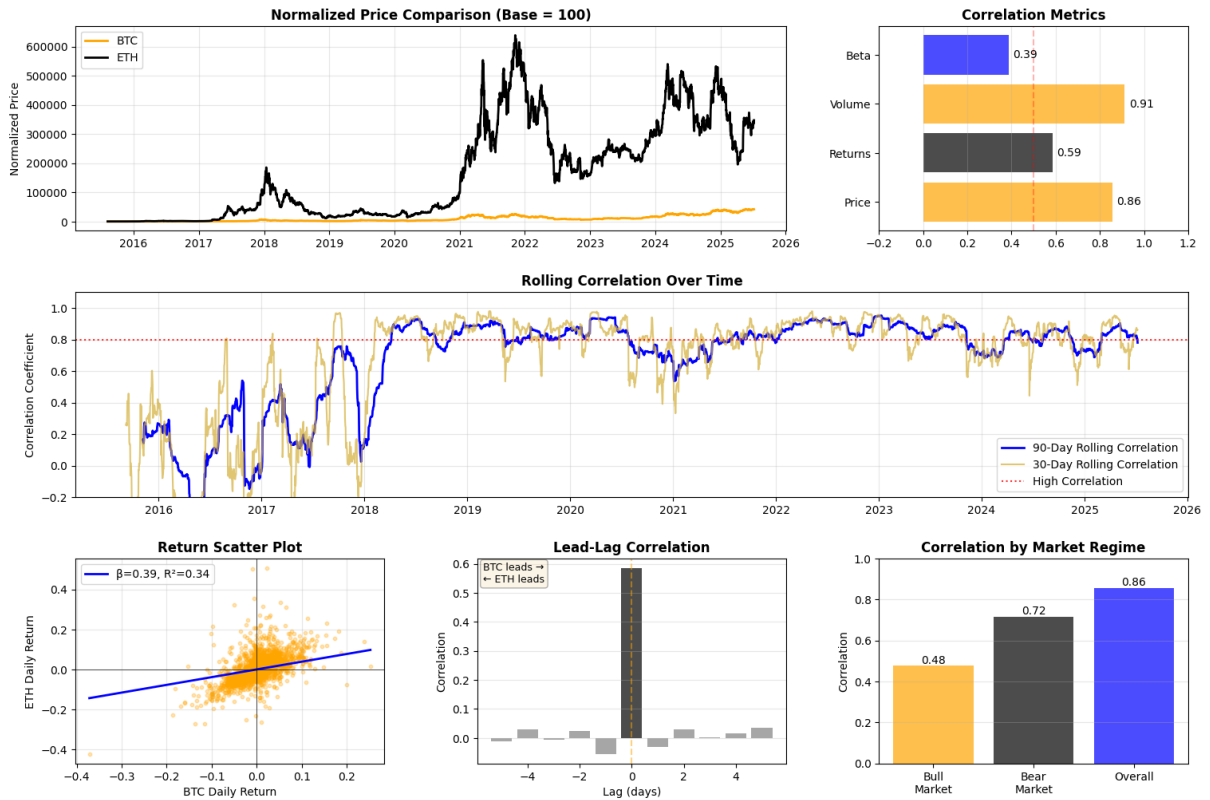
- **Volatility Modeling:** Calculation of annualized volatility, rolling volatility windows, and Parkinson volatility estimators
- **Elasticity Analysis:** Supply and demand elasticity calculations using log-linear regression
- **Event Study Analysis:** Examination of price behavior around significant market events
- **Linear Regression:** Multiple regression models to quantify relationships between cryptocurrencies and macroeconomic variables
- **Time Series Forecasting:** Prophet algorithm implementation for price prediction

3. Analysis

3.1 Inter-Asset Correlations

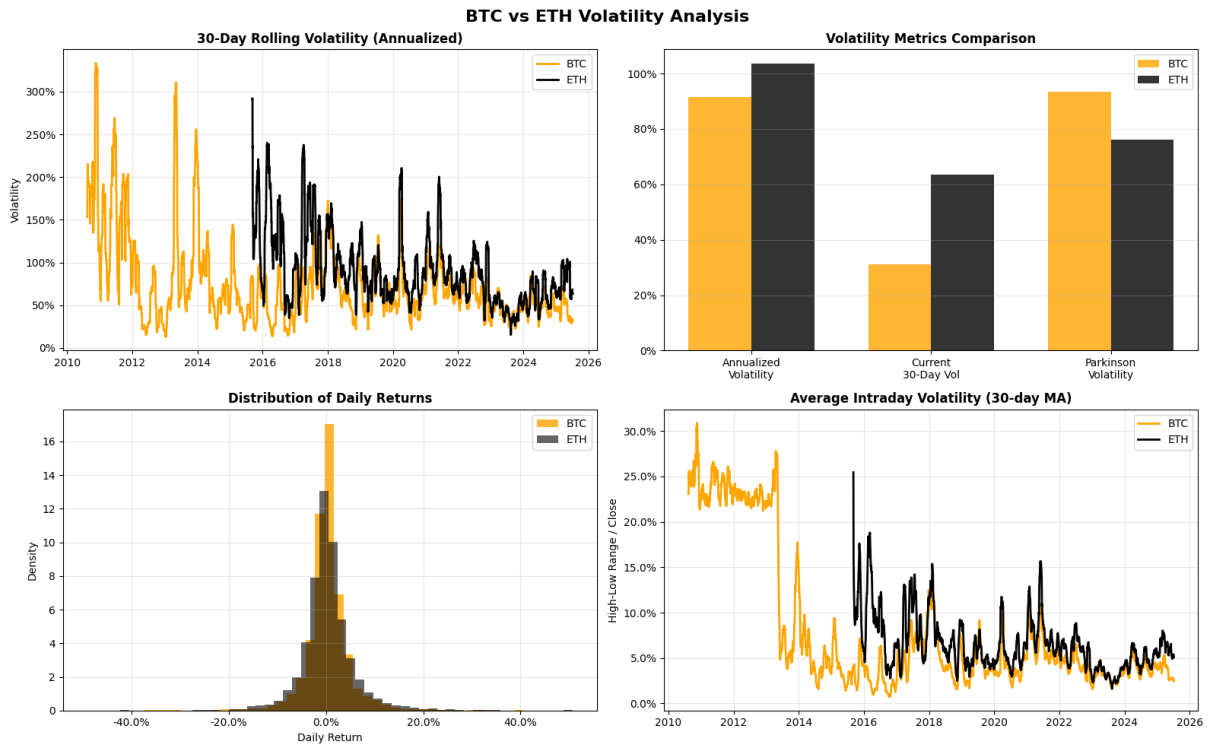
Bitcoin and Ethereum demonstrate high price correlation (0.855) and exceptionally high-volume correlation (0.912), indicating they generally move in tandem. However, their daily return correlation is more moderate (0.586), suggesting short-term price movements maintain some independence. Importantly, correlation strength varies significantly by market regime: bear markets exhibit correlation of 0.716 compared to only 0.477 in bull markets.

BTC vs ETH - Comprehensive Correlation Analysis



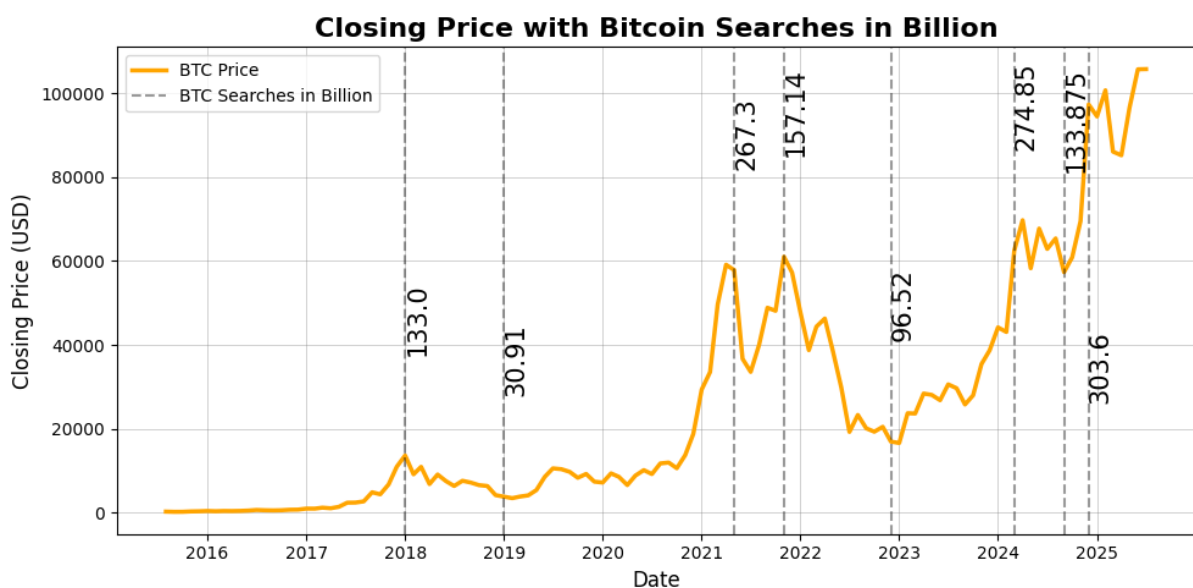
3.2 Volatility Comparison

Comprehensive volatility analysis reveals significant differences between the two cryptocurrencies. Ethereum exhibits higher historical volatility at 103.52% annualized compared to Bitcoin's 91.38%. However, current market conditions show a divergence: Bitcoin experiences exceptionally low 30-day volatility (31.11%), while Ethereum maintains more typical levels (63.64%).



3.3 Sentiment-Price Relationships

The analysis of Google Trends data reveals strong positive correlations between search interest and cryptocurrency prices. Ethereum demonstrates a correlation coefficient of 0.793 between search volume and closing prices, while Bitcoin exhibits an even stronger correlation of 0.809. These findings suggest that public interest, as measured by search behavior, serves as a reliable leading or concurrent indicator of price movements.





Key Finding: The largest recorded search volumes (68.85B and 34.92B for Ethereum, 267.3B and 274.85B for Bitcoin) occurred precisely during major market peaks in 2021 and 2024, demonstrating that peak euphoria directly correlates with maximum valuations.

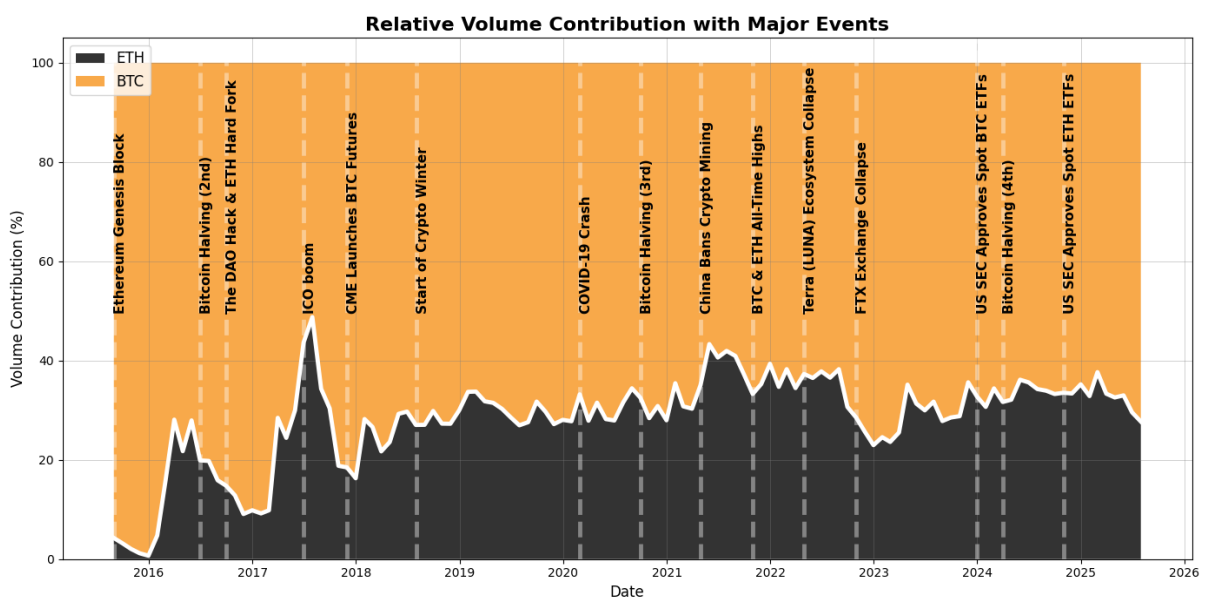
3.4 Halving Events Effects

Bitcoin halving events consistently precede major bull runs for both cryptocurrencies, confirming their role as powerful catalysts for the entire cryptocurrency ecosystem. The analysis identifies halving events in 2016, 2020, and 2024 as marking the beginning of significant growth periods extending into 2018, 2021, and 2024-2025 respectively.



3.5 Volume Dynamics During Major Events

Bitcoin consistently dominates overall trading volume, but Ethereum's relative share surges during periods of innovation and market exuberance. During the 2017 ICO boom and 2021 all-time highs, Ethereum's volume contribution peaked above 40% of total combined volume. Conversely, during market crashes such as the crypto winter and exchange collapses, investors prioritize Bitcoin for exits, reducing Ethereum's relative volume share.



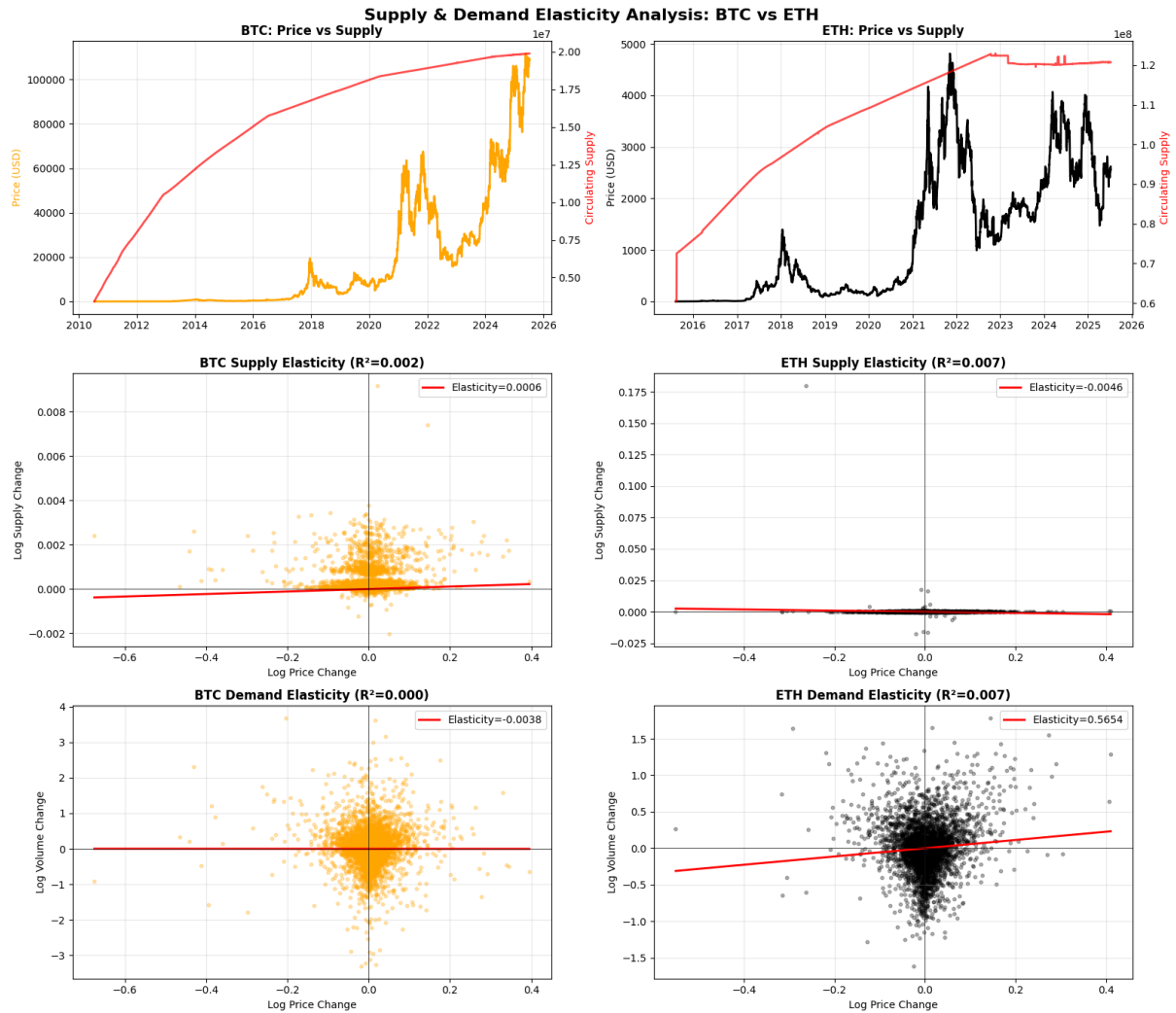
4. Supply-Demand Interpretation

4.1 Supply Elasticity

Both cryptocurrencies exhibit highly inelastic supply characteristics. Bitcoin's supply elasticity of 0.0006 and Ethereum's -0.0046 indicate that supply responds minimally to price changes, consistent with their programmatic issuance schedules. This inelasticity reinforces their potential as stores of value, as supply cannot be arbitrarily increased in response to demand.

4.2 Demand Elasticity

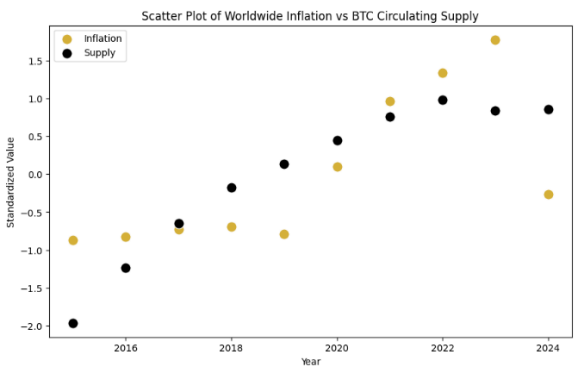
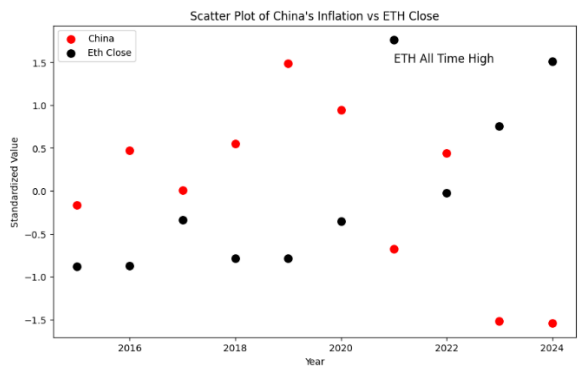
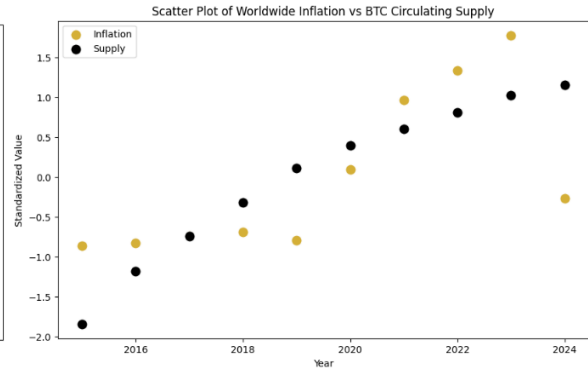
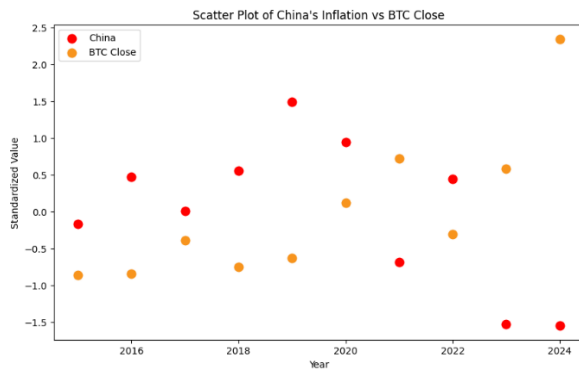
On the demand side, BTC shows virtually no sensitivity to price (-0.0038), implying a relatively stable user and investor base, while ETH's positive elasticity (0.5654) indicates a more speculative market where higher prices stimulate greater trading volume. This suggests momentum-driven or speculative trading behavior dominates rational economic response.



5. Macroeconomic Correlation

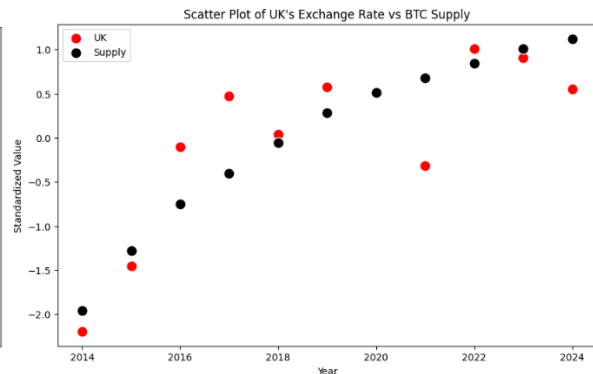
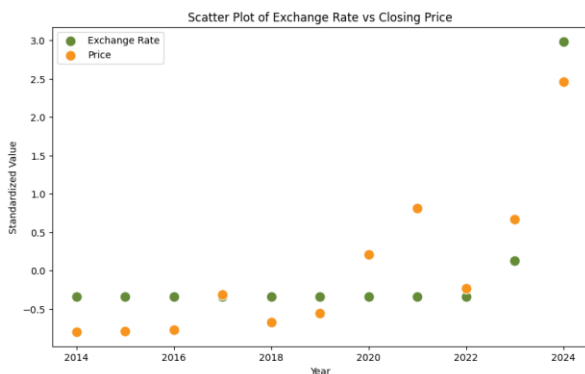
5.1 Inflation Relationships

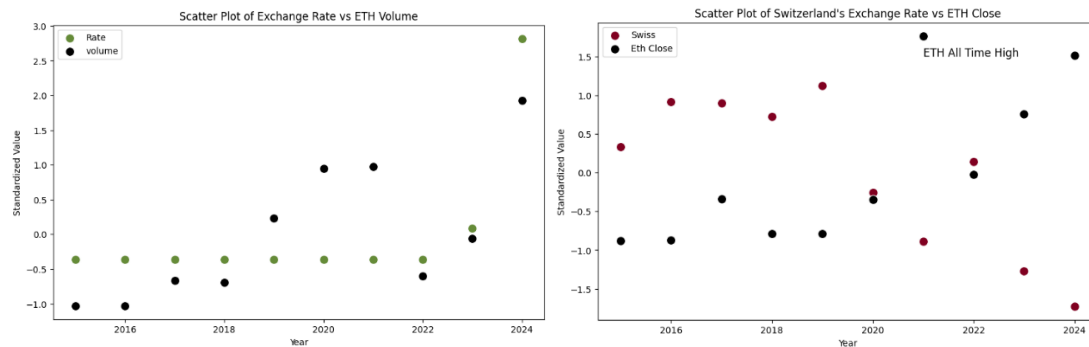
The analysis reveals surprisingly strong relationships between cryptocurrency prices and specific national inflation rates (Worldwide: ETH $R^2 = 0.528$, BTC $R^2 = 0.512$). China's inflation rate demonstrates the highest explanatory power, accounting for 58.8% of Ethereum's price variability ($R^2 = 0.588$) and 53.8% of Bitcoin's variability ($R^2 = 0.538$). This relationship appears particularly strong before 2022, suggesting structural changes in recent years.



5.2 Exchange Rate Sensitivity

Exchange rate analysis reveals Switzerland's currency exhibiting the strongest correlation with cryptocurrency prices and volume (Worldwide: ETH $R^2 = 0.458$, BTC $R^2 = 0.724$). The Swiss Franc exchange rate explains 77.1% of Ethereum's price variance ($R^2 = 0.771$) and demonstrates significant correlation with Bitcoin as well. This finding suggests cryptocurrencies may serve as hedges against specific currency debasements rather than general inflation.





5.3 Unemployment Rate Correlations

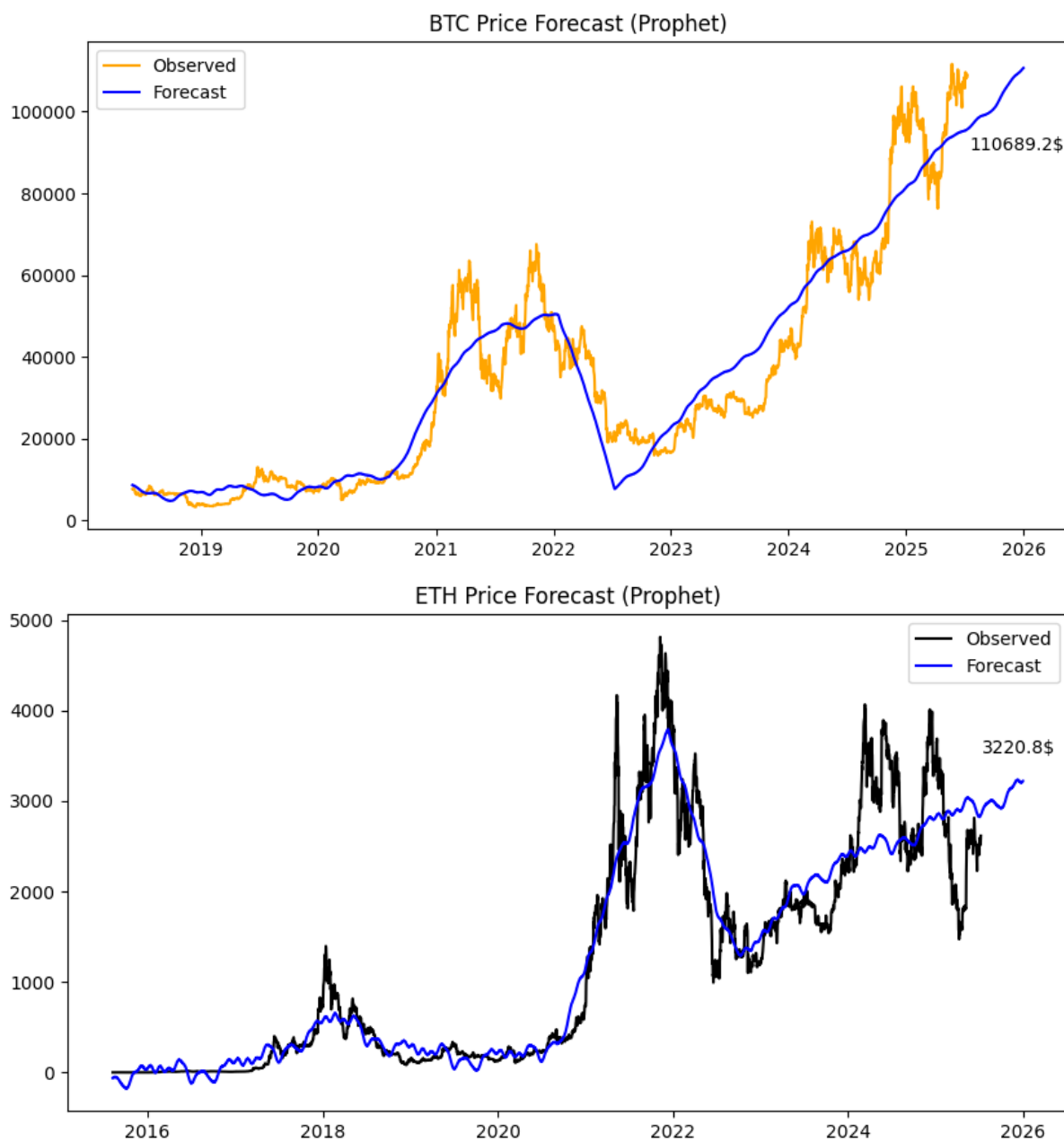
France's unemployment rate shows an exceptionally high correlation with cryptocurrency supply metrics, explaining 48.4% of Ethereum's price variance and 42.4% of Bitcoin's. While Worldwide rate highlights a weak correlation with both prices.

5.4 Combined Macroeconomic Model

When combining inflation, exchange rates, and unemployment data into comprehensive models, the explanatory power increases substantially. The combined model explains 73.6% of Ethereum's price variance and an impressive 93.4% of Bitcoin's price movements, suggesting macroeconomic factors collectively drive a significant portion of cryptocurrency price behavior.

6. Forecasting

Using Prophet as a forecasting procedure implemented in Python, Bitcoin's price is project to be 110689.2 \$ and 3220.8\$ for Ethereum.



7. Results & Insights

7.1 Key Statistical Findings

1. **High Inter-Asset Correlation:** Bitcoin and Ethereum prices correlate at 0.855, but this strengthens to 0.716 in bear markets while weakening to 0.477 in bull markets
2. **Volatility Divergence:** Ethereum exhibits 12.14 percentage points higher annualized volatility than Bitcoin, confirming its status as the riskier asset

3. **Sentiment-Price Synchronization:** Search interest peaks coincide precisely with price maxima, with correlation coefficients exceeding 0.79 for both assets
4. **Macroeconomic Sensitivity:** Combined macroeconomic models explain over 73% of price variance, indicating strong fundamental drivers
5. **Supply Inelasticity:** Both cryptocurrencies demonstrate highly inelastic supply (elasticity < 0.01), supporting store-of-value propositions

7.2 Market Dynamics Insights

Bitcoin functions as the market leader and sentiment barometer, with its price movements dictating overall cryptocurrency market direction. However, Ethereum serves as the primary vehicle for technological innovation and risk appetite, experiencing volume surges during periods of development activity such as the ICO boom and DeFi expansion.

The analysis reveals that Bitcoin halving events serve as fundamental catalysts for entire market cycles, consistently preceding major bull runs that benefit both cryptocurrencies. This suggests supply constraint mechanisms in Bitcoin create spillover effects throughout the cryptocurrency ecosystem.

8. Answers & Discussion

8.1 Does Ethereum behave as a hedge against inflation compared to Bitcoin?

The evidence suggests neither cryptocurrency functions as a reliable traditional inflation hedge. While both show correlations with specific national inflation rates (particularly China's), their high volatility and positive correlations with risk assets contradict typical hedge characteristics. However, Ethereum demonstrates slightly stronger sensitivity to macroeconomic factors ($R^2 = 0.736$) compared to Bitcoin's inflation relationships ($R^2 = 0.145$ for average inflation), suggesting it may be more responsive to inflationary pressures but also more volatile.

8.2 How correlated are Bitcoin and Ethereum with inflation and exchange-rate volatility?

Both cryptocurrencies exhibit significant correlations with specific macroeconomic variables rather than broad inflation measures. China's inflation explains approximately 54-

59% of their price variability, while Switzerland's exchange rate shows 77% correlation with Ethereum prices. These relationships suggest cryptocurrencies may hedge against specific economic conditions rather than serving as universal inflation hedges.

8.3 How do supply constraints and demand variations influence price dynamics?

Supply constraints prove fundamental to price dynamics. Bitcoin's halving events create predictable supply shocks that trigger market-wide bull runs. Both cryptocurrencies exhibit highly inelastic supply (elasticity < 0.01), meaning prices are primarily demand-driven. Demand elasticity analysis reveals momentum-driven behavior, where higher prices attract increased volume rather than reducing it.

8.4 Does investor sentiment explain differences in price movements?

Investor sentiment, measured through Google search trends, strongly correlates with price movements (0.79-0.81 correlation coefficients). Sentiment spikes consistently precede or coincide with price peaks, suggesting public interest serves as both a driver and indicator of price movements. The synchronization between search volume and valuations indicates sentiment-driven speculation significantly influences both cryptocurrencies.

8.5 How does macroeconomic instability influence crypto adoption or price resilience?

Macroeconomic instability appears to increase cryptocurrency correlation rather than providing diversification benefits. During the COVID-19 crisis and subsequent inflationary periods, both cryptocurrencies became more correlated with traditional risk assets rather than serving as safe havens. However, specific regional economic instabilities (such as Lebanon's crisis) show positive correlations with cryptocurrency prices, suggesting potential utility as escape assets from specific economic collapses.

8.6 During macroeconomic instability, is price behavior driven more by scarcity or speculation?

The evidence suggests speculation dominates during instability periods rather than scarcity premiums. The positive demand elasticity indicates speculative momentum, while the strengthened correlations during bear markets (0.716 vs 0.477 in bull markets) demonstrate that both assets face similar selling pressure during uncertainty. However, Bitcoin's halving-induced supply constraints provide a fundamental scarcity mechanism that

eventually drives recovery cycles.

9. Recommendations

9.1 Strategic Recommendations for Investors

Portfolio Construction: Given the high correlation (0.855) between Bitcoin and Ethereum, investors should avoid overweighting both assets simultaneously for diversification purposes. The 12-percentage point volatility difference suggests Ethereum positions should be sized smaller than Bitcoin positions to maintain equivalent risk exposure.

Timing Considerations: Bitcoin halving events provide relatively predictable catalysts for market cycles, offering strategic entry points approximately 6-18 months before anticipated supply reductions. However, the high sentiment-price correlations suggest avoiding purchases during peak public interest periods.

Risk Management: The current volatility divergence (Bitcoin 31% vs Ethereum 64%) suggests Bitcoin may be entering a consolidation phase suitable for lower-risk accumulation, while Ethereum offers higher-risk, higher-reward trading opportunities.

9.2 Limitations and Future Research

Temporal Limitations: The analysis spans a relatively short historical period for macroeconomic analysis, and structural relationships may evolve as markets mature. The apparent breakdown in correlations after 2022 suggests ongoing structural changes requiring continuous monitoring.

Model Limitations: While the combined macroeconomic models explain substantial variance, the positive demand elasticity and momentum characteristics suggest behavioral factors may be equally important as fundamental economic relationships.

Future Research Directions: Investigations should expand to include other major cryptocurrencies, analyze the impact of institutional adoption on correlation structures, and develop regime-switching models to better capture the apparent structural changes in recent years. Additionally, research into the mechanisms behind the China inflation correlation and Swiss exchange rate relationships could provide valuable insights into cryptocurrency's role in international finance.

Conclusion: While neither Bitcoin nor Ethereum functions as a reliable inflation hedge in the traditional sense, both demonstrate significant sensitivity to specific macroeconomic conditions and maintain potential utility as components of diversified portfolios. Their high volatility, momentum-driven characteristics, and increasing correlation with traditional assets suggest they should be treated as speculative growth assets rather than defensive hedges against economic uncertainty.