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Research Project

Determinants of Bitcoin Pricing

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Introduction

Since the emergence of Bitcoin in 2009, crypto-assets have attracted increasing interest from both investors and the academic world. Due to their high volatility and growing adoption, they now represent a market capitalisation of 3 trillion dollars. However, unlike traditional assets, their valuation appears to follow specific dynamics, combining macroeconomic factors, programmed supply and demand mechanisms, as well as behavioural influences. This uniqueness explains why Bitcoin is considered both a speculative asset, a potential safe haven, and a proxy for overall risk appetite, making it a hybrid object of analysis.

The study of the determinants of crypto-asset prices is essential to better understand the underlying mechanisms of these still-young markets, which are consequently in constant evolution. Indeed, due to their exposure to exogenous shocks, they challenge the theory of market efficiency. Furthermore, structural models suggest that certain events, such as Bitcoin halvings or regulatory developments, directly influence price dynamics. Additionally, understanding these determinants is crucial for assessing the sustainability of a bull cycle, anticipating a correction phase, or identifying new correlations with traditional asset classes.

This context therefore raises the following question: “What are the main determinants of Bitcoin’s price?” To answer it, we will focus on Bitcoin due to its dominant market weight and its role as a benchmark for all crypto-assets.

This study has two objectives. Firstly, to identify the main factors influencing Bitcoin’s valuation. Secondly, to empirically test their impact using econometric analysis. To this end, we will employ a multiple regression approach, along with statistical tests and corrections. Finally, we will discuss the practical implications of these results to understand the extent to which Bitcoin is integrated into the global financial ecosystem and asset reallocation decisions.

I. Literature Review and Theoretical Framework

Contemporary literature on crypto-assets is mainly based on two theoretical currents borrowed from classical financial models. Firstly, there is the efficient market hypothesis, which postulates that prices incorporate all available information. However, the application of this paradigm to crypto-assets is challenged by their sensitivity to exogenous shocks and irrational behaviours, as suggested by several studies, such as Urquhart (2016). This leads to the conclusion that these markets are only partially efficient, or even semi-efficient, due to behavioural factors such as FOMO (fear of missing out) amplified by social media. These behaviours resemble temporary speculative bubbles, similar to those described by Shiller, where price dynamics are more closely linked to collective narratives than to fundamentals.

Secondly, supply-demand equilibrium models, inherited from the Walrasian framework, are used to model the impact of structural mechanisms on valuation. For example, Bitcoin’s halving, which reduces supply in a programmed manner (maximum of 21 million BTC), is regularly associated with phases of bullish rallies. Moreover, the dynamics of technological adoption, illustrated by major updates such as Ethereum 2.0, highlight the importance of innovation in the valuation of digital assets. These dynamics can thus be likened to “S-curve” innovation cycles, where each adoption phase leads to a reassessment of market expectations.

<u>Four key determinants emerge from the literature review:</u>
Firstly, programmed scarcity and liquidity, notably via staking in DeFi, generate price pressures. Historical analysis reveals a positive correlation between supply reduction events (halvings) and price rallies. Secondly, sentiment indices, particularly those constructed from social media publication volumes, exhibit a predictive effect on price fluctuations, especially during periods of intense speculation. Thirdly, regulatory announcements, such as the ban in China in 2021 or the implementation of the MiCA regulation by the EU in 2024, generate immediate, often bearish shocks,

followed by corrective adjustments. Finally, the growing interconnection between Bitcoin and stock indices such as the S&P 500, as well as the influence of Federal Reserve interest rates on risky assets, reflects a gradual integration of crypto-assets into global macroeconomic dynamics. This indicates a shift: Bitcoin is no longer outside the financial system but tends to become a cyclical component, particularly sensitive to global monetary conditions.

Based on these findings, six research hypotheses are formulated:

- H1: An increase in trading volume, an indicator of liquidity and speculation, increases Bitcoin's valuation.
- H2: Regulatory announcements generate an immediate exogenous shock.
- H3: An increase in electricity costs (proxy for mining costs) is associated with a decrease in Bitcoin's price.
- H4: Bitcoin's price evolves positively with the S&P 500, reflecting integration into traditional financial markets.
- H5: An increase in interest rates is expected to exert downward pressure on Bitcoin's price, due to investors' preference for less risky assets and higher capital costs.
- H6: Investor sentiment, measured by the Fear & Greed Index, is expected to influence Bitcoin's price: extreme levels of fear or greed could respectively exert temporary upward or downward pressures.

II. Methodology and Empirical Approach

The data consists of monthly time series covering the period from 01/02/2018 to 21/03/2023. Bitcoin is taken as the reference asset because other crypto-assets are correlated with it, partly due to it representing approximately 45% of the crypto market in 2025. Furthermore, the United States is used as the reference for interest rates, average electricity price, and the benchmark index, as it accounted for approximately 40% of the global hashrate from 2021 to 2024. This approach prioritises data robustness but does not capture certain recent phenomena, such as the entry of institutional investors via Bitcoin spot ETFs in 2024, nor local geopolitical dynamics (differentiated regulation in Asia, adoption in El Salvador, etc.).

The data come from two sources: a dataset by Adil Bhatti from Kaggle, including Bitcoin's closing price, the Fear and Greed Index, and trading volume, as well as public FRED databases for interest rates, the S&P500 price, and the average electricity cost in the United States. The joint use of open academic databases and institutional sources ensures sufficient reliability but could ultimately be enhanced by high-frequency (intraday) data to capture market microstructures.

We therefore perform a multiple regression in R, with Bitcoin's price as the dependent variable and the following explanatory variables: BTC_volume (trading volume), Price_SP (S&P500 price), Consumption (electricity cost), Rate (FED interest rate), FearGreed (sentiment index). An additional variable, RegShock, takes the value 1 in months marked by a regulatory announcement (China 2021, MiCA 2023, ETF 2024). This selection of variables allows the integration of structural factors (supply/mining cost), macro-financial factors (S&P500, rates), and behavioural factors (sentiment, regulation), thus constituting a relevant comparison base with traditional asset valuation models.

Following the regression (model including RegShock), the obtained coefficients are:

- BTC_volume: 1.303e-07 ($p = 0.072$), marginally significant positive effect on price.
- Price_SP: 24.94 ($p < 0.001$), strong and significant coefficient, confirming a positive correlation with the stock market.

- Consumption: -4.747e+05 (p = 0.009), significant and negative, suggesting that an increase in electricity cost is associated with a price decrease.
- Rate: 414.1 (p = 0.74), not significant.
- FearGreed: 0.6495 (p = 0.99), not significant.
- RegShock: 1254 (p = 0.49), not significant.

Robustness tests confirm the presence of autocorrelation (Durbin-Watson = 0.58, p < 1e-13) and significant heteroskedasticity (Breusch-Pagan: p = 0.0089), justifying the use of robust error corrections (HAC). These results underscore the difficulty of modelling Bitcoin with simple linear regressions, given that price dynamics incorporate exogenous shocks and second-order effects (global liquidity, mimetic behaviours, technical innovations).

Finally, the ARIMA(0,1,1) model fitted to Bitcoin's price shows a significant MA coefficient (0.5193, p < 0.001), confirming the persistence of price shocks. This reflects the autocorrelated nature and high path-dependency of Bitcoin, which is closer to a speculative dynamic than to valuation by stable fundamentals.

Conclusion

Far from responding solely to traditional financial models, Bitcoin operates in an environment combining programmed supply, speculative behaviours, and increasing interactions with global financial markets. It now constitutes a "frontier" asset, at the crossroads of global macroeconomic dynamics and disruptive technological innovations.

The strong and significant correlation between Bitcoin and the S&P 500 confirms its integration into traditional macroeconomic dynamics. Furthermore, the effect of trading volume, marginally significant, emphasises the importance of liquidity and speculation in Bitcoin's valuation. Conversely, interest rates, the sentiment index, and regulatory announcements do not have a significant impact, partially contradicting some initial hypotheses. It should nevertheless be noted that these variables may play a differentiated role depending on market regimes (bull, bear, systemic crisis), calling for a dynamic rather than static approach to the determinants.

The results of this study therefore confirm hypotheses H1, H3, and H4, but refute H2, H5, and H6. This highlights the need to deepen the analysis of interactions between crypto-assets and financial markets, particularly during periods of crisis or high volatility. Subsequently, it would be necessary to integrate other explanatory variables, such as differentiated regulatory developments (by geographic zone) or technological innovation, which are playing an increasingly important role. Finally, extending the study to other crypto-assets would refine our understanding of the specificities of each market. More broadly, Bitcoin's evolution appears as a barometer of the state of the global financial system: it behaves as an indicator of risk appetite, sensitive to monetary policy and liquidity cycles, while retaining an idiosyncratic dimension linked to its unique architecture. This duality explains both its appeal and its complexity in being integrated into a rational asset allocation.

Datasets :

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