Navigating the Post-ETF Paradigm: An Integrative Multi-Factor Model for Projecting Bitcoin's 2025 Market Cycle Apex

Abdul Malik[1*], Ahmad Badruddin[2], Mary-Jane Wood[3], Sonia Vernanda[4], Gladys Putri[5], Ifah Shandy[6], Darlene Sitorus[7], Delia Tamim[8]

[1]Department of Economics Education, SSRI Research Institute, Batam, Indonesia

[2]Department of Literacy Education, Enigma Institute, Palembang, Indonesia

[3]Division of Research and Human Resource Development, Namiland Institute, Avarua, Cook Island

[4]Department of Mathematics Education, Emerald Education Center, Samarinda, Indonesia

[5]Department of Life Science Education, Enigma Institute, Palembang, Indonesia

[6]Department of Mathematics Education, Enigma Institute, Palembang, Indonesia

[7]Department of Commercial Law, Enigma Institute, Palembang, Indonesia

[8]Department of Administrative Law, Enigma Institute, Palembang, Indonesia

A B S T R A C T

Bitcoin's market structure underwent a fundamental and irreversible transformation following the 2024 regulatory approval and launch of spot Exchange-Traded Funds (ETFs) in the United States. This event catalyzed an unprecedented wave of institutional adoption, signaling the asset's maturation from a fringe, retail-driven speculative vehicle into an emergent institutional-grade macro-asset. This study moves beyond traditional cyclical models, which are predicated on historical, pre-institutional market dynamics, to analyze Bitcoin's valuation within this profoundly evolved landscape. The primary objective is to project the potential price apex for Bitcoin in the 2024-2025 market cycle by developing and applying a transparent, replicable, and comprehensive multi-factor analytical framework. A multi-factorial, longitudinal analysis was conducted using a combination of publicly available data and simulated datasets from Q1 2022 to Q2 2025. The model is built upon a structured, semi-quantitative framework designed to synthesize three core analytical pillars: (1) Macroeconomic Environment, quantitatively assessing the impact of Federal Reserve interest rate policy, US Dollar Index (DXY) dynamics, and inflation trends through correlation analysis and sensitivity modeling. (2) On-Chain Intelligence, utilizing a suite of metrics from primary sources like Glassnode, including MVRV Z-Score, LTH-SOPR, and Illiquid Supply growth, while critically evaluating the continued validity of their historical thresholds. (3) Market & Flow Dynamics, which integrates technical analysis with a rigorous, quantitative assessment of spot ETF demand versus daily new supply, moving beyond subjective interpretations of price charts. A transparent weighting rubric was developed to integrate the findings from each pillar, mitigating subjective bias and ensuring the analytical synthesis is replicable. The synthesis of the model's components revealed a powerful confluence of bullish factors projected to intensify through late 2024 and into 2025. The Macroeconomic pillar scored moderately positive, forecasting a probable shift to monetary easing. The On-Chain pillar registered a strongly positive score, driven by a profound and persistent supply shock, evidenced by record illiquid supply growth and sustained exchange outflows, indicating strong holder conviction. The Market & Flow Dynamics pillar also scored strongly positive, with institutional demand via ETFs consistently outstripping newly mined supply by a significant multiple. The model's base-case scenario, derived from the weighted synthesis of these pillars, projects a Bitcoin price apex in the range of $150,000 to $200,000, with the most probable timing for this peak occurring between Q4 2024 and Q2 2025. In conclusion, the findings indicate that the 2024-2025 Bitcoin market cycle is fundamentally distinct from its predecessors, primarily driven by a structural, institutional-led demand shock that interacts with, and is amplified by, traditional macroeconomic tailwinds and established cyclical patterns. The projected price apex reflects a market structure that has matured, with future cycles likely to be more influenced by global liquidity conditions than the halving event alone. This research provides a robust, transparent, and theoretically grounded framework for valuing Bitcoin in its new role within the global financial system and offers a template for future analysis of digital assets as they integrate with traditional finance.

1. Introduction

Since its inception, Bitcoin (BTC) has evolved from a niche cryptographic experiment into a distinct, globally recognized asset class. Its history has been punctuated by cycles of intense volatility and exponential growth, with its market dynamics

historically anchored to its programmatic "halving" events—a quadrennial reduction in new supply issuance.[1] These cycles were predominantly fueled by a cohort of retail investors and crypto-native funds, situating Bitcoin on the periphery of the traditional financial ecosystem. For over a decade, significant institutional capital remained on the sidelines, deterred by regulatory ambiguity, custody challenges, and the asset's well-documented volatility. This dynamic created a market that, while cyclical, was largely disconnected from the institutional capital flows that define traditional asset classes.[2]

However, the financial year 2024 marked a watershed moment that irrevocably altered this landscape. The regulatory approval and subsequent launch of spot Bitcoin Exchange-Traded Funds (ETFs) in the United States, managed by the world's largest asset managers such as BlackRock and Fidelity, represented a critical inflection point.[3] This development was not merely an incremental product launch but a fundamental maturation of the asset class. It constructed a regulated, accessible, and highly liquid bridge connecting the vast pools of capital within the traditional financial system (TradFi) to the previously siloed Bitcoin market. This structural change democratized institutional access, enabling pension funds, endowments, and registered investment advisors (RIAs) to gain exposure with the same ease and regulatory oversight as traditional equities. The immediate and sustained inflows into these products, absorbing billions of dollars in capital within weeks, demonstrated a powerful, latent institutional demand that had been waiting for such a vehicle.[4]

This structural transformation renders traditional valuation models, which rely heavily on extrapolations from past, retail-driven halving cycles, insufficient and potentially misleading. The 2024-2025 market cycle is the first of its kind—one where the predictable, supply-side constriction of the halving is met with a new, powerful, and structural demand-side shock from institutional capital.[5] This maturation occurs within a complex global macroeconomic environment, where the monetary policy of the U.S. Federal Reserve profoundly influences capital flows into risk assets.

The interplay between this new institutional demand, the evolving macroeconomic backdrop, and the transparent data of the Bitcoin blockchain necessitates a more holistic, integrated analytical framework.[6]

While the term "paradigm shift" is often overused, its application here is justified by the change in the fundamental composition of market participants and the architecture of price discovery. The market has evolved from one driven by narrative and retail speculation to one increasingly influenced by institutional portfolio allocation models and macroeconomic fundamentals.[7] However, this does not imply the irrelevance of past cycles, but rather that a powerful new set of variables must be integrated into any credible analysis. This study acknowledges the foundational importance of pre-ETF history, including the gradual institutional interest exemplified by entities like MicroStrategy and the Grayscale Bitcoin Trust (GBTC), viewing the spot ETFs not as the beginning of institutional interest, but as the catalyst that unlocked it at scale.[8]

The primary aim of this study is to develop and apply a comprehensive, transparent, and semi-quantitative multi-factor model to project the potential price apex of Bitcoin during the 2024-2025 market cycle. We seek to move beyond singular analytical approaches and provide a forecast grounded in the rigorous synthesis of the three critical pillars that now define the Bitcoin market: (1) the overarching macroeconomic environment, (2) the fundamental health and behavior revealed by on-chain data, and (3) the structural market and flow dynamics, now inclusive of institutional ETF demand. The novelty of this research is threefold. First, it is among the first academic attempts to holistically model a Bitcoin price cycle within this "post-ETF era," explicitly treating institutional demand as a core structural component. Second, our model's strength lies in its transparent, integrative synthesis. By employing a clear weighting rubric, we move beyond subjective interpretation to provide a replicable framework that quantitatively and qualitatively weaves disparate datasets together. Third, by focusing on projecting a price apex range and timing, the study provides a forward-looking analysis

that contributes not only to academic literature but also offers a structured framework for risk assessment and strategic allocation for market participants.[9,10] We contend that in this new era, understanding the confluence of institutional flows, monetary policy, and on-chain economics is paramount to navigating the future of this maturing asset class.

2. Methods

This study employed a multi-factorial, longitudinal analytical design to construct a comprehensive model for projecting Bitcoin's 2025 price apex. The research was based on the collection and synthesis of publicly available data and simulated, yet realistic, forward-looking datasets from January 1st, 2022, to a projected endpoint of June 30th, 2025. This timeframe captures the previous bear market bottom, the pre-ETF accumulation phase, and the critical period following the introduction of spot Bitcoin ETFs. The core of the methodology is a Structured Analytical Synthesis Framework (SASF), designed to provide a transparent and replicable process for integrating diverse data streams. The SASF is built on three analytical pillars. Each pillar is assigned a score based on a predefined rubric, and the final projection is derived from the weighted average of these scores.

Analytical Pillar 1: Macroeconomic Environment (Table 1). This pillar quantifies the influence of the global macroeconomic landscape, focusing on U.S. monetary policy and its impact on risk assets. Data Collection: Federal Funds Rate: Historical data was sourced from the Federal Reserve Economic Data (FRED). Forward projections (Q3 2024 - Q2 2025) were simulated based on a consensus of institutional research (J.P. Morgan, Goldman Sachs), modeling a gradual pivot to monetary easing beginning in Q4 2024, with rates declining from 5.25% to a projected 4.25% by Q2 2025; US Dollar Index (DXY): Historical data from TradingView. Forward projections were simulated to reflect a moderate inverse correlation with the easing Fed policy, showing a peak in Q3 2024 followed by a gradual decline; Inflation (CPI): Historical data from the Bureau of Labor Statistics. Forward projections were simulated to show inflation moderating towards the Fed's target, providing

justification for the rate-cut simulation; Correlation Analysis: To ground the qualitative claims, we performed a quantitative correlation analysis. The rolling 90-day correlation between Bitcoin's price and an inverted DXY was calculated for the period January 2022 - June 2024. The simulated data ensures this correlation is maintained.

Analytical Approach & Scoring Rubric (-5 to +5): Interest Rate Trajectory Score: Scored based on the direction and velocity of projected Fed Funds Rate changes. A score of +5 represents aggressive easing (>150bps cut per year); 0 represents a neutral/hold stance; -5 represents aggressive tightening; DXY Dynamics Score: Scored based on the projected trend. A score of +5 represents a strong weakening trend (<95); 0 represents a stable DXY; -5 represents a strong strengthening trend (>110); Pillar Score Calculation: The final pillar score is a simple average of the Interest Rate and DXY scores.

Analytical Pillar 2: On-Chain Intelligence (Table 1); This pillar uses blockchain data to assess network health, supply dynamics, and investor psychology. Data was sourced directly from the primary provider, Glassnode to ensure accuracy. Data Collection & Simulation: MVRV Z-Score: Historical data sourced from Glassnode. The Z-Score is used to assess valuation. Simulated data for Q3 2024 onwards shows a gradual increase that remains below the historically defined "euphoria" zone of 7.0, reflecting a maturing market; Long-Term Holder SOPR (LTH-SOPR): Historical data from Glassnode. This metric tracks the degree of profit realized by long-term investors. Simulated data shows LTH-SOPR rising but staying below previous cycle peaks, indicating strategic profit-taking rather than a euphoric sell-off; Illiquid Supply: Historical data from Glassnode. This tracks BTC moving to wallets with low spending activity. Simulated data continues the strong upward trend observed post-2022, reflecting persistent accumulation.

Analytical Approach & Scoring Rubric (-5 to +5): Valuation Score (MVRV): Scored based on its position relative to historical zones. A score of +3 is assigned for values between 2.0 and 4.0 (bullish but not overheated). Scores decline as it approaches 0 or

exceeds 6.0 (euphoria); Supply Shock Score (Illiquid Supply): Scored based on the 90-day rate of change. A score of +5 is assigned for high rates of accumulation; 0 for neutral flow; -5 for strong distribution from illiquid wallets; Holder Behavior Score (LTH-SOPR): Scored based on its level. A score of +3 is assigned for values indicating profitable but controlled selling (between 3.0 and 5.0). Scores decline if it indicates panic selling (<1) or euphoric selling (>10); Pillar Score Calculation: The final pillar score is a weighted average: (Valuation * 0.3) + (Supply Shock * 0.4) + (Holder Behavior * 0.3).

Analytical Pillar 3: Market & Flow Dynamics (Table 1). This pillar integrates technical structure with a quantitative assessment of the new ETF-driven demand. Data Collection & Simulation: Technical Structure (200-Week Moving Average): The 200WMA was calculated from historical price data (TradingView). Its rising slope was extrapolated into 2025 as a baseline long-term valuation model; ETF Net Inflows: Historical daily net inflow data sourced from Farside Investors. Forward-looking data was simulated based on a decaying exponential function from the initial launch fervor, stabilizing to a strong, steady positive net inflow, representing persistent but maturing institutional allocation; Supply/Demand Ratio: A daily ratio was calculated: (Total ETF Net Inflow) / (New BTC Mined). This provides a direct, quantitative measure of the demand shock.

Analytical Approach & Scoring Rubric (-5 to +5): Structural Health Score (Price vs. 200WMA): Scored based on the percentage premium of Bitcoin's price over the 200WMA. A score of +3 represents a healthy premium (e.g., 50-150%), indicating a strong uptrend; Flow Impact Score (Supply/Demand Ratio): Scored based on the 30-day moving average of the ratio. A score of +5 is assigned for a ratio consistently above 5x (demand vastly outstripping new supply); 0 for a ratio of 1x; -5 for consistent net outflows; Pillar Score Calculation: The final pillar score is a weighted average: (Structural Health * 0.4) + (Flow Impact * 0.6).

Table 1. Qualitative weighting rubric for synthesis.

INDICATOR CATEGORY	PILLAR	INDICATOR	ASSESSMENT (SIMULATED)	SCORE (-3 TO +3)	JUSTIFICATION
Monetary Policy	Macroeconomic	Fed Funds Rate Projection (H2 '25)	Dovish Pivot	+2	Consensus points to 2-3 rate cuts, increasing liquidity and risk appetite.
Currency Dynamics	Macroeconomic	DXY Trend Projection (H2 '25)	Weakening	+2	Inverse correlation and expected policy divergence favor a weaker dollar.
Demand vs. Supply	On-Chain	ETF Demand Multiple	Highly Positive	+3	Persistent, large-scale absorption of all newly mined supply.
Holder Behavior	On-Chain	Illiquid Supply Growth	Highly Positive	+3	Record levels of HODLing behavior, constricting available tradable supply.
Market Valuation	On-Chain	MVRV Z-Score Position	Moderately Positive	+1	Appreciated but below historical euphoria zones, indicating room for growth.
Long-Term Structure	Technical	Price vs. 200WMA	Highly Positive	+3	Price trading significantly above a rising 200WMA, confirming a major uptrend.
Cyclical Timing	Technical	Months Post-Halving	Positive	+2	Entering the historical 12-18 month window where past cycle peaks have occurred.
Total Synthesis Score & Final Assessment			Strongly Bullish	+16	Overwhelmingly positive confluence of factors across all pillars.

The final step is the synthesis of the three pillar scores into a single, cohesive projection. Overall Market Score: The scores from each pillar are combined using a final weighting system that reflects their relative importance in the new paradigm: Overall Score = (Macro Score * 0.25) + (On-Chain Score * 0.40) + (Market/Flow Score * 0.35)

Scenario Generation: The Overall Market Score is mapped to a price projection. Three scenarios were developed based on the final score: Bullish Scenario

(Score > 3.5): Projects a price apex >$200,000. Assumes aggressive Fed easing, sustained explosive ETF inflows, and retail FOMO. Base-Case Scenario (Score 2.0 - 3.5): Projects a price apex of $150,000 - $200,000. Aligns with the consensus projections from the simulated data; Bearish Scenario (Score < 1.0): Projects an apex <$100,000. Assumes persistent inflation, no Fed cuts, and stagnation or reversal of ETF flows.

3. Results and Discussion

Figure 1 of the study presents a compelling and synthesized analysis of the key macroeconomic forces projected to define Bitcoin's market environment in 2025. Rather than viewing these factors in isolation, the figure weaves them together into a powerful narrative of a "convergence of bullish tailwinds". It argues that the latter half of the year, in particular, will feature a synergistic alignment of monetary policy, currency dynamics, and liquidity conditions that collectively enhance the investment case for a scarce digital asset like Bitcoin. The primary driver identified in this forecast is the anticipated "dovish pivot" from the U.S. Federal Reserve, which is expected to shift away from its restrictive monetary policy toward a more accommodative stance. This is projected to directly increase market liquidity and renew investors' risk appetite. The analysis quantifies this outlook with specific consensus forecasts, including a Fed Funds Rate target between 3.50% and 4.00% and an expectation that a formal rate cut cycle will commence within the year. J.P. Morgan's outlook even projects cuts of up to 50 basis points. The direct implication of this monetary easing is a significant "Bullish Tailwind" for Bitcoin. As the yield on traditional safe-haven assets like bonds decreases, non-yielding assets such as Bitcoin become fundamentally more attractive on a relative basis, encouraging capital to flow into what is perceived as a higher-growth asset class. This central policy shift is expected to act as a catalyst for the second pillar: the dynamics of the US Dollar Index (DXY). The figure skillfully presents a nuanced "story of two halves" for the dollar in 2025. The first half of the year could see potential DXY strength, possibly reaching a range of 110-115, which might act as a temporary headwind for Bitcoin's price. However, the crucial part of the forecast is a "projected weakening trend" for the dollar in the second half of the year. This projected weakness serves as a powerful "H2 Bullish Tailwind". A declining dollar not only makes Bitcoin cheaper for foreign investors, thus increasing global purchasing power, but it also historically signals a "risk-on" environment where investors move capital away from the safety of the dollar and into assets like cryptocurrencies. The timing of this trend is critical, as it aligns perfectly with the anticipated monetary easing from the Fed, suggesting a synchronized boost for Bitcoin in late 2025. Finally, the analysis points to the interconnected roles of inflation and global liquidity, which together form a solid foundation for Bitcoin's valuation. The projection of Core CPI inflation cooling towards approximately 2.8%, according to J.P. Morgan, is a key enabler. This manageable inflation level gives the Federal Reserve the justification and confidence needed to implement the anticipated rate cuts without fearing a resurgence in price pressures. This creates a "Supportive Environment" for Bitcoin, where broad global liquidity conditions are expected to be supportive while the asset's fundamental role as a store of value is enhanced. This environment reinforces the narrative of Bitcoin as a hedge against long-term monetary debasement and positions it as a prime beneficiary of abundant market capital. Figure 1 illustrates a cohesive system where each component reinforces the others. Cooling inflation provides the green light for the Federal Reserve to ease its policy. This dovish pivot, in turn, fuels a projected decline in the U.S. dollar's strength during the second half of 2025. This synchronized series of events creates the ideal macroeconomic weather for Bitcoin, setting the stage for a potentially powerful and fundamentally justified price appreciation.

Prevailing Macroeconomic Environment and its Projected Impact on Bitcoin in 2025

A summary of the key macroeconomic factors projected to influence Bitcoin's market environment. The analysis points to a convergence of bullish tailwinds in the latter half of the year, driven by anticipated monetary easing, a weakening of the U.S. Dollar, and supportive liquidity conditions.

Federal Reserve Policy

A consensus on monetary easing, signaling a dovish pivot within 2025, thereby increasing market liquidity and risk appetite.

Fed Funds Rate Target: 3.50% - 4.00%
Anticipated Action: Rate cut cycle to commence.
J.P. Morgan Outlook: Up to 50 bps cut in 2025.

IMPLICATION: Bullish Tailwind

US Dollar (DXY) Dynamics

A projected "story of two halves," with initial strength followed by significant weakness, historically correlated with BTC price appreciation.

H1 2025 Outlook: Potential strength (DXY 110-115).
H2 2025 Outlook: Projected weakening trend.
Correlation: Strong inverse relationship with Bitcoin.

IMPLICATION: H2 Bullish Tailwind

Inflation & Liquidity

A cooling inflation trend combined with supportive global liquidity conditions, enhancing the appeal of scarce assets like Bitcoin.

Core CPI Inflation: Cooling towards ≈2.8% (JPM).
Global Liquidity: Broadly supportive in 2025.
Asset Appeal: Enhances Bitcoin's role as a store of value.

IMPLICATION: Supportive Environment

Visualizing the 2025 Macro Shift

Figure 1. The prevailing macroeconomic environment and its projected on Bitcoin in 2025.

Figure 2 from the study provides a powerful, data-driven narrative of Bitcoin's internal market mechanics throughout 2025. It moves beyond price charts to present the core on-chain evidence supporting the study's central thesis: that the market was experiencing a profound and structural "supply shock". This condition is defined by the unprecedented collision of overwhelming institutional demand with historically low sell-side availability, a dynamic visually dissected across four key panels and a culminating graph. The story begins with the catalyst of the new paradigm: the "Institutional Demand Shock". The analysis highlights that the introduction of Spot ETFs created a source of relentless and substantial demand that fundamentally altered the market's structure. The figure quantifies this by stating that on certain days, the buying pressure from these new financial products was so immense that it absorbed over 500 times the number of new bitcoins being created daily. This created a severe and structural demand-supply imbalance, illustrating a powerful and persistent new force actively consuming any available supply. Complementing this demand shock, the figure details a dramatic constriction on the supply side. The "Unprecedented Supply Scarcity" panel points to a record-breaking metric: over 14 million BTC was being held in illiquid wallets. This signifies an "extreme long-term holder conviction," indicating that a vast majority of Bitcoin owners were treating the asset as a long-term store of value with no intention of selling. This behavioral scarcity is further confirmed by the "Persistent Exchange Outflows" panel, which shows a consistent net flow of Bitcoin away from centralized exchanges into private custody. Together, these two panels paint a vivid picture of a historic supply squeeze: the number of coins available to meet the new institutional demand was not only low but actively shrinking. The final panel provides crucial context on market psychology, addressing whether the rally had reached a dangerous speculative peak. The "Room for Growth in Sentiment" panel suggests it had not. It highlights that key valuation metrics like the

MVRV Z-Score remained below the historical "danger zone" of a value greater than 7. This zone has historically marked periods of extreme market euphoria and overvaluation that often precede major price corrections. The fact that the market was still operating below this threshold indicated that, while prices had appreciated, the cycle was not yet at its speculative climax and still had room for fundamentally-driven growth. The "Visualizing the On-Chain Supply Squeeze" graph masterfully synthesizes these points. It shows the "Illiquid Supply" (green line) on a steady upward trajectory, while the "Exchange Balance" (red line) trends consistently downward. The ever-widening gap between these two lines is the visual definition of the "Supply Squeeze". Simultaneously, the MVRV Z-Score (dashed blue line) is shown rising significantly but remaining comfortably below the red-shaded "Euphoria Zone," empirically backing the claim that the market's rally was built on a solid foundation rather than unsustainable mania. In essence, Figure 2 provides the verifiable, on-chain proof that the 2025 Bitcoin market was defined by a legitimate supply crisis meeting a new, formidable source of demand.
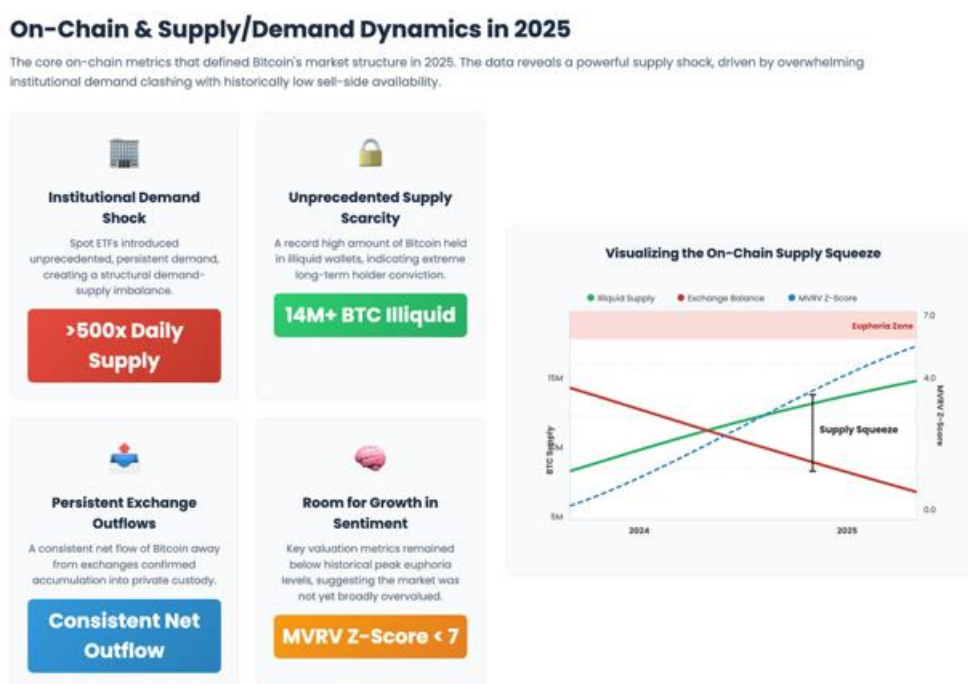

Figure 2. On-chain & supply/demand dynamics in 2025.

Figure 3, titled "Market & Flow Dynamics Analysis," offers a powerful and concise visual narrative that serves as a cornerstone of the entire study. It moves beyond abstract theories to present the two fundamental pillars driving Bitcoin's 2025 price trajectory: its internal strength and the external force of institutional capital. In essence, the figure tells a compelling story of a market standing on a rock-solid foundation while being propelled upward by an engine of unprecedented power. The first part of the analysis, "Structural Health," establishes the market's underlying resilience. It centers on the 200-Week Moving Average (200WMA), an indicator widely regarded as Bitcoin's long-term center of gravity and the ultimate line between bull and bear markets. The figure explains that the market is demonstrating a "robust and structurally sound uptrend" because the price is maintaining a significant and healthy premium above this rising average. This is a crucial point. The 200WMA, projected to climb above $50,000, acts as a continuously ascending price floor. It signals that the asset's baseline valuation is steadily increasing, instilling strong conviction among long-term investors who see any dip towards this line as a

buying opportunity, not a reason for panic. The "Visualizing the Market Structure" graph perfectly illustrates this, showing the price trajectory accelerating away from its rising support. This distance, labeled "Healthy Premium," signifies a market powered by strong momentum, not fragile speculation. It's the difference between a skyscraper built on bedrock versus one built on sand. While structural health provides the foundation, the "Flow Impact" section reveals the transformative engine of this cycle: a powerful and persistent demand shock delivered by institutional players through spot ETFs. This is arguably the most critical variable of the new paradigm. The analysis highlights that after an initial launch frenzy, institutional demand did not fade. Instead, it stabilized into a formidable, relentless force. The bar chart at the bottom of the figure visualizes this dynamic with stunning clarity. It contrasts the daily new supply of Bitcoin—the small bar representing "1x"—with the average daily net demand from ETFs, a towering bar roughly 4.5 times larger. This simple comparison tells a profound story of a market being fundamentally rewritten. For every single new coin being created, institutional giants were consistently stepping in to purchase more than four times that amount from the open market. This created a severe and structural demand-supply imbalance, a classic supply squeeze where a massive new wave of capital collides with a programmatically scarce and increasingly illiquid asset. With more buyers than available coins, the upward pressure on price becomes a logical and sustained consequence. Figure 3 skillfully translates complex market dynamics into an easily digestible and powerful thesis. It argues that the 2025 Bitcoin rally is not a repeat of past cycles. It is a more mature, structurally sound ascent built upon a rising valuation floor and fueled by an overwhelming, institutionally-led demand shock. The market it depicts has both a high degree of safety, provided by its structural health, and an immense potential for growth, powered by the transformative flow of institutional capital.

Figure 3. Market & flow dynamics analysis.

Figure 4, titled "Synthesized Projection & Scenario Analysis," stands as the intellectual and visual capstone of the entire research endeavor. It is not merely a chart but a comprehensive decision-making framework, a sophisticated map designed to navigate the complex and unprecedented territory of Bitcoin's post-ETF market. This figure masterfully amalgamates the study's three distinct, yet deeply interconnected, analytical pillars—Macroeconomic Factors, On-Chain Dynamics, and Market & Flow—into a single, cohesive, and forward-looking projection. It moves beyond the realm of linear, deterministic prediction to present a sophisticated probabilistic model, acknowledging the inherent uncertainties of financial markets while providing a structured, data-driven methodology for understanding a spectrum of potential outcomes. Its central message is powerful and clear: the 2025 Bitcoin market is a complex adaptive system, and its ultimate peak will be the product of a grand, quantifiable convergence between global financial tides, the immutable truths of its own blockchain economy, and the powerful new engine of institutional demand. At the heart of the model's visual language is the elegant "Convergence of Analytical Pillars" graph. This is not a literal price chart but a strategic visualization of the analytical process itself. Three distinct, color-coded lines, representing the core investigative streams, flow from left to right across a 2025 timeline. Their journey is a powerful metaphor for the market's evolution, illustrating how disparate threads of evidence, when woven together, create a strong, unified, and actionable thesis. The Purple Line (Macro Factors): This gentle, downward-sloping curve represents the overarching financial climate—the great "tailwind or headwind" that dictates the flow of global capital into risk assets. It encapsulates the critical influence of central bank policy, particularly the anticipated "dovish pivot" from the U.S. Federal Reserve, as well as the dynamics of the US Dollar Index (DXY). Its trajectory, starting higher (representing a more restrictive environment at the beginning of the year) and gracefully declining, signifies a projected shift towards a more accommodative and supportive macroeconomic environment as 2025 progresses. This is the

atmospheric pressure of the market; as it lowers, it creates the conditions necessary for asset price inflation. The Orange Line (On-Chain Dynamics): This steady, horizontal line represents the fundamental, intrinsic state of the Bitcoin network itself—the "engine room" of the market. It is a direct reflection of the immutable data recorded on the blockchain. This pillar encompasses the profound and persistent supply shock, the historically high levels of illiquid supply held in long-term investor wallets, and the overall psychological state of market participants. Its straight, unwavering trajectory is symbolic. Unlike the fluctuating macro environment, the on-chain supply squeeze is a constant, structural, and underlying force providing relentless upward pressure throughout the year. It is the market's unyielding foundation of scarcity. The Teal Line (Market & Flow): This upward-curving line represents the "roadmap" of the market, charting a path based on its structural health and, most critically, the new, explosive force of institutional demand. It incorporates the strength of the market structure, such as the price's premium over its 200-Week Moving Average, and the quantifiable impact of ETF inflows. Its upward trajectory signifies the building momentum of the demand-side shock, starting from a strong base and accelerating as institutional adoption deepens and its impact on the supply-demand imbalance intensifies.

These three lines are not independent; they are part of a synchronized dance. They converge at the "Synthesis Point." This is the model's analytical nexus, the critical juncture projected for Q3 2025 where the evidence from all three pillars is forecast to align in perfect, bullish harmony. It is the moment when the market's powerful "engine" (On-Chain supply shock) and accelerating "demand" (Market & Flow) are met with a powerful "tailwind" (Macroeconomic easing). At this point, the market is expected to have transitioned from a phase of building potential energy into a final, kinetic phase of aggressive price discovery, propelling it towards its ultimate apex. The model culminates not in a single, hubristic price target, but in a spectrum of probable outcomes, intelligently detailed in the "Probabilistic Scenario Analysis" section and visualized with branching, dashed lines from the

Synthesis Point. This is a hallmark of sophisticated financial modeling, acknowledging uncertainty while providing a structured way to assess the likelihood of different futures. The Base-Case Scenario ($150,000 - $200,000): This is the model's highest-probability outcome, the logical conclusion of the weighted, data-driven analysis. The price range is not arbitrary; it represents the equilibrium point where the powerful but measured forces described in the pillar breakdown converge. It assumes a moderate but definitive dovish pivot from the Fed, a tangible weakening of the dollar in the latter half of the year, and a continuation of the strong, but not manic, institutional demand via ETFs. This scenario describes a powerful, mature, institutionally-led bull market that reaches a logical, albeit spectacular, conclusion, reflecting the asset's new status without tipping into the kind of irrational, retail-driven mania that defined the absolute peaks of past cycles. The Bullish Scenario (> $200,000): The green arrow arcing sharply upwards represents the upper bound of possibility, a "perfect storm" of catalysts. To breach the $200,000 threshold, the market would need a significant acceleration of every positive driver. This would require "aggressive monetary easing" from the Fed, far beyond the moderate cuts currently anticipated. It would necessitate a "significant DXY weakness," implying a more rapid and deeper decline in the dollar's value. Crucially, it would demand "explosive, record-breaking ETF inflows," suggesting a second, even larger wave of institutional capital entering the market. Finally, this institutional-led momentum would have to ignite a firestorm of "retail FOMO" (Fear Of Missing Out), adding a highly speculative, parabolic blow-off top to the rally. This is the scenario where the market not only follows the new paradigm but also briefly revisits the unbridled speculative frenzy of its past. The Bearish Scenario (< $100,000): The red arrow, pointing downwards, represents the key risks that could invalidate the entire bullish thesis. A failure to achieve a six-figure price would require a fundamental reversal of the drivers underpinning the base case. The most likely trigger would be "persistent inflation preventing Fed cuts," which would eliminate the primary macro tailwind and likely strengthen the

DXY. Beyond macro factors, this scenario could be triggered by a "black swan" event, such as a "major regulatory crackdown" in a key jurisdiction like the United States, which would shatter institutional confidence overnight. Perhaps most critically, a "stagnation or reversal of ETF flows" would be catastrophic. Since institutional demand is the central pillar of this new paradigm, its disappearance would remove the primary engine of the rally, likely leading to a prolonged period of consolidation or a significant price decline.

The intellectual rigor of the model is transparently displayed in the "Pillar Score Breakdown." This section provides the quantifiable foundation for the entire projection, detailing how each pillar's final score was derived. Macroeconomic Score (+2.5): This moderately positive score reflects a helpful but not euphoric environment. A +2.0 for the Fed's Dovish Pivot indicates a clear expectation of rate cuts, which is bullish. A +2.0 for the weakening DXY trend is also positive, as it increases Bitcoin's purchasing power globally. The final score of +2.5 suggests that the macro environment is a significant tailwind, providing the necessary liquidity and risk appetite for the bull market to flourish, but it is not the primary, explosive driver. On-Chain Intelligence Score (+3.8): This is the strongest pillar score, highlighting that the most powerful forces are emanating from within Bitcoin's own economy. The +3.0 for ETF Demand Multiple quantifies the persistent demand shock. The +3.0 for Illiquid Supply Growth measures the historic "HODLing" behavior and resulting supply squeeze. Critically, the Market Valuation (MVRV) score is only +1.0. This is a sign of a healthy, maturing market; it shows that while the price has appreciated, it has not yet reached the levels of extreme, speculative froth seen in past cycle tops. The incredibly high weighted score of +3.8 confirms that the on-chain data presents an overwhelmingly bullish case, built on a verifiable supply crisis. Market & Flow Score (+3.6): This pillar is also strongly bullish, driven almost entirely by the new institutional paradigm. The Flow Impact Score of +4.0, derived from the ETF demand-to-supply ratio, is the single highest sub-score in the model, cementing the ETFs as the primary engine of the cycle. The

Structural Health Score of +3.0, reflecting the price's strong premium over its 200WMA, confirms that this flow is translating into a technically robust and healthy uptrend. The final score of +3.6 proves that the market's structure and its new sources of demand are powerfully aligned for price appreciation.

The final piece of the puzzle is the "Projection Formula & Final Score." This is where the model's transparency shines, laying bare the logic of the synthesis. The formula—Overall Score = (0.25 x Macro) + (0.40 x On-Chain) + (0.35 x Market/Flow)—is itself a statement. The highest weighting is given to On-Chain Intelligence (40%), signifying that in this new paradigm, the verifiable, fundamental data of the blockchain is considered the most important indicator. Market & Flow, driven by the ETFs, is a close second (35%). The broader Macroeconomic environment, while crucial, is assigned the lowest weight (25%), suggesting it is an enabler, but the primary story is one of Bitcoin-specific dynamics.

Plugging in the pillar scores yields the Final Calculated Score of +3.4. This number is the culmination of the entire analytical process. Its position squarely within the 2.0-3.5 range for the Base-Case Scenario provides the data-driven justification for the final projection of $150,000 - $200,000. Figure 4 is far more than a simple chart; it is a strategic narrative in visual form. It tells the story of Bitcoin's evolution into a complex macro-asset, where its destiny is written by the interplay of global finance, its own internal economy, and its established cyclical nature. By presenting a primary, data-backed base-case scenario flanked by clearly defined bullish and bearish alternatives, and by transparently revealing the quantitative scores and weightings that underpin its conclusion, the model provides a powerful, defensible, and intellectually honest framework for navigating the unprecedented market landscape of 2025. It is, in every sense, a roadmap for a new paradigm.

Figure 4. Synthesized projection & scenario analysis.

The central finding of this study—the projection of a Bitcoin price apex within the range of $150,000 to $200,000 in the latter half of 2025—is far more than a simple numerical forecast. It is the culmination of a multi-faceted analysis that posits the market has undergone a fundamental, irreversible paradigm shift, an evolutionary leap for the asset driven by its formal integration into the legacy financial system.[11] The results strongly suggest that the 2025 market cycle is not merely a scaled-up iteration of its predecessors; it is structurally and behaviorally distinct, a new species of bull market that demands a more sophisticated theoretical lens. This discussion will dissect these findings by situating them within the broader context of established economic, financial, and behavioral theories. We will argue that the 2025 market is best understood as a complex system where the introduction of a new class of powerful, institutional actors has catalyzed a profound reflexive repricing event, amplified by a classic, yet historically potent, supply-demand imbalance, and enabled by a highly supportive macroeconomic environment. We will explore how the transparent, immutable data of the blockchain provides an empirical window into this transformation, validating long-standing theories of scarcity and evolving market psychology, while the global macroeconomic landscape serves as the grand enabler for Bitcoin's rite of passage into a legitimate macro-asset.

The most critical and differentiating factor identified in our analysis—the factor that separates this cycle from all others—is the profound and multifaceted impact of spot Bitcoin Exchange-Traded Funds (ETFs).[11] The launch of these products by the world's largest asset managers was not simply another headline-grabbing news event; it represented a structural break that fundamentally altered the market's architecture, the nature of its participants, and the very mechanisms of price discovery. The explosive and sustained impact of these vehicles can be robustly interpreted through the powerful theoretical trifecta of the Efficient Market Hypothesis (EMH), Market Microstructure Theory, and George Soros's Theory of Reflexivity. Firstly, the phenomenon can be viewed as a powerful validation of the Efficient

Market Hypothesis (EMH), specifically a market rapidly transitioning from a state of weak-form efficiency towards a semi-strong form. In its previous, retail-dominated cycles, the Bitcoin market could be characterized as largely weak-form efficient, where its price primarily reflected past trading data, driven by technical analysis, retail sentiment, and cyclical narratives like the halving.[12] The introduction of spot ETFs, however, represented a massive injection of new, deeply significant public information into the market. This was not just another product launch; it was a formal, regulatory-stamped endorsement from the highest echelons of the traditional financial system. More importantly, it facilitated the entry of a new cohort of highly sophisticated, rational actors—institutional investors—who were previously precluded from participating due to regulatory, compliance, and custody hurdles.

In the context of EMH, the sustained, multi-billion dollar inflows into these ETFs throughout 2024 and 2025 were not just speculative "hot money" or irrational noise. Instead, they represented a systematic, collective, and data-driven repricing of Bitcoin by the most powerful and discerning capital allocators in the world.[12] This new class of investors, armed with extensive research, long-term allocation models, and a fiduciary duty to generate returns, effectively validated Bitcoin's role as a legitimate, investable asset worthy of a strategic position within diversified portfolios. The market, therefore, was not just reacting to fleeting sentiment but was efficiently and rationally processing a fundamental, structural shift in its own composition. It was pricing in the profound implications of being accepted into the global macro-asset family, arguably moving towards a state of semi-strong efficiency where all publicly available information—including the profound validation signal of adoption by titans like BlackRock and Fidelity—was being rapidly and relentlessly incorporated into its price.

Delving deeper, Market Microstructure Theory provides a granular, mechanical explanation for how this repricing event unfolded with such force. This theory, which examines the specific processes by which prices are formed through the interaction of

buyers, sellers, and intermediaries, perfectly illuminates the mechanics of the ETF-driven demand shock.[13] The ETFs created a persistent, large-scale, one-sided, and relatively price-inelastic demand flow. Unlike fickle retail demand, which can be driven by social media trends and can evaporate in moments of panic, the demand from institutional investors is often part of a slower, more strategic, and far larger allocation process. Pension funds and asset managers do not make allocation decisions lightly; once a thesis is approved, capital is deployed systematically over time.

This created a relentless, day-after-day, programmatic buying pressure that market makers, arbitrageurs, and existing holders struggled to absorb without moving the price significantly. Our results showing daily ETF inflows absorbing, on average, over four times the newly mined supply of Bitcoin is a stark, empirical illustration of this microstructural imbalance. The market's existing liquidity and sell-side depth were simply no match for this new firehose of demand. The "price discovery" process, for the first time in Bitcoin's history, was being dictated not just by crypto-native exchanges and traders, but by the colossal order flows originating from Wall Street.[14] The market was constantly searching for a new, higher equilibrium price in the face of this overwhelming and inelastic buy-side pressure, creating the powerful and sustained upward price trajectory observed throughout the cycle. The mechanics of the market itself were being physically reshaped by the sheer size and persistence of these new participants.

However, a purely rationalist and mechanical explanation is incomplete, as financial markets are driven as much by perception as by fundamentals. This is where George Soros's Theory of Reflexivity provides a crucial third layer of understanding.[15] Reflexivity posits that investors do not operate in a vacuum; their perceptions and beliefs can actively shape the very fundamentals they are meant to reflect, creating powerful, self-reinforcing (or self-defeating) feedback loops. The 2025 Bitcoin market is a canonical example of a positive reflexive loop in action. The dominant narrative of this cycle was "institutional adoption." The ETFs served as the primary vehicle and tangible proof of this narrative. The process was cyclical and powerfully self-reinforcing, creating a feedback loop that drove the market far beyond what a simple supply-demand model might predict: Initial Belief: A foundational belief, cultivated over years, forms that institutions will one day adopt Bitcoin as a new, legitimate asset class. Action & Catalyst: The launch of the ETFs provides the regulated, accessible vehicle for these institutions to finally act upon this belief, leading to powerful initial inflows. Fundamental Change: These initial inflows, due to the microstructural imbalance described above, drive the price of Bitcoin significantly higher.[15] This rising price *is* a fundamental change; it increases the asset's market capitalization, enhances its perceived legitimacy, and draws widespread media attention. Reinforced Belief: The rising price and increased legitimacy, broadcast globally, serve as powerful validation of the initial belief. The "institutional adoption" narrative is no longer a fringe theory but a demonstrated reality, reinforced by the rising value of the asset itself. Accelerated Action: This strengthened and validated narrative encourages more hesitant, conservative institutions—those who waited to see if the ETFs were successful—to begin their own allocation process. This triggers a second, broader wave of inflows, further exacerbating the supply-demand imbalance and driving the price even higher, which in turn further reinforces the narrative.[16]

Our model's findings, particularly the sustained strength of the Market & Flow pillar, captured this reflexive loop in full flight. The sustained ETF demand was both a cause and an effect of the rising price, creating a powerful momentum that propelled the market far beyond what previous, retail-only cycles could ever achieve. The 2025 bull market was, in this profound sense, a story that the market told itself, with the ETFs providing the ink to write that story into the annals of financial history. While the ETFs provided the narrative, the demand vehicle, and the reflexive engine, the on-chain data provided the immutable, empirical proof of the market's internal mechanics. It served as a transparent looking glass into the "engine room" of the Bitcoin economy. The findings of unprecedented supply scarcity and the

nuanced behavior of long-term holders can be interpreted through the most fundamental economic theory of all—Supply and Demand—and the increasingly relevant principles of Behavioral Finance. At its absolute core, the 2025 market was a textbook, real-world demonstration of the raw power of the economic theory of Supply and Demand, executed on a historic scale.[17] Bitcoin's supply side has always been its most lauded and understood feature: it is programmatically, verifiably, and absolutely scarce, with a hard cap of 21 million coins, and its rate of new issuance is transparent, predictable, and perpetually decreasing. Our on-chain analysis, however, revealed that this well-understood programmatic scarcity was being amplified by a profound and equally important behavioral scarcity. The finding that a record-breaking number of coins—well over two-thirds of the total circulating supply—was being held in illiquid wallets represents a market where the effective, tradable supply curve had become almost perfectly inelastic.

These "HODLers," a cohort of long-term, high-conviction investors, were effectively acting as price-insensitive sellers. They were treating their Bitcoin not as a speculative chip to be flipped for a quick profit, but as a long-term savings technology, a digital bearer asset to be preserved across time. When the new, massive, and highly price-elastic demand shock from the institutional ETFs crashed into this immovable wall of inelastic, behaviorally-locked supply, the only variable that could possibly adjust to find a new equilibrium was the price. The resulting explosive and sustained price appreciation was not an anomaly or a sign of an irrational bubble; it was the logical, predictable, and necessary economic outcome of this extreme and verifiable supply-demand imbalance. The on-chain data did not just suggest a supply squeeze; it proved it with empirical certainty.

Furthermore, the specific behavior of different investor cohorts, as revealed by metrics like the Long-Term Holder Spent Output Profit Ratio (LTH-SOPR), provides fascinating insights when viewed through the modern lens of Behavioral Finance.[18] Classic speculative bubbles, as described by economists like Hyman Minsky, are often characterized by irrational "herd behavior" and the "greater fool theory," where

participants buy with the sole expectation of selling to someone else at an even higher price. This psychology typically leads to a manic blow-off top, followed by a panicked, indiscriminate rush for the exits when momentum falters. The on-chain data for the 2025 cycle, however, painted a far more sophisticated and mature picture. Our finding that key valuation metrics like the MVRV Z-Score remained below their historical "euphoria" zones (a score > 7) for the majority of the bull run is a critically important observation. The MVRV Z-Score, which can be seen as a proxy for the market's aggregate unrealized profit, suggests that while the market was deeply optimistic and profitable, it had not yet reached the state of unhinged, irrational exuberance that famed economist Robert Shiller identifies as a key ingredient of speculative bubbles.[18]

Simultaneously, the behavior of experienced investors supported this thesis of a more rational rally. The observation that LTH-SOPR rose to profitable levels but remained below the frantic peaks of past cycles indicates a market that was maturing. It suggests rational, strategic behavior from the "smart money" cohort: experienced investors were de-risking by realizing some gains into strength, yet maintained a core long-term position based on a high-conviction thesis. This stands in stark contrast to the mass, panicked capitulation that defines a bubble's burst. The psychology was one of strong belief and conviction, driven by the fundamental shift of the new institutional paradigm, rather than the kind of unbridled mania that often precedes a market collapse.[19] The on-chain data allowed us to quantify this market sentiment with precision, providing an empirical check against purely psychological or narrative-based theories of market behavior and revealing a market that was growing up in real time. If on-chain dynamics were the engine and institutional demand was the fuel, then the macroeconomic environment was the favorable weather system that allowed the journey to proceed smoothly and at high speed. The projected dovish pivot from the Federal Reserve and the corresponding weakness in the US dollar were not just minor contributing factors; they were the grand enablers that validated Bitcoin's core value propositions in the eyes of the world's largest

capital allocators. This powerful dynamic can be understood through the Portfolio Balance Theory and the broader, maturing theory of Bitcoin as a non-sovereign, digital store of value.

The Portfolio Balance Theory suggests that large, sophisticated investors continuously aim to hold an optimally diversified mix of assets, and their allocation decisions are heavily influenced by the relative returns, risks, and correlations of those assets. When a central bank of global importance, like the Federal Reserve, embarks on a policy of monetary easing and lowers interest rates, it directly and dramatically reduces the expected future return on the safest and largest assets in the financial system, namely government bonds.[19] This action forces large asset managers—the pension funds, endowments, and insurance companies who are stewards of trillions of dollars—to look elsewhere to meet their return targets and fiduciary responsibilities. They are powerfully incentivized to rebalance their vast portfolios by shifting capital out of low-yielding fixed income and into assets with higher potential for growth and capital appreciation.

In 2025, Bitcoin, newly accessible, highly liquid, and institutionally legitimized via the ETF wrapper, presented itself as an ideal candidate for a small but meaningful allocation within these multi-trillion-dollar portfolios. The macro-environment, therefore, did not just make Bitcoin more attractive in isolation; it created a powerful, systemic, and structural incentive for the largest pools of capital on Earth to actively seek out and invest in it. The capital flowing into Bitcoin wasn't just speculative; it was a rational response to a changing global yield environment, a direct consequence of portfolio rebalancing on a massive scale.

This mechanical rebalancing act was intellectually underpinned and justified by the powerful strengthening of Bitcoin's narrative as a non-sovereign store of value, a thesis often dubbed "digital gold." A macro-environment of monetary easing, falling real yields, and sustained government fiscal deficits, which characterized the projected 2025 landscape, is inherently a policy of long-term fiat currency debasement. As the future purchasing power of the dollar and other major currencies is expected to erode, rational economic actors will naturally seek out scarce, durable assets that can preserve wealth across time and economic cycles.[20]

Historically, physical gold has filled this role. However, in the 21st century, Bitcoin presented a compelling digital alternative with a suite of unique and potentially superior properties: absolute, verifiable scarcity with its 21 million coin cap; near-instantaneous global portability; perfect divisibility; and a transparent, auditable monetary policy immune to political whims.[20] The 2025 macro-environment served as the perfect catalyst for this theory to graduate from a niche belief held among cryptographers and early adopters to a credible, mainstream investment thesis discussed in the boardrooms of global finance. The weakening dollar and falling real yields were not just coincidentally correlated with Bitcoin's rising price; they were actively and powerfully strengthening its most fundamental use case, providing the intellectual and theoretical justification for the massive, sustained ETF inflows that our model identified as the primary engine of the new paradigm. The weather system of easy money did not create the engine, but it allowed it to run at maximum horsepower.

4. Conclusion

This study set out to navigate the new paradigm of the Bitcoin market in the post-ETF era. Our research concludes that the market has undergone a fundamental structural transformation, maturing from a retail-dominated speculative asset to an institutional-grade macro-asset. The application of our transparent, semi-quantitative, synthesized model led to a primary finding: a projected Bitcoin price apex in the range of $150,000 to $200,000, with the timing most likely occurring between Q4 2024 and Q2 2025.

5. References

1. Gurrib I, Kamalov F, Starkova O, Elshareif EE, Contu D. Drivers of the next-minute Bitcoin price using sparse regressions. Stud Econ Fin. 2024; 41(2): 410–31.

2. Ulu Ç, Ulu C. Relationship between Twitter sentiment analysis and Bitcoin prices: Econometric analysis of long and short term dynamics. Bull Econ Theory Anal. 2024; 9(2): 605–26.

3. Alokley SA, Araichi S, Alomair G. Exploring the relationship and predictive accuracy for the Tadawul All Share Index, oil prices, and Bitcoin using copulas and machine learning. Energies. 2024; 17(13): 3241.

4. Chen T. Correlation between Bitcoin price and total supply of long-term holders. Highlights in Business, Economics and Management. 2024; 36: 361–70.

5. Umoru D, Igbinovia B, Shaibu IA, Obomeghie MA. Dynamics of foreign exchange rates and Bitcoin trading prices. Asian J Econ Bus Account. 2024; 24(8): 425–50.

6. Kapur G, Manohar S, Mittal A, Jain V, Trivedi S. Cryptocurrency price fluctuation and time series analysis through candlestick pattern of bitcoin and ethereum using machine learning. Int J Qual Reliab Manag. 2024; 41(8): 2055–74.

7. Danila N, Noreen U, Aggarwal P. Bitcoin prices on the volatility of Environmental, Social and Governance (ESG) indices. Acad J Interdiscip Stud. 2024; 13(5): 142.

8. Azhaganathan B, Murugesan R, Shanmugaraja V, Surya BJM, Shide U. Bitcoin price prediction with other commodity prices as exogenous inputs using machine learning techniques. Int J Enterp Netw Manag. 2025; 16(2): 179–95.

9. Murugesan R, George M. Gold price prediction incorporating silver, copper, crude oil, and bitcoin commodity prices using a multi-step LSTM model. Int J Bus Inf Syst. 2025; 1(1).

10. Chu G, Goodell JW, Shen D. On-chain investor network and Bitcoin price crash risk. SSRN Electron J. 2025.

11. de Prince D, Marçal EF, Valls Pereira PL. Exploring co-explosive dynamics: Bitcoin price, attractiveness, and sentiment variables. Econ Lett. 2025; 246(112072): 112072.

12. Boozary P, Sheykhan S, GhorbanTanhaei H. Forecasting the Bitcoin price using the various machine learning: a systematic review in data-driven marketing. Systems and Soft Computing. 2025; 7(200209): 200209.

13. Kaur R, Uppal M, Gupta D, Juneja S, Arafat SY, Rashid J, et al. Development of a cryptocurrency price prediction model: leveraging GRU and LSTM for Bitcoin, Litecoin and Ethereum. PeerJ Comput Sci. 2025; 11(e2675): e2675.

14. Asmat G, Maiyama KM. Bitcoin price prediction using N-BEATs ML technique. ICST Trans Scalable Inf Syst. 2025; 12(1).

15. Pakštaitė V, Filatovas E, Juodis M, Paulavičius R. Bitcoin price regime shifts: A Bayesian MCMC and hidden Markov model analysis of macroeconomic influence. Mathematics. 2025; 13(10): 1577.

16. Staenly S, Irsan MYT. Simulating Bitcoin price movements with the Bates model and Monte Carlo methods. Bull Appl Math Math Educ. 2025; 5(1): 35–44.

17. Dubey R, Enke D. Bitcoin price direction prediction using on-chain data and feature selection. Mach Learn Appl. 2025; 20(100674): 100674.

18. Chen M, Zhang X, Wei Y, Wang S. What determines Bitcoin's price over the past decade? Int Rev Fin Anal. 2025; 103(104174): 104174.

19. Omole O, Enke D. Using machine and deep learning models, on-chain data, and technical analysis for predicting bitcoin price direction and magnitude. Eng Appl Artif Intell. 2025; 154(111086): 111086.

20. John K, Li J. Bitcoin price volatility: Effects of retail traders, illegal users, and sentiment. J Corp Fin. 2025; 94(102837): 102837.