GREENFIELD RESEARCH

Do Fundamentals Drive DeFi Valuations? Analyzing Evolving Market Efficiency with Random-Forest Models (2021–2025)

Authors
Felix Machart
felix@greenfieldcapital.com
Mateusz Dominiak
mateusz@greenfieldcapital.com

Contributors
Sehjal Agarwal, Markus Hujara

Abstract
This paper tests whether onchain fundamentals drive DeFi token valuations across horizons and regimes. Using random-forest models (2021–25), we predict returns at 1-, 3-, and 6-month intervals. Market beta dominates short horizons, but by 2024–25 fundamentals – especially TVL, protocol fees and revenues – explain up to 88% of six-month variance. Their influence extends beyond bull and flat markets to downturns more recently, though pricing lags remain. Results point to a maturing DeFi market with increasing weight on onchain cash flow drivers.

Table of Contents

1. Executive summary

We believe in 1) Decentralized Finance (DeFi) with real-time onchain verifiable fundamentals leading to a more efficient market and 2) a professionalizing DeFi market with increasing institutional participation. Using onchain data, we test whether fundamental metrics have been driving DeFi valuations using growth-rate random forest models on monthly data from 2021 to mid-2025.

Influence of fundamentals and market pricing efficiency

Our analysis finds that fundamentals do drive valuations, but their impact varies greatly by time horizon. We show that adding fundamental metrics (e.g., TVL, active users, protocol fees) to a market-only baseline yields no reliable improvement at 1-month (−0.73 pp on average since Jan-2024), but adds +2.12 pp at 3-months and +8.66 pp at 6-months. Market cap growth is estimated based on the same period fundamentals growth and compared against actuals to assess their influence.

After re-emerging in the late-2022 post-crash period, their signal has strengthened steadily (in the brutal 2022 bear market beta dominated). In test periods beginning in early 2024 and from mid-2024 to mid-2025, the fundamentals-only model explains an average of 8.66 and 12.05 percentage points (pp) more variance (R^2) than the market-only baseline at the six-month horizon, respectively. It outperforms all other models, as market beta introduces noise – reversing earlier patterns. While previously fundamentals mainly outperformed in flat and to a lesser extent in bull regimes, they have added a significantly increased signal in more recent bearish phases.

While DeFi markets are increasingly driven by fundamentals, they do not price signals nearly at real-time speed as theoretically enabled. Substantial pricing delays in fully assimilating onchain data are evident in the fact that at the shorter horizons tested, the outperformance of models including fundamentals represents an average of -0.7 pp at the 1-month and +2.1 pp at the 3-month horizon. Those being significantly below the added signal at the 6-month horizon could indicate inefficiencies. A more compelling interpretation, however, is that this lag is not purely a sign of inefficiency. Short-term fluctuations in fundamentals can be noisy or temporary (especially given token incentives), so it may be rational to wait to see whether such trends persist and have sticky traction before adjusting valuations. Also, qualitative factors, such as strategic positioning, product velocity and defensibility that indicate how KPIs might evolve in the future are often not evident in quantitative metrics, albeit critical for mid- to long-term performance. This is true to even greater extents at an early and growth stage where valuations depend even more on future growth and thus predictions thereof. Either way, these delays in fundamentals being priced-in, whether due to inefficiency or rational behavior, provide opportunities for investors to blend fundamental analysis of quantitative and qualitative factors to generate alpha.

Horizon	Fundamentals vs market-only (R²)
1-month	−0.73 pp
3-month	+2.12 pp
6-month	+8.66 pp

Best fundamentals-based model vs market-only (absolute Pearson R^2 uplift, pp, means from Jan 2024). 1M/3M: Market+fundamentals; 6M: fundamentals-only.

Ultimately, we do expect the trajectory toward improved efficiency to continue with further institutional participation and advanced analytics. We will, however, likely continue to see time lags and volatility – due to rational reasons and behavioral biases – and speculative episodes.

Evolving fundamental drivers (2024–2025)

The most influential fundamental drivers for the 6M horizon evolved notably by 2024–2025, shifting emphasis from pure liquidity metrics toward sustainable economic indicators:

- TVL and protocol fees now co-lead the 6M fundamentals-only model (19.7% and 19.2% feature importance – FI, respectively).
- Protocol revenue has risen to a solid third place (15.7% FI).
- A balanced second tier consists of DAU (13.9%), daily transactions (12.4%), and DEX volumes (11.8%).

This trend signifies a maturing market that increasingly values sustainable fee and revenue generation beyond pure liquidity inflows and usage spikes.
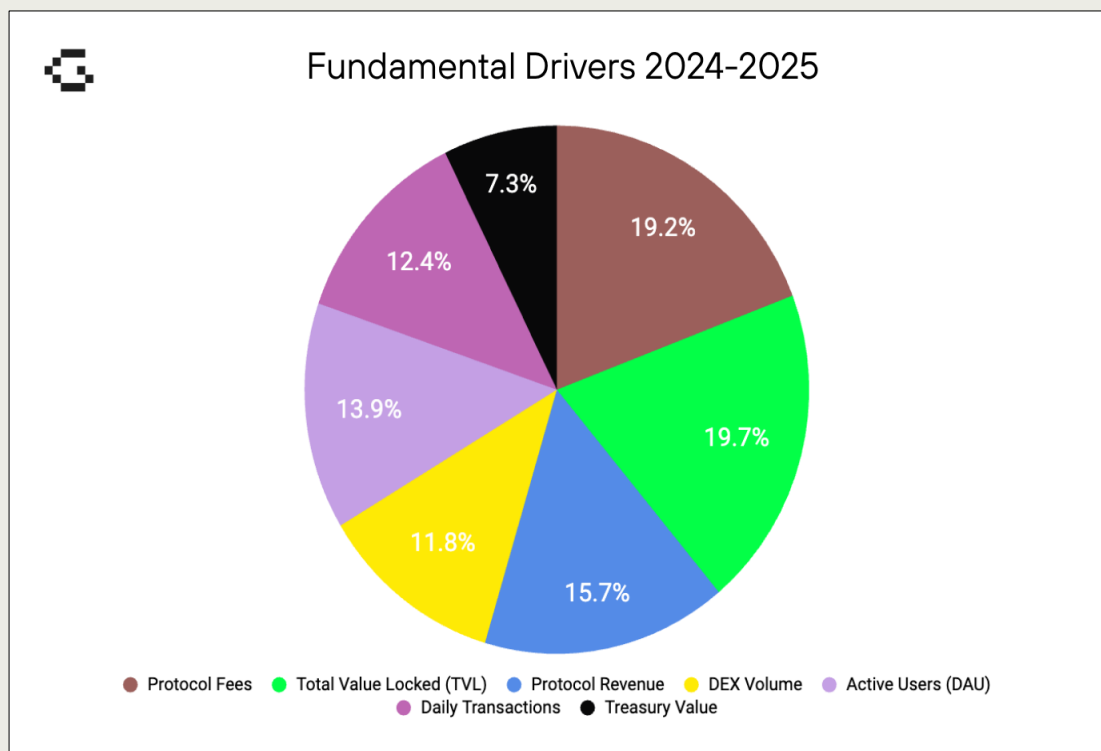

Figure 1: Average feature importance of the best model over 6M: fundamentals-only in evaluation windows from January 2024 onward: TVL 19.7%, protocol fees 19.2%,

protocol revenue 15.7%, DAU 13.9%, daily transactions 12.4%, DEX Volumes 11.8%, treasury 7.3% (KPI-only view - see appendix E for more details).

Read, write, re-price with increasing efficiency

Investors should increasingly emphasize long-term fundamentals, particularly protocol fees, revenues and TVL, to capture delayed market repricing opportunities. For DeFi founders, demonstrating sustainable, verifiable economic value and actively retaining users will be crucial as market sophistication and competitive differentiation increase.

Ultimately, while DeFi markets have evolved substantially, real-time onchain data is not being priced-in as swiftly as one could think. We believe this has, to a large extent rational reasons, yet there is room for improvement in information processing. Since we expect the market to mature even further and become increasingly more efficient and believe it is essential in order to live up to its true potential of an open, decentralized, verifiable, internet-native financial system, we will continue pushing the industry forward via research (incl. further model iterations) and supporting the builders that lead the change. Reach out to collaborate!

2. Introduction & research questions

We have been excited about and investing in crypto networks and decentralized finance protocols that are building toward an internet native financial system (IFS) based on public, permissionless blockchains and tokenization that enable the following benefits:

- Reduced transaction costs and settlement speeds (thus increasing capital efficiency) due to reduced fragmentation that's inherent in the siloed servers of today's financial system
- Digitize, enhance and cryptographically enforce property rights, empowering individuals to protect their savings using cryptocurrencies, invest in global assets, and strengthen legal certainty through onchain registries and smart contracts
- Enable rapid permissionless innovation via a stack of financial primitives based on open-source code and tokenized, composable assets, which levels the playing field and provides global access to investments, capital and sophisticated financial tools
- Automation via smart contracts, algorithms and agents reducing the reliance on manual processes and risk management
- Cryptographic verifiability of time-stamped, real-time, signed data for reduced information asymmetry and thus more efficient asset pricing, as well as better idiosyncratic and systemic risk-management

These characteristics suggest that DeFi markets should, in principle, exhibit high levels of efficiency. Asset prices should reflect all available information, including usage statistics and

economic flows observable onchain. However, in practice, market behavior has been heavily influenced by memes, narratives, and macro liquidity cycles, often overshadowing project-specific fundamentals.

A pressing question faces DeFi investors and founders: Do fundamentals influence DeFi token valuations, or are prices driven largely by speculation and broader crypto market swings? As the industry matures and with increased institutional participation, one expects price discovery to gradually reward projects with real adoption and revenue, echoing how equity markets eventually anchor to fundamentals. Our research aims to empirically assess whether this transition is happening. By analyzing 2021–2025 performance using machine learning models, we find compelling evidence that the market is increasingly pricing in protocol fundamentals, especially over longer time horizons.

Research questions:

(1) Do fundamental metrics drive DeFi token valuations?

We interpret this as asking whether measurable protocol "health" indicators - e.g., user growth, transaction volumes, total value locked (TVL), fee revenue - have explanatory and explanatory power for token price movements.

(2) How does that influence evolve over time and across market regimes?

We hypothesize that fundamentals' impact may not be static: it could strengthen as the market matures, and it might wax or wane under different conditions (bull markets vs bear markets vs flat markets). By addressing these questions, we situate DeFi within the broader asset pricing context: Are we seeing the emergence of "crypto fundamentals" analogous to equity fundamentals, and under what circumstances do they matter most?

Background

While research on crypto valuation is nascent, some prior studies and market analysts have explored fundamentals as well as theoretical models that incorporate adapted notions of discounted cash flows years ago. Ultimately, free cash flows should determine valuations, but there are leading indicators that should enable anticipating value capture further down the line. Commonly used metrics include network size (users or addresses), network and application activity (transaction counts, volumes), liquidity (TVL in DeFi context), and protocol fees, revenues, as well as earnings (accumulated as well as distributed). Theoretically, tokens that confer governance or claim on cash flows should be valued based on those cash flows (similar to stocks), and tokens used as staking collateral might derive value from network utility and value flows to stakers. In practice, empirical and anecdotal evidence have been mixed. During frothy periods, prices often overshoot fundamentals; during panics, they undershoot. Our work systematically quantifies these relationships.

We also note parallels with traditional asset pricing research. Classic models (CAPM, Fama-French) explain cross-sectional returns with factors linked to fundamentals (value, profitability, investment). Machine learning approaches (e.g., [Gu, Kelly, and Xiu, 2020](#)) further show that complex, nonlinear combinations of many firm characteristics can improve return predictions. Our approach brings similar techniques to crypto: we employ a random forest (tree-based ML) to learn relationships between a set of protocol metrics and token performance. Due to the availability of real-time onchain data and since we evaluate to what extent investors have priced-in fundamentals signal, we predict returns based on the same-period data, as opposed to ex-ante data typical in TradFi papers. We thus contribute to the emerging literature on cryptoasset valuation by providing a longitudinal, out-of-sample test of fundamental significance in DeFi.

In summary, this study aims to provide evidence on whether fundamentals matter in DeFi, and if so, when and how.

Based on the results we also gauge the level of market efficiency in DeFi. The next sections describe our data and methodology, followed by detailed results for each predicting horizon, a cross-regime analysis, and a discussion relating our findings to both crypto market events and traditional finance analogues.

3. Data & methodology

3.1 Data overview

Our dataset, sourced from [Artemis Analytics](#) (a leading institutional-grade data provider, designed to enhance protocol visibility) consists of fundamental and market metrics for a panel of 77 DeFi projects from mid-2021 through mid-2025. We track each project's market capitalization (our primary valuation measure) alongside key performance indicators (KPIs) that reflect protocol fundamentals. The fundamental KPIs include:

- daily active users (addresses), transactions,
- total value locked (TVL) in the protocol's contracts,
- protocol fees and revenue accrued,
- trading volume on the project's decentralized exchange (if applicable), and
- the project's treasury holdings.

These capture usage, trust and liquidity available in the protocols, monetization and financial health. We also incorporate two broader market variables - the price growth of bitcoin (BTC) and ether (ETH) - as proxies for overall crypto-market movements and liquidity (since most DeFi tokens have high beta to BTC/ETH). We did not include earnings defined as revenues minus token incentives in the Artemis dataset or any other metric related to token incentives since it

contains the dependent variable - market cap – we are predicting (leaking the target). Table A1 (Appendix) details each feature, rationale for inclusion and data source. In addition, we have classified the projects into sub-segments, which we used as an additional feature in model training in order to account for differences in the importance of specific KPIs across verticals (e.g. lending/money markets, DEX spot, perps/derivatives, etc.). All market cap and monetary figures are in USD. Data frequency is monthly for modeling purposes (features are computed monthly, and predictions are for monthly or multi-month returns).

3.2 Same-period growth-rate features

We transform levels into log growth rates over the horizon (e.g., 3-month Δln for 3M). This aligns features with the logreturn target (market cap growth), treats up/down symmetrically, and reduces heteroskedasticity. Further, this approach normalizes metrics across projects of different sizes. Using absolute levels of KPIs on the other hand, would make it easier to make model predictions fit actuals, since the models can learn to differentiate between projects (based on level-memorization), as opposed to learning generalizable patterns regarding the extent to which investors have priced-in fundamentals.

The estimation target is the same-period log-change in market cap within 1- to 6-month time windows. By explaining valuation growth over the same periods as feature (KPI) growth, we utilize an ex-post design to measure how market participants have priced assets during the respective time period based on the then available information.

3.3 Model framework

We employ random forest regression models (a Machine Learning – ML technique) for prediction. Random forests (RFs) are ensemble tree models that capture nonlinear relationships and interactions among predictors while resisting overfitting through averaging many decision trees. They are well-suited given the likely nonlinear nature of crypto markets (e.g., a certain level of user growth might only translate to price gains if accompanied by TVL growth, etc.). We train separate RF models for different prediction horizons to test for temporal differences (1M, 3M, 6M). Each RF is trained on historical windows up to a cutoff and then applied out-of-sample to the current evaluation window (parameters fixed from prior data), following a rolling-window backtesting design described below. Default RF hyperparameters (10,000 trees, depth not explicitly limited) were used.

To encode the domain belief that improvements in protocol fundamentals should not reduce contemporaneous valuation growth, we add a soft monotonicity constraint for all fundamental features (a bias toward the positive impact of fundamentals). The feature importance metric we report is based on each variable's average reduction in node impurity across the forest, normalized for comparison. This indicates which features the model found most explanatory of outcomes in each period as a percentage per variable.

3.4 Four model variants

To isolate the effect of fundamentals, we define four feature sets and train a separate RF model on each:

- **Market-only model:** Uses only the market proxies – BTC and ETH price growth rates (chosen due to significant dominance of these 2 largest cryptoassets and their widespread use as collateral in DeFi markets) and sub-segment (to control for fundamentals model outperformance due to sub-segment only). This model captures the baseline of broad market movement based on crypto-specific events as well as the macro environment and liquidity flows (akin to a "beta" model). It serves as a benchmark: any improvement from adding fundamentals will be measured relative to this model's performance.

- **Market+followers model:** Uses BTC and ETH growth, plus a social media metric – specifically, the growth in each project's X follower count (as a proxy for community interest and hype, given that we deem X, formerly Twitter, as the still most dominant social platform in DeFi), as well as a sub-segment. We include this because social sentiment is often said to drive short-term crypto prices. This model represents an expanded baseline that accounts for general market conditions and each project's popularity/attention, but no onchain fundamentals. It helps us ask: do fundamentals add explanatory power beyond what one could get from just knowing the market trend and which projects are popular?

- **Fundamentals-only model**: Uses only project-specific fundamental features except followers, without BTC/ETH. This model tests how well one could predict performance using only fundamentals, ignoring overall market ups and downs as well as social sentiment.

- **Market+fundamentals model:** Uses all features except followers (BTC, ETH, fundamentals). This represents the full model that an investor aware of both market conditions and protocol fundamentals would use. We expect this to typically perform best (or tie for best) if both market and fundamentals contain complementary information and we are benchmarking it to the other models to assess whether adding fundamentals increases explanatory accuracy and thus whether investors have been pricing such in.

In addition, we add a naive baseline: Last valuation (no-change) model, which simply assumes each token's market cap will remain the same over the prediction horizon. It has to be pointed out that as opposed to the RF models, this naïve baseline compares previous levels of market caps with current levels and not percentage growth. While overly simple, we include it for reference to gauge whether sophisticated models are truly beating a trivial prediction.

3.5 Rolling window backtesting

We conduct a rolling out-of-sample evaluation from mid-2021 to mid-2025. Models are fit using a rolling 12-month training window and applied to the current evaluation window (typically 12

months; shorter at the sample end due to limited data). Each month, we roll forward by one month and re-fit. Most evaluation windows are 12 months; the last few are 3–11 months to allow us to analyse more recent data as well. In total, we evaluate 48 overlapping windows. This rolling scheme allows us to trace the temporal evolution of model performance and feature importance.

3.6 Performance metric

We measure performance primarily by Pearson correlation (and its square, R^2) between predicted and actual outcomes in each evaluation window since it indicates the magnitude of fundamentals' impact on valuation. We report R^2 (the square of Pearson R) as a percentage of variance explained. We also compute Spearman rank correlation similarly (to check robustness in ranking and whether the results are biased by outliers). In practice, Pearson and Spearman trends were very similar in our results (we focus on Pearson R^2 for consistency with regression literature and since it answers the research questions to a greater extent). An R^2 of 100% would mean the model perfectly predicts the relative change of valuations; 0% means no better than chance. Our figures often plot R^2 over time for each model. We subsequently compare uplifts of R^2 values of models that contain fundamentals against a benchmark (primarily market-only). Unless stated otherwise, uplifts are reported as absolute R^2 percentage point delta relative to the market-only baseline.

3.7 Market regime classification

Each evaluation window is labeled as bull, bear, or flat based on the total DeFi market movement in that period. We use the aggregate market cap of our sample as a proxy for the DeFi market. If the average market cap growth over the window is greater than +0.5 standard deviations above mean growth (computed across all windows' growth), we call it a Bull regime; if it is less than -0.5 σ, a bear regime; otherwise flat. Intuitively, bull windows have strong overall growth (up-markets), bear windows significant decline, and flat windows are in-between or mixed. This classification (using a ±0.5 σ threshold) yielded 18 bull, 17 flat and 13 bear windows in our sample. We will use this to analyze how model efficacy and feature importance differ by regime. Because each validation period spans 12 months, they may blend multiple market regimes. Readers should interpret uplift values in such mixed periods as an average across embedded regime phases. In summary, our methodology combines a feature set of DeFi fundamentals and overall crypto-market / macro proxies (BTC + ETH), a rolling time-window ML prediction framework, and a rolling time-window evaluation to capture changing dynamics. We next present the results, beginning with the shortest horizon (1 month) and moving to longer horizons (3- and 6-months), followed by a comparative analysis across regimes and time.

4. Results & Discussion

In this section, we discuss 1) the results of the RF models across prediction time horizons, evaluation windows and market regimes 2) what we can observe regarding the market efficiency of DeFi markets from our results and 3) how the market has been evolving in terms of which fundamentals matter.

4.1 One month horizon

For 1-month window market cap predictions, market factors alone already explain the vast majority of variance - unsurprisingly, since in the short run most DeFi tokens move together with the overall crypto market.
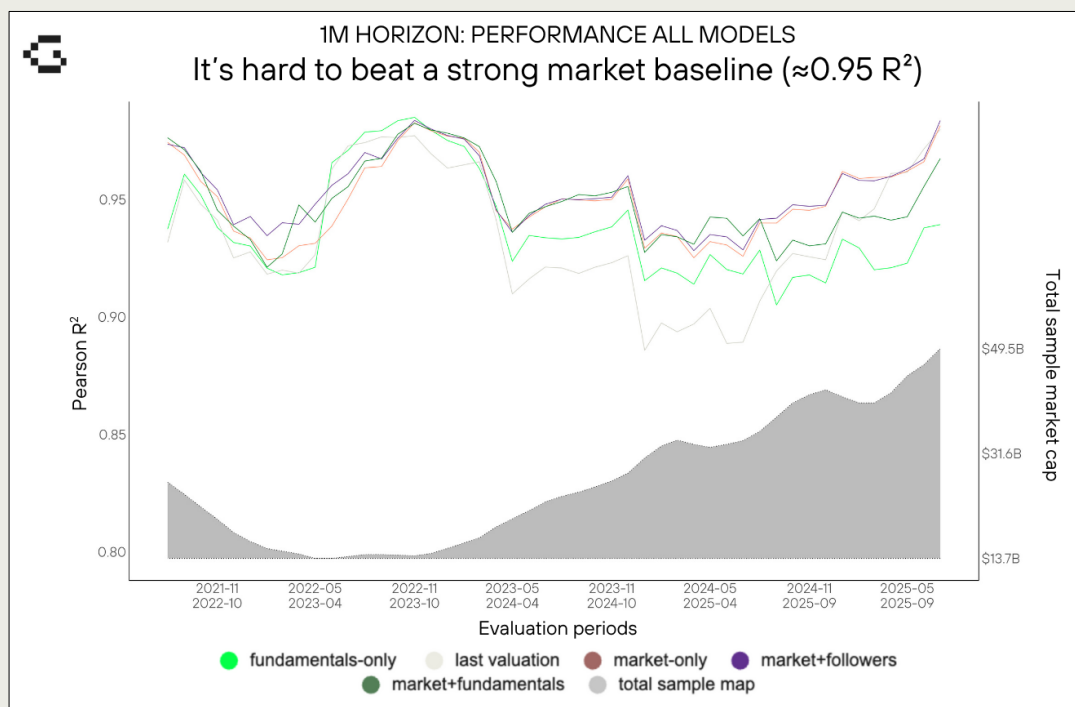

Figure 2: Rolling 1-month-window model performance (Pearson R^2). Each point on the timeline represents the average of a 12-month evaluation period (e.g., 2021–08 to 2022–08) of models trained on data of the previous 12 months. Total average sample market cap is represented by the shaded area (there might be bullish or bearish sub-periods in an overall bearish or bullish period). The market line alone already explains ~95 % of variance; market + fundamentals line often touches it, confirming that fundamentals add <2 pp at this horizon.

The market-only model achieved an average Pearson R^2 around 95% (over 2021–25), meaning it often captures >95% of cross-sectional return variance even without any token-specific inputs (see Figure 2). This high baseline left little room for improvement; adding fundamentals yielded only minor and sporadic uplifts. Figure 3 shows the R^2 uplift (in pp) from including fundamentals alongside market factors in the 1-month model over time. Most evaluation periods saw an uplift
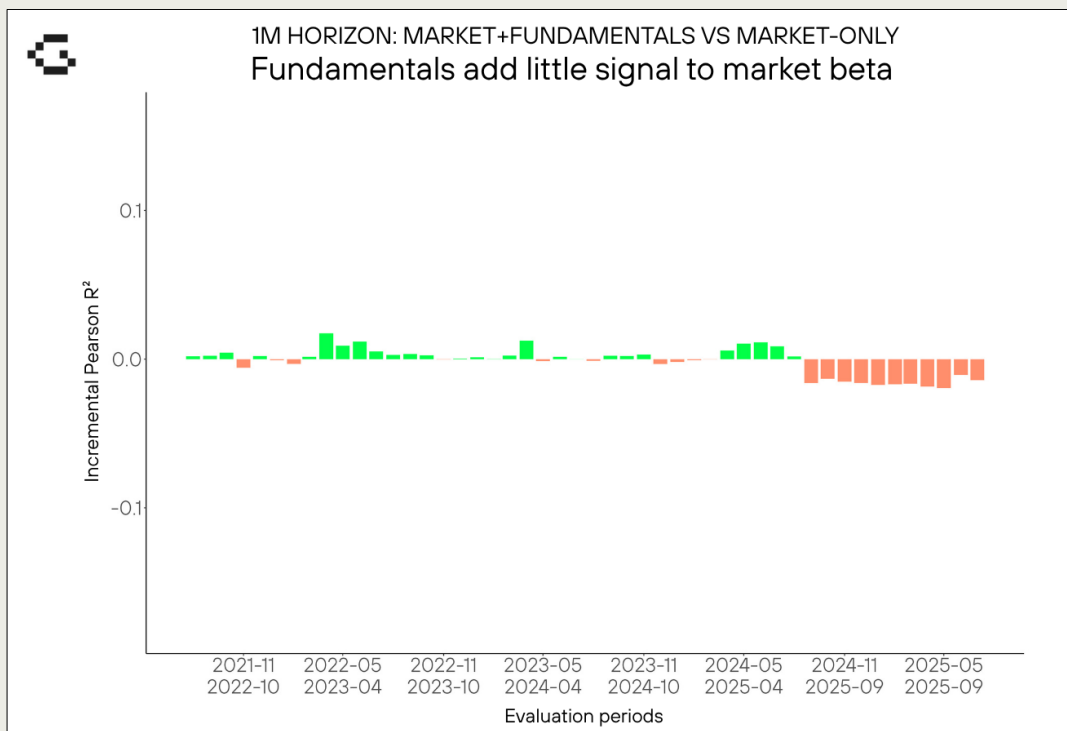
of only 0–2 pp, with the benefit occasionally rising to ~2–3 pp in some windows and actually turning negative from the end of 2024.

Figure 3: Uplift in R^2 (Δ Pearson R^2) gained by adding fundamental features to the market-only model for 1-month window predictions. Green bars indicate the combined (market+fundamentals) model outperformed the market-only baseline; orange bars indicate it underperformed slightly. Over 2021–2025, average uplift is ~0 pp; focusing on Jan 2024 onward, the combined model's mean uplift is –0.73 pp, i.e., fundamentals add no reliable short-term lift and can slightly reduce R^2. P-value = 0.84.

Figure 3 initially shows a clear regime pattern at the 1-month horizon: in the earliest windows around late-2021, uplifts are small but positive (+0–2 pp R^2); during the mid-2022 drawdown (Terra–Luna and contagion), uplift turns negative (~–1 to –3 pp) as systemic risk swamps cross-sectional differentiation.

Through 2023, the results hover around zero with only brief, modest positives. In periods starting from the end of 2024, however, beta dominates and fundamentals provided noise rather than additional signal with slight negative uplifts over market-only (typically ~–2 pp – min around –1.94 pp) – potentially due to newly emerging projects in the data set over that period.

In terms of rank accuracy, the Spearman uplift (no dedicated figure) follows the same pattern, though generally smaller in magnitude than Pearson and close to flat for most of 2023, before turning modestly negative from late-2024 onward, indicating that adding fundamentals also eroded short-horizon winner/laggard discrimination.
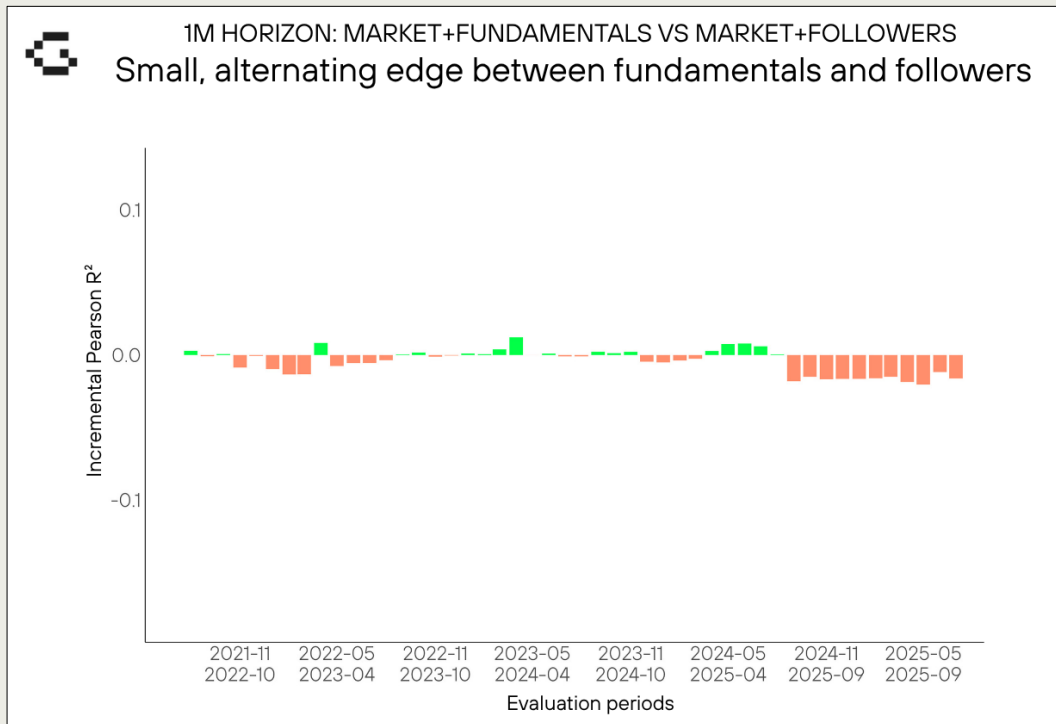
1M HORIZON: MARKET+FUNDAMENTALS VS MARKET+FOLLOWERS
Small, alternating edge between fundamentals and followers

Figure 4: Uplift in R^2 (Δ Pearson R^2) between the market+fundamentals model and the market+followers model (1-month horizon). Both models perform very similarly at 1-month horizon, with neither consistently outperforming the other by more than a couple pp. P-value >0.99.

Social sentiment data provided negligible benefit at 1-month horizons - roughly on par with market-only. Figure 4 compares the fundamentals-augmented model to the Twitter followers-augmented model directly.

One month feature importance

At the 1M horizon, the market-only baseline captures most of the explainable variation, so adding onchain KPIs or follower counts provides little, and since late-2024, often negative, incremental uplift. In the combined model's feature importance (Jan 2024 onward), BTC+ETH together account for ~19.2%. The top fundamentals are TVL (~14.7%) and revenue (~14.2%), followed by fees (~11.5%), DAU (~10.9%), daily transactions (~10.9%), and DEX volumes (~10.5%); net Treasury contributes ~7.9%. This profile is consistent with short-horizon returns being beta-dominated, even though the trees still draw on several fundamentals.

This implies that short-term DeFi valuations are driven overwhelmingly by market-wide sentiment and liquidity across most regimes, not just during euphoria or panic. This mirrors equities, where short-run returns are typically dominated by market/sector factors. Correlations spike in stress and can remain elevated in macro-led rallies, leaving limited room for an idiosyncratic signal.

13

4.2 Three month horizon

At 3M, fundamentals start to matter. Overall fit is lower than 1M (top models ~86% Pearson R^2 vs ~95% at 1M) leaving more variance for fundamentals to explain. The market-only baseline still does well, but adding fundamentals delivers a time-dependent boost.
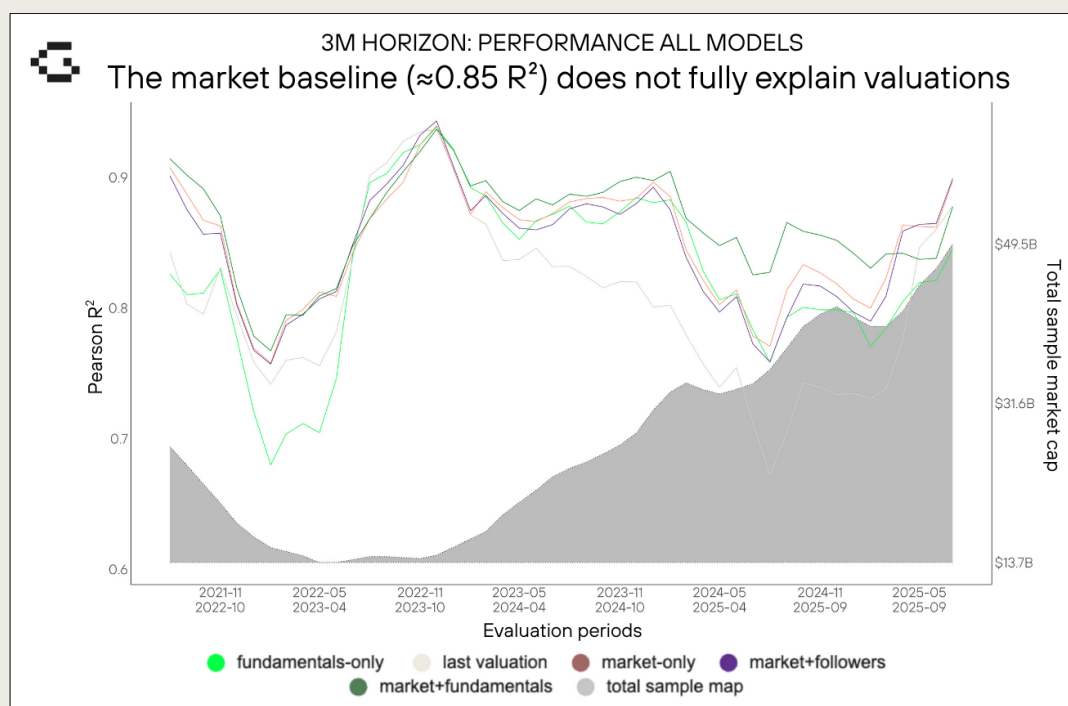

Figure 5: Rolling 3-month-window model performance (Pearson R^2). Overall fit moderates (~0.86 R^2); the market+fundamentals model starts to edge past market-only in 2024–25.

From Jan 2024 onward, the market+fundamentals model averages a +2.12 pp Pearson R^2 uplift over market-only (median +2.89 pp), peaking around +5.67 pp in the window starting Aug 2024. On rank accuracy, the combined model's Spearman uplift is positive on average since Jan 2024 (≈ +1.24 pp, median ≈ +1.25 pp), but it has faded in recent windows – about +0.1 pp over the last six and roughly flat over the last four, suggesting fundamentals still help with sorting, albeit marginally.

Compared to the market-only baseline, the market+followers variant performs very similarly, leaving just slightly stronger uplifts of the market+fundamentals model over the market beta + social attention benchmark. Overall, we observe an increasing uplift in the market+fundamentals model over time vs both market-only and market+followers. The last 4 observations show negative uplifts, which could point toward a trend reversal. However, based on shorter evaluation periods toward the end of the analysis, these observations are not as reliable as the ones further in the past.
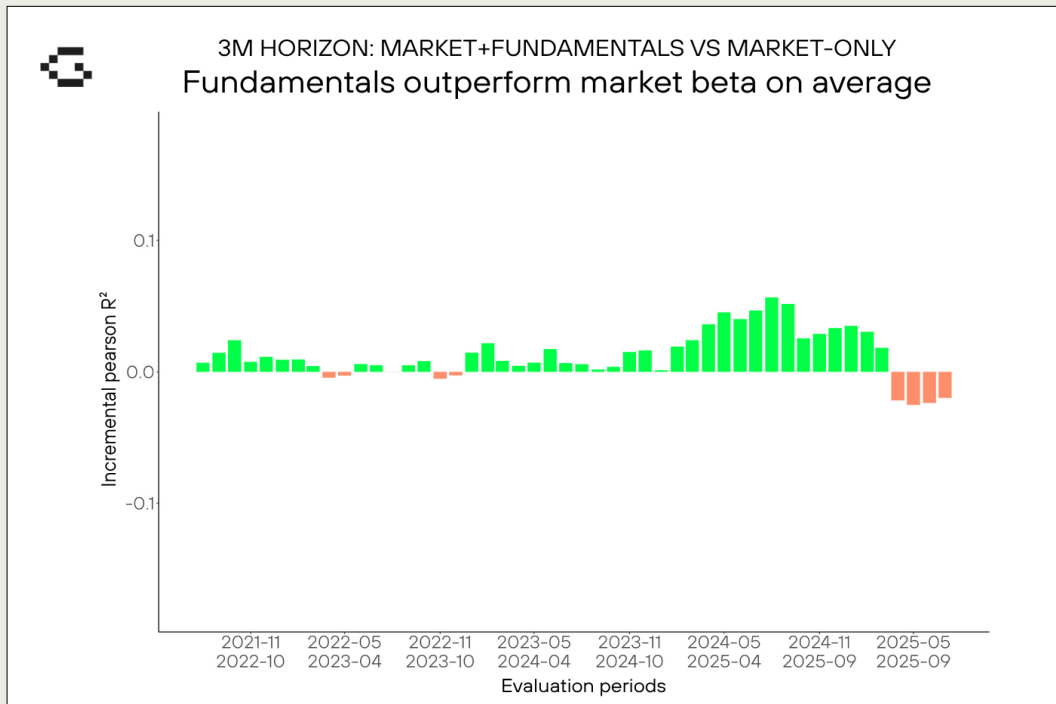
3M HORIZON: MARKET+FUNDAMENTALS VS MARKET-ONLY
Fundamentals outperform market beta on average

Figure 6: Uplift in R^2 (Δ Pearson R^2) of the market+fundamentals model over the market-only model for 3-month predictions. Avg. uplifts are positive and trending higher with trend reversal in recent periods - on shorter validation periods though. P-value < 0.01.
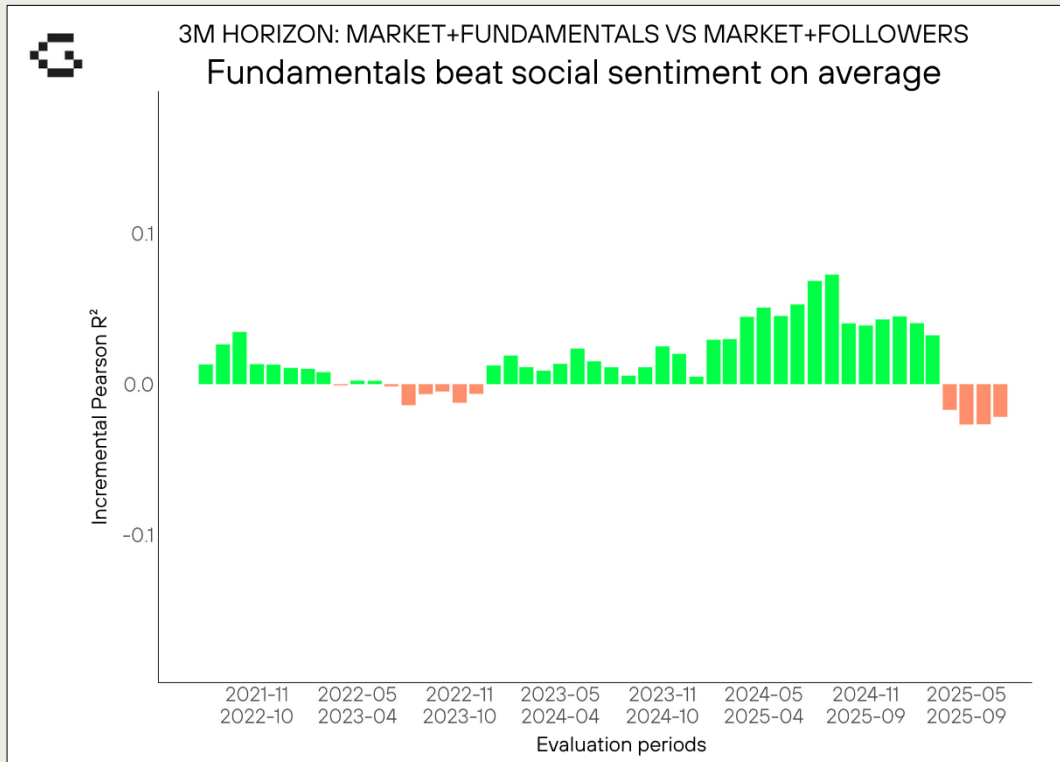

3M HORIZON: MARKET+FUNDAMENTALS VS MARKET+FOLLOWERS
Fundamentals beat social sentiment on average

Figure 7: Uplift in R^2 (Δ Pearson R^2) between the market+fundamentals model and the market+followers model (3-month horizon). Since Jan 2024, market+fundamentals outperforms the market+followers benchmark by +2.9 pp on average (Pearson R^2; median +4.0 pp, peak ~+7.3 pp). P-values < 0.01.

Three month feature importance

Over the 3-month horizon, fundamentals play a more visible role. Figure 8 shows a rotation away from pure market beta toward TVL and monetization signals. Early in the sample (2021–2022), ETH and BTC dominated ($\approx$ 20.0% and 16.7%). By 2025, their shares are much lower (ETH $\approx$11.0%, BTC $\approx$12.5%), while protocol revenue and protocol fees moved up materially (revenue $\approx$7.9% $\rightarrow$ 12.9%, fees $\approx$7.3% $\rightarrow$ 10.9%), and DEX volumes climbed ($\approx$5.7% $\rightarrow$ 9.5%). TVL remains a steady top-tier fundamental ($\approx$13.8% early vs 14.1% in 2025. In full-sample averages, the 3M model allocates ~25.8% to market (BTC+ETH), ~18.9% to income (fees+revenue), ~26.1% to usage (DAU/txns/DEX), ~12.5% to TVL, ~5.9% to Treasury, and ~2.6% to sub-segment – a clear drift over time from market to income/usage.

From Jan 2024 onward, the significant features (means across windows) are:

- TVL ~13.5%
- Revenue ~12.9%, fees ~11.4%
- BTC ~11.8% & ETH ~11.0%
- DAU ~10.5%, daily txns ~10.0%, DEX vol. ~10.0%, net treasury ~7.0%, sub-segment ~1.8%

Relative to the long-run baseline, Jan 2024+ emphasizes income (+3.6 pp) and usage (+2.1 pp) while dialing down market (−5.3 pp), increasingly rewarding protocols converting activity into cash flow rather than just riding BTC/ETH.
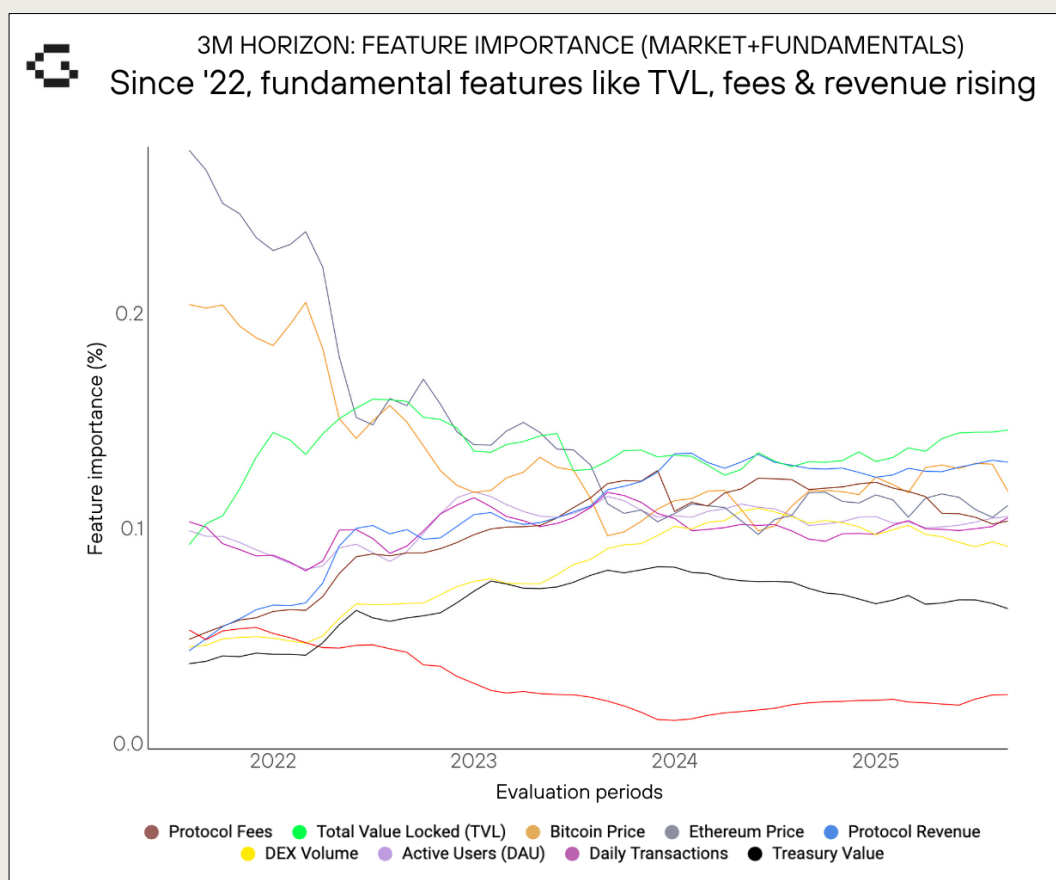

Figure 8: Feature importance trends for the 3-month horizon random forest model. Each colored line tracks the normalized importance of a particular feature (BTC

price growth, ETH price growth, and the top onchain fundamentals) over rolling windows. Sub-segment (structure) is rather negligible.

In summary, for the 3-month horizon, we find consistent incremental explanatory power from fundamentals, TVL growth stands out as the most reliable fundamental indicator of a DeFi token's medium-term performance, joined by protocol revenue and fee metrics in importance. Thus, fundamentals did drive valuations, increasingly so once the speculative tide went out.

It remains to be seen if the latest trend reversal we have observed in the data will persist though.

4.3 Six month horizon

At 6 months, fundamentals contribute the most. Compared with shorter horizons, overall explanatory accuracy declines at 6 months for every model, since more time passes between signal and outcome and path-dependence and regime noise dilute the fit. Versus market-only, the fundamentals-only model adds +8.66 pp Pearson R^2 on average since Jan 2024 (median +9.09 pp), while market+fundamentals adds +6.00 pp (median +5.55 pp). On ranking, market+fundamentals (Jan-2024+) averages +2.56 pp Spearman ΔR^2 (median +1.50 pp), while fundamentals-only averages +1.37 pp (median +0.55 pp). In the combined model, the share of feature importance attributed to fundamentals (usage/TVL/fees/revenue/volumes/treasury) rises from ~55.7% pre-2024 to ~73.8% since 2024, while BTC/ETH fall from ~29.6% to ~22.3%.
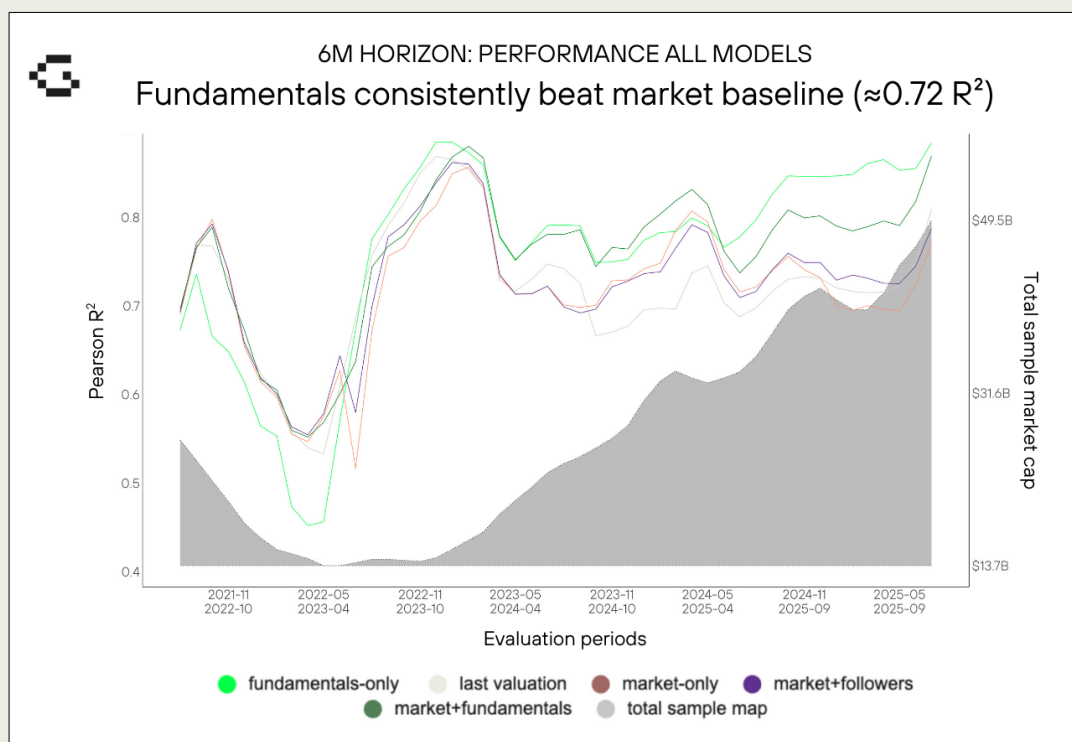

6M HORIZON: PERFORMANCE ALL MODELS
Fundamentals consistently beat market baseline (≈0.72 R²)

Figures 10 and 11 show uplifts of models containing fundamentals over the market-only variant. Market+followers is not shown, since it did not perform significantly better than market-only and the notable winner is fundamentals-only, which outperformed in the latest periods.
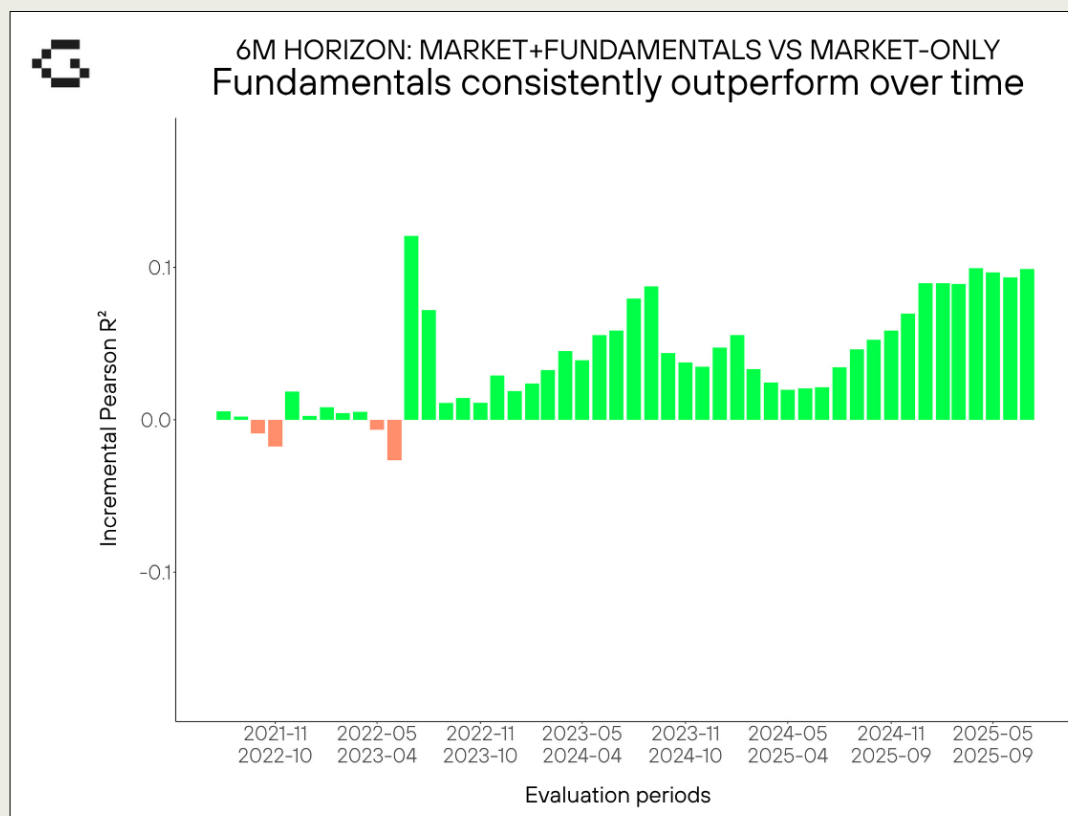

Figure 10: Uplift in R^2 (Δ Pearson R^2) of the market+fundamentals model over the market-only model for 6-month horizon. We observe that until 2023, adding fundamentals provided limited benefit (sometimes slightly negative in 2021–22), but turned positive in 2023 and continued the growth trend post-mid-2024: Since Jan-2024, mean +6.00 pp (median +5.55 pp). Since Jul 2024, mean +7.23 pp (median +8.91 pp). P-values < 0.01.

Outperformance of fundamentals-models has been dependent on time-period and regime. From late-2021 to mid 2022, market panic overwhelms fundamentals. The only sustained block of negative uplifts sits around the bear market following the 2021 peak and the May–June 2022 Terra/Luna collapse. In these windows, fundamentals-only vs market turns red on both magnitude and ranking: cross-sectional differences were swamped by beta/liquidity stress, so a market-only model briefly ranked and sized returns as well as (or better than) fundamentals. Fundamentals-only underperformed across that whole bearish period (Figure 12) and into early 2023. Around the USDC de-peg / SVB shock in early 2023, uplifts dip again (more on ranking than magnitude). Uplifts normalize through mid-2023, with occasional upside outliers as investors reprice fundamentally stronger protocols after the turmoil. From Jan–May 2024, flows

and narratives again compress the cross-section: the spot BTC ETF launch (Jan 2024) and the Bitcoin halving (Apr 2024) concentrate leadership in beta, and several windows in Mar–May 2024 show a Spearman dip for fundamentals-only vs market. From mid-2024 onward, fundamentals gain in importance and then lead on magnitude. After ETH spot ETF approvals (May 2024) and trading launch (Jul 2024), cross-sectional dispersion returns.
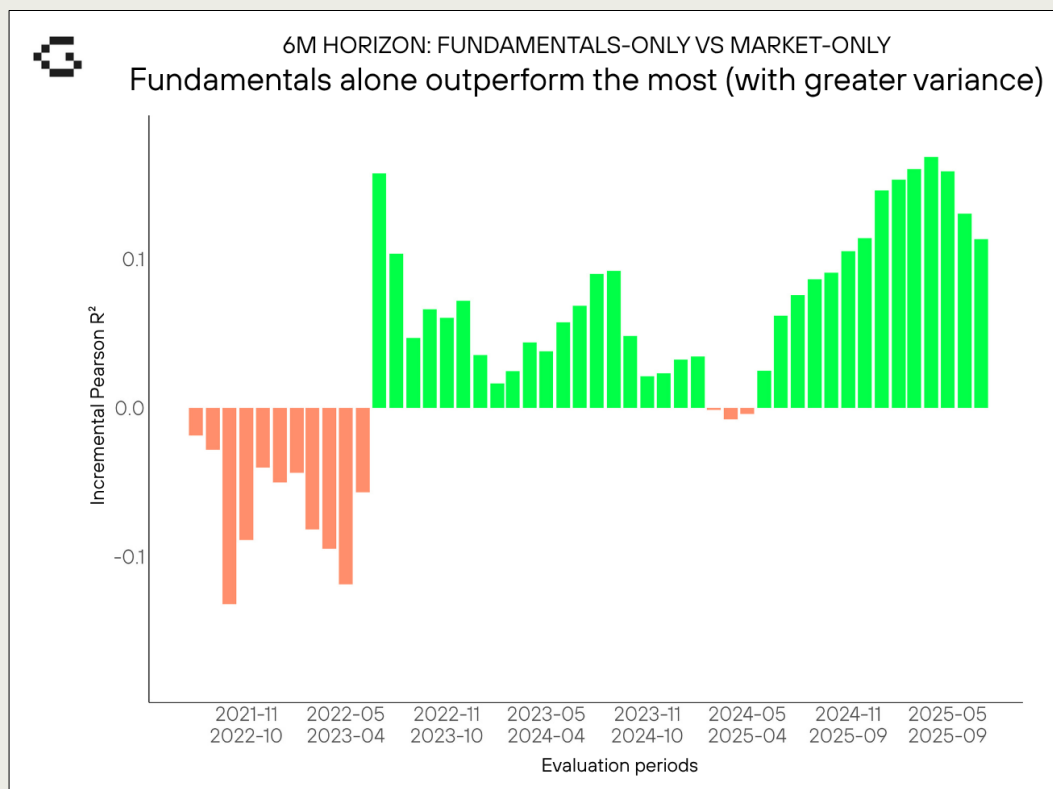

Figure 11: Uplift in R^2 (Δ Pearson R^2) of the fundamentals-only model and the market-only model (6-month horizon). After underperforming in earlier periods (negative in 2021–22), the fundamentals-only model began to outperform the market model in late 2023 and continued the growth trend post-mid-2024 after a brief slump: Since Jan-2024 mean +8.66 pp (median +9.09 pp). Since Jul-2024, mean +12.05 pp (median +11.41 pp). P-values < 0.01.

Summing up, fundamentals are most additive to magnitude (Pearson), and increasingly so. The ranking (Spearman) advantage is however small and episodic at 6M. This indicates fundamentals outperformance has been driven by a subset of outlier projects.

Window start subset	Model	Pearson mean uplift	Pearson median uplift	Spearman mean uplift	Spearman median uplift
Jan 2024 onward	FO	+8.66	+9.09	+0.78	+0.30
Jul 2024 onward	FO	+12.05	+11.41	−0.24	−0.69
Jan 2024 onward	MF	+6.00	+5.55	+1.44	+0.82
Jul 2024 onward	MF	+4.15	+5.17	+0.46	+0.27

Average uplifts in R² pp of fundamentals-only (FO) model and market+fundamentals (MF) over the market-only baseline for time periods starting in Jan 2024 and Jul 2024 onward.

Six month increase in fundamentals' (feature) importance

As seen above, fundamentals increasingly outexplain market beta at 6 months. Also, feature importance trends (combined model) confirm a structural shift toward onchain KPIs (see Figure 12).

In evaluation windows that start before 2024, the combined 6-month model leans materially toward market proxies: BTC+ETH ≈ 32.54% of total feature importance, versus fundamental KPIs ≈ 59.80% and sub-segment ≈ 7.66%. Within fundamental KPIs, the mix skews to TVL ≈ 12.62%, DAU ≈ 10.31%, daily transactions ≈ 9.81%, protocol revenue ≈ 8.28%, protocol fees ≈ 8.27%, DEX volumes ≈ 5.64%, net treasury ≈ 4.86%, and sub-segment ≈ 7.66%.

This baseline underscores a market still anchored in beta and raw activity; monetization signals (fees/revenue) are visibly smaller– setting up the contrast with Jan 2024 onward, where KPIs rise to ≈ 73.8% of the mix and market proxies shrink to ≈ 22.3%.
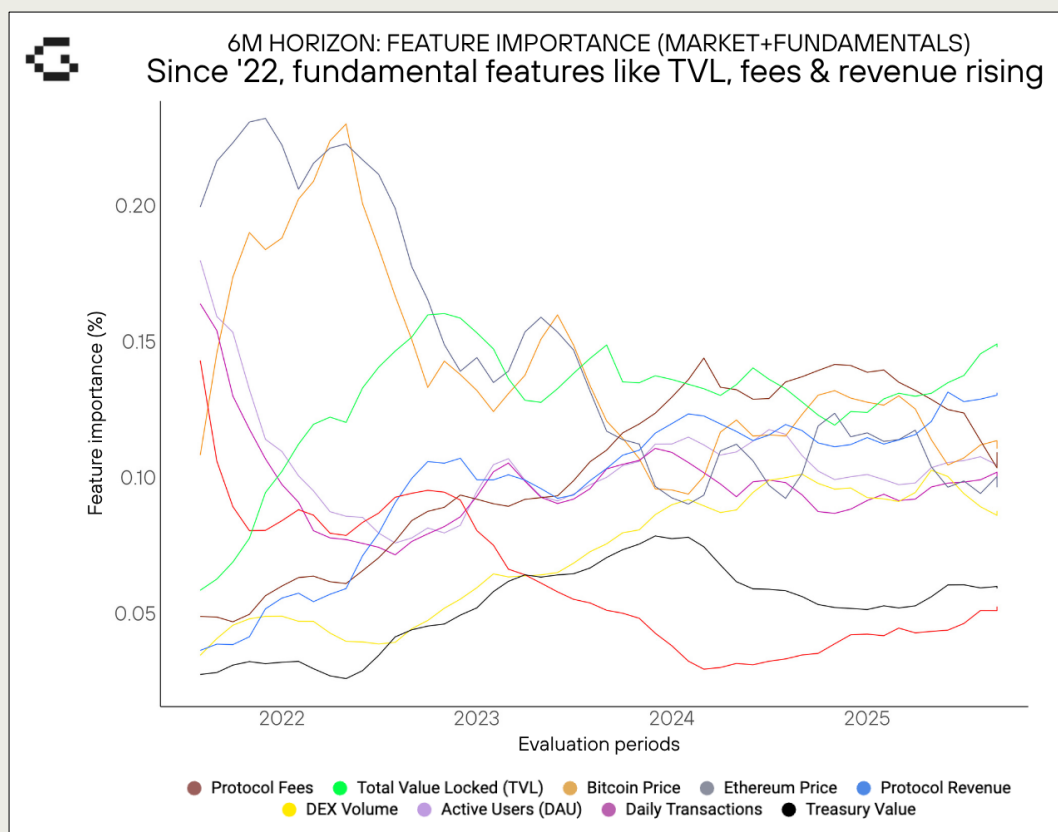

Figure 12: Feature importance trends for the 6-month horizon model. Post-2024, fundamentals dominate the mix (~74%) while BTC/ETH shrink to ~22%.

Since 2023 and after we have seen a clear rotation away from pure market beta and structural effects. Averaging windows that start Jan 2024 onward, the feature importance mix is:

- TVL ~13.3%
- Fees ~13.1%, revenue: ~12.0%
- BTC ~11.73%, ETH ~10.52%
- DAU ~10.6%, daily transactions ~9.6%, DEX volumes ~9.4%. net treasury ~5.9%, sub-segment: ~4%

Within KPIs, revenue and TVL trend slightly up month-over-month since Jan 2024. Fees, DAU/Txns, and treasury trend down modestly, while market is flat-to-slightly up. This is consistent with an ETF-era backdrop where beta has influence but TVL and revenue growth carry a durable 6-month cross-sectional signal.

In other words, since 2024, the 6-month model increasingly rewards monetization, while TVL is still the top feature.

For completeness, the fundamentals-only (KPI-only) view of 6-month feature importances (i.e., the model excluding BTC/ETH and sub-segment) in windows starting Jan 2024 onward averages:

- TVL 19.8%, fees 19.2%
- revenue 15.7%,
- DAU 13.9%, daily transactions 12.4%, DEX volumes 11.8%, net treasury 7.3%.

Our 6M results point to a clear tilt toward fundamentals: post-Jan 2024, the combined model's feature mix is KPI-heavy (~74%) and market-light (~22%), and fundamentals-only delivers consistent uplift versus the market baseline. However, fundamentals' incremental power has historically been regime-sensitive. Severe drawdowns (as in 2022) compressed or even reversed the signal. We now turn to the regime analysis, detailing how 6M uplifts vary across bull, flat, and bear environments.

4.4 Cross-Regime Analysis: bull vs bear vs flat periods

Because model outperformance concentrates at the 6-month horizon, we analyze regime effects at 6 months. Regimes are defined by the change in average DeFi market cap (Δavg_mc) relative to ±0.5·σ. Figure 13 shows boxplots comparing differing uplifts across regimes for all time windows, figure 14 shows the same for periods starting from Jan 2024 to display the temporal change. In all windows (2021–2025) fundamentals add magnitude in bull and flat markets, and historically struggled in bears. Medians (pp) and counts: Bull n=18, flat n=17, bear n=13.

- Fundamentals-only (FO): +3.6 pp (bull), +3.3 pp (flat), −2.5 pp (bear).
- Market+fundamentals (MF): +2.8 pp (bull), +1.1 pp (flat), +0.3 pp (bear).

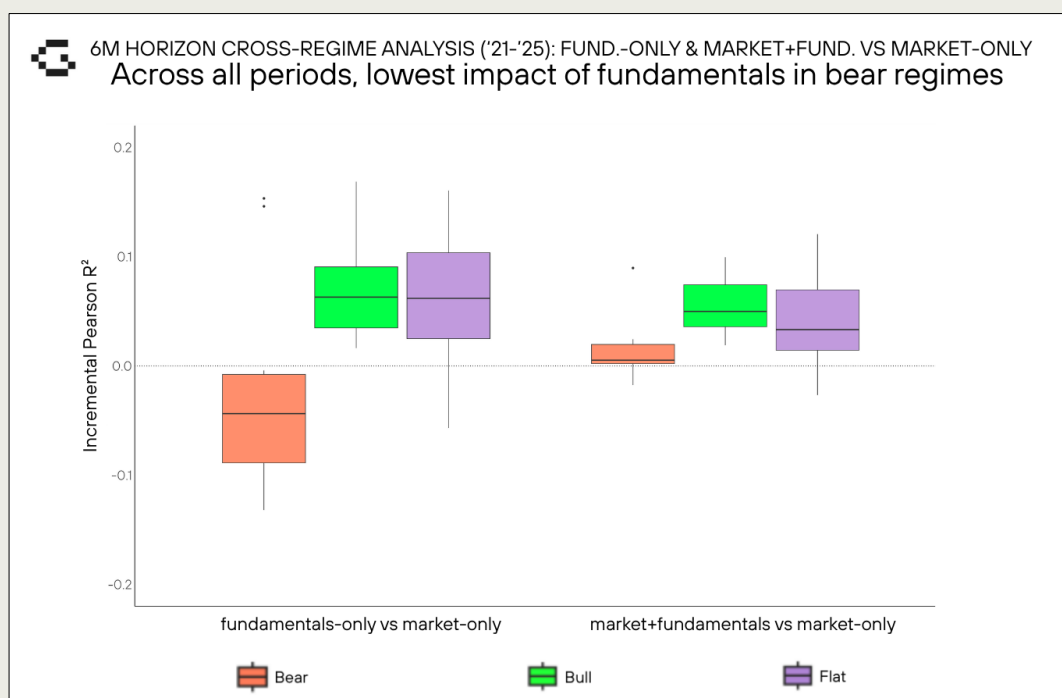In the full sample, FO turns negative in bears; MF stays mildly positive with lower dispersion.

6M HORIZON CROSS-REGIME ANALYSIS ('21-'25): FUND.-ONLY & MARKET+FUND. VS MARKET-ONLY
Across all periods, lowest impact of fundamentals in bear regimes

Figure 13: Cross-regime distribution of 6-month uplifts (Δ Pearson R^2 vs market-only), all windows 2021–2025. Each boxplot shows the out-of-sample increase (or decrease) in Pearson R^2 obtained by replacing the market-only baseline (left) with a fundamentals-only (FO) model (right) and a market+fundamentals (MF) model; colors partition validation slices by regime. The dotted line at 0 marks parity with market-only. Fundamentals add in bull/flat (p-values < 0.01); FO turns negative in bears (p-value = 0.94) while MF stays mildly positive (p-value = 0.04) with tighter dispersion (n=18/17/13).
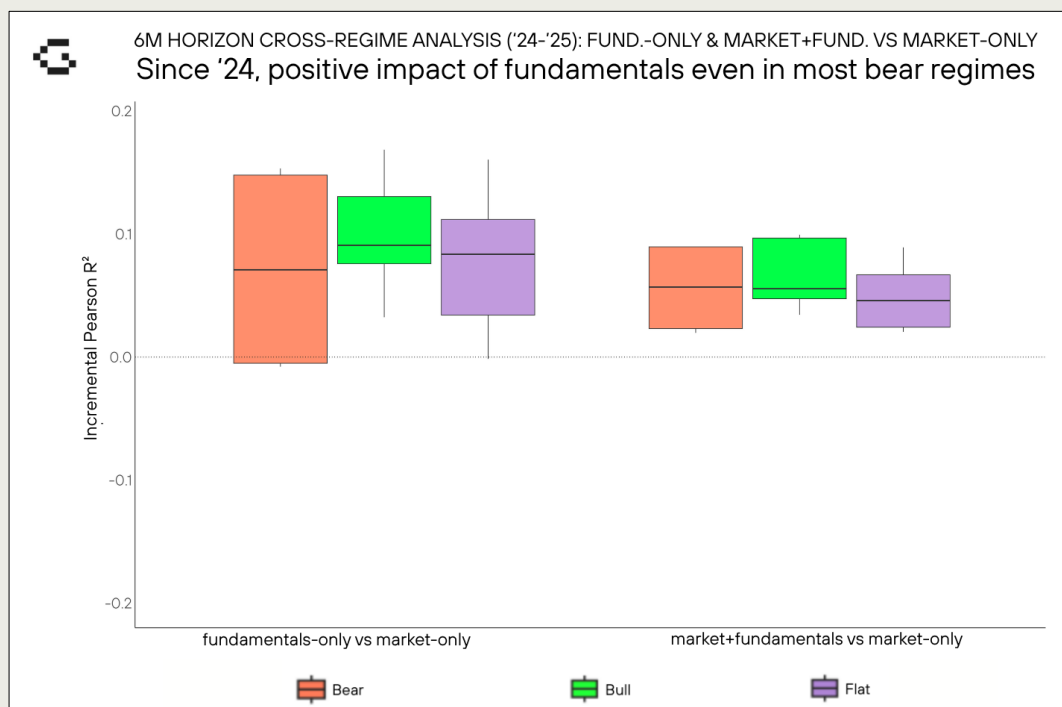
Figure 14: Cross-regime distribution of 6-month uplifts (Δ Pearson R² vs market-only), windows starting Jan 2024. Same design as Figure 13, restricted to recent windows. Uplifts are positive across all regimes, with the largest step-up in bears. (n=9/6/4; small sample in bears). Bear regime p-values = 0.1/0.03 for FO/MF. P-values otherwise <= 0.01.

In windows starting Jan 2024 (figure 14), fundamentals strengthen across all regimes – most visibly in bears (small-n caveat - 4 bear periods only):

- Fundamentals-only (FO): +9.1 pp (bull), +8.4 pp (flat), +7.1 pp (bear)
- Market+fundamentals (MF): +5.6 pp (bull), +4.6 pp (flat), +5.7 pp (bear)

In exuberant bulls, uplifts are positive but moderate (FO > MF). In flats, fundamentals provide steady differentiation, adding beta can dilute the pure signal. In bears, the recent windows show the largest step-up in uplift, led by FO – an inversion of the pre-2024 pattern.

Improving bear-regime robustness – early evidence

Since Jan 2024, we have only four bear-regime evaluation windows. Within this small sample, both fundamentals-based models show positive magnitude uplifts vs the market baseline, with fundamentals-only (FO) larger on average.

This pattern suggests greater bear-regime resilience of fundamental signals: projects with stronger usage/liquidity/income/treasury tended to decline less or rebound faster, allowing fundamentals to add explanatory power even as the aggregate fell. The market+fundamentals (MF) model remains consistently positive in bears and typically exhibits lower dispersion; it does not underperform in this period, it just delivers a smaller uplift than FO. MF shows greater

statistical significance of fundamentals impact, though than FO with p-values of 0.03/0.1 respectively.

Ultimately, the bear-regime conclusions for 2024–25 are directional rather than definitive due to n=4 and the absence of a 2022-style capitulation in the recent sample. We will reassess as more bear windows accrue.

4.5 Increasing impact of fundamentals – a maturing market

The following table summarizes the findings from previous sections regarding the temporal improvements and regime-specific impacts for fundamentals-only (FO) and market+fundamentals (MF) vs market-only for each horizon.

Horizon + Model	Temporal trend (Δ Pearson R^2 vs market-only, mean pp)	Spearman trend (mean pp)	Key Takeaway
1M / FO	All: −1.23 Jan 24+: −2.42 Jul 24+: −2.99	All: −0.44 Jan 24+: −0.45 Jul 24+: −0.53	At 1M, FO subtracts value; short-term moves are dominated by beta/noise.
1M / MF	All: −0.13 Jan 24+: −0.73 Jul 24+: −1.25	All: +0.03 Jan 24+: +0.04 Jul 24+: −0.05	Combined model offers negative 1M uplift recently; market-only often suffices for magnitude.
3M / FO	All: −2.28 Jan 24+: −1.95 Jul 24+: −2.94	All: −0.20 Jan 24+: −0.24 Jul 24+: −0.77	FO is not a driver of 3M magnitude; ranking signal is inconsistent.
3M / MF	All: +1.30 Jan 24+: +2.12 Jul 24+: +1.82	All: +1.49 Jan 24+: +1.24 Jul 24+: +0.71	MF is a dependable 3M model; fundamentals add steady, moderate lift.
6M / FO	All: +4.08 Jan 24+: +8.66 Jul 24+: +12.05	All: +1.47 Jan 24+: +1.37 Jul 24+: −0.45	FO is now most powerful at 6M for magnitude; biggest recent gains in flat/bear regimes.
6M / MF	All: +4.05 Jan 24+: +6.00 Jul 24+: +7.23	All: +2.81 Jan 24+: +2.56 Jul 24+: +0.84	MF remains consistently additive at 6M, less on magnitude than FO though; better rank stability than FO.

The 6-month evidence points to a maturing market: conditioning on the same regimes, the incremental explanatory power of fundamentals rose meaningfully in 2024+, and the combined model's feature importance shifted toward KPIs ($\approx$ 74%) and away from market proxies ($\approx$ 22%). That said, the period lacks a 2022-style crash. While the absence of extreme drawdowns helps fundamentals express, the within-regime uplift gains – bull, flat, and even bear – indicate the effect is not solely driven by the regime-mix of the respective period.

4.6 Pricing efficiency in DeFi: What our ex-post ML models reveal

Evidence points to a maturing market that increasingly prices fundamentals, especially over longer horizons. In 2021, narrative/liquidity dominated. By 2024–25, fundamentals explain a meaningful incremental share of 6-month returns. However, the effect is smaller at 1–3M and largest at 6M, which means onchain information that is available in real-time is priced-in only with significant time lags.

It's similar to early-stage equity markets or new industries in general: initially, a lot of noise and hype; later, actual earnings and growth prospects determine winners (with hype still present but not the sole determinant). We expect this trend to continue: as more sophisticated investors (including institutional) enter the space,that will increasingly employ fundamental analysis, further enforcing these relationships (much like equity analysts do for stocks).

However, an interesting nuance: the DeFi fundamentals we use are not audited financials like in equities – they're onchain metrics that can sometimes be gamed or not fully indicative of profit. For example, high TVL can be achieved by offering unsustainably high yield incentives. High transaction counts could be spam. We partially mitigate that by looking at fees (harder to fake - fees imply someone paid for usage).

But "quality of fundamentals" is a consideration. When assessing an individual project, we would look deeper: e.g., protocol revenue that's purely paid in its own inflationary token is less valuable than revenue in a blue-chip asset. Our model doesn't distinguish revenue quality, it just sees growth. In the future, one could refine features (maybe categorize fee quality, user retention vs new user growth, etc.).

Because DeFi fundamentals stream onchain in real-time, the key efficiency question we posed was "Have investors already priced this period's publicly visible fundamentals by the end of the same period?" in order to assess the impact of fundamentals on DeFi valuations. We therefore used ex-post models, matching month-over-month fundamental growth to month-over-month returns, and analogously over 3- and 6-month windows. This design, impractical in quarterly-reporting equity markets, is uniquely informative for DeFi: it lets us measure residual mis-pricing despite continuous data availability.

Core findings based on mean / median uplifts				
Horizon + model	Market-only Pearson R²	Fund. uplift 2024–25 (Pearson R²)	Fund uplift 2024–25 (Spearman R²)	Pricing-efficiency reading
1M MF	≈ 0.95	–0.73 pp / –1.31 pp	0.00	Nearly all cross-sectional variance explained by BTC/ETH beta; fundamentals slightly underperform in magnitude (Pearson) but are equal in ranking (Spearman).
3M MF	≈ 0.85	2.12 pp / 2.89 pp	1.24 pp	Modest, reliable incremental fit in magnitude and ranking since 2024.
6M FO	≈ 0.72	8.66 pp / 9.09 pp	1.37 pp / 0.55 pp	Largest residual explained by 6M. Evidence of significantly slower than real-time assimilation of onchain KPI signals, not instant efficiency.

MF in the table above refers to the market+fundamentals model and FO refers to the fundamentals-only model. Uplifts in absolute Pearson R² are reported based on which of the models outperformed the most over the respective time-frame. Averages are reported as mean / median, while in some cases they were close enough to report only one figure. Evaluation windows starting January 2024 until mid-2025 have been chosen for this analysis of pricing efficiency, while other parts of this article focus on longer timeframes in order to show the evolution of increasing fundamentals impact. Appendix D details a more complete set of summary statistics on mean and median uplifts for Pearson R² as well as Spearman R².

4.7 Why do fundamentals impact models increasingly with horizon? Why the lag?

Beta dominance fades over time

Beta dominance fades with time. Market-only R² is very high at 1M (~95%) and lower at 6M (~72%), expanding room for fundamentals.

Information assimilation is slow

Even though every block discloses new TVL, fee, and user data, investors need multiple months to act on a visible trend – to filter noise, source liquidity, or pass governance hurdles. That delay allows fundamentals to deliver >5 pp incremental R² over 6-months.

Rational persistence filtering

A complementary explanation for the stronger 6-month uplifts is that short-term changes in fundamentals are often not sticky. Market participants may anticipate this and refrain from fully pricing in a KPI trend until it proves durable over several months. Under this view, the apparent lag is partly rational: it avoids over-reacting to temporary spikes in TVL, user counts, or volumes that later mean-revert. The distinction between inefficiency and rational confirmation lag is important. In practice, both likely contribute to the horizon pattern we observe.

Does DeFi leverage theoretical pricing efficiency yet?

Relative to the 2021–22 hype cycle, DeFi pricing today is more aligned with verifiable fundamentals, a clear step toward efficiency. However, DeFi's block-level transparency enables rapid information dissemination, yet our ex-post checkpoints show that markets take months, not minutes, to finish incorporating onchain fundamentals. At the same time, it might be rational to wait for trends in fundamentals' growth to prove persistent, making the case for efficiency despite the time lag. Nevertheless, the large 6-month uplifts likely indicate significant elements of an inefficiency gap, and thus a trading opportunity that remains open in today's internet-native financial markets. In the future, this gap will likely compress.

4.8 TradFi studies as contextual mile-markers

Traditional equity-pricing research sets a conservative benchmark for how much fundamentals typically improve model fit. Closest TradFi mile-markers come from single-stock, ex-ante tests. In Bartholdy & Peare (2005), Capital Asset Pricing Model (CAPM) - i.e., a single market factor as the beta benchmark - explains ~3% of cross-sectional variation in one-year stock returns using five years of monthly data. Adding size & value (as per the Fama-French 3-factor-model) lifts fit only to ~5%, so fundamentals add little incremental signal at the stock level. Pushing prediction with 90+ characteristics, Gu, Kelly & Xiu (2020) still find stock-level out-of-sample R^2 well under 1% per month (≈0.1–0.4%). Methodologically, CAPM's market factor is a rough comparison to our BTC/ETH market-only proxies (both are broad beta baselines), though ours uses two crypto betas (no risk-free leg) and nonlinear trees. Because those studies mostly forecast while we assess contemporaneous pricing, we treat them as conservative contextual mile-markers, not one-to-one efficiency benchmarks. Nevertheless, we wanted to include brief references for our results, showing that several percentage point uplifts are significant, albeit not fully comparable.

5. Limitations & future direction

Our evidence that onchain fundamentals increasingly explain DeFi valuations is encouraging, but several caveats temper the result.

- Data quality and availability: Our dataset likely included only established DeFi projects (survivorship bias – projects that died early might be dropped). If so, our results could be overstating how well fundamentals work, because the worst failures (with poor fundamentals) simply disappeared (and their tokens likely went to zero regardless). In a full dataset including dead projects, fundamentals such as "TVL going to zero" would have predicted collapse (which is good, that's a strong relation), but those tokens might skew the stats.

- Sybil and manipulation risk: As mentioned, user counts, etc., can be faked. To the extent that happened, it could either fool our model (thinking fundamentals improved when actually it's fake activity) or if investors weren't fooled, it wouldn't correlate with returns. Our findings that users/txns did matter in bulls might reflect some fake activity did pump tokens in bull (market rewarding metrics without discerning quality). Over time the market likely got wiser, focusing on fees (harder to fake) – which our model picks up on. Still, it's a cat-and-mouse: projects could try to game fee metrics outright themselves or via incentives (e.g., wash trading to generate fake fees). Researchers and investors will need more sophisticated metrics and qualitative assessments to avoid being misled.

- Nested variables and multicollinearity: Several fundamental variables directly depend on each other. E.g., revenues are often a direct function of fees, which are often a direct function of DEX volumes for decentralized exchange projects. As a result, feature importances need to be viewed with multicollinearity in mind. Theoretically, earnings and subsequently free cash flows (FCF) are what matter for fundamentally driven investment returns. Some KPIs are more or less direct drivers of FCF, while some are more or less leading indicators (e.g., TVL in an automated market maker DEX provides the potential for trading volume to occur, which in turn drives protocol fees and subsequently revenues depending on the revenue share model with the entire stakeholder base).

  Since we intended to test to what extent and which fundamental KPIs are priced-in by investors in a given time period, we were explicitly curious about whether it is more leading/lagging and direct/indirect indicators of current or future profitability that have mattered. A different research design could include random sampling of different combinations of variables to measure the level of multicollinearity.

- Macro is only included via proxy of BTC and ETH: Macro factors (like a variable for Fed policy or USD liquidity) could further improve predictions by capturing regime shifts and BTC/ETH might lose (further) in market cap and collateral dominance vis-a-vis DeFi, warranting a change in market beta proxies. More recently, there have been more DeFi projects from newer Layer 1 ecosystems such as Solana or Sui that correlate more with

their respective tokens e.g. via common trading pairs or collateral usage, so the decline in market beta impact could stem from these effects. However, the models with fundamentals have also increasingly outperformed the simple last valuation benchmark to an increasing extent over time.

- Shortening validation periods: Towards the end of the observation period we have been shortening the validation period, up to a minimum of 3 months, every month towards the end (from an initial standard period of 12 months), which makes the results towards the end increasingly unreliable.

- Short sample and evolving landscape: 4 years is short. Relationships we found might not hold in the future if the market structure changes. In crypto, cycles are compressed but also possibly more regime-dependent. We partly addressed regime changes, but our models didn't explicitly have a regime-switching mechanism - we just rolled and observed differences. Our data up to 2025 shows a clear trend of fundamentals mattering more, but if say, a new massive bull market occurs (comparable to the 2017 ICO boom) where speculation runs wild, we might temporarily revert to hype-over-fundamentals for a period.

- Coarse regime labeling: our $\pm 0.5\,\sigma$ rule over 12-month evaluation periods may miss local regime shifts, decreasing the reliability of the cross-regime analysis.

- DeFi tokens are not identical to stocks: Many have no cash flow rights, so why fundamentals matter is interesting. It could be that the market collectively assumes governance tokens' value should relate to protocol success (either via future fee distribution or at least increased buy pressure if the protocol is used). It's a reflexive/psychological link more than a formal one in some cases. But as the industry evolves, more tokens may adopt value accrual mechanisms (fee sharing, buy-backs, etc.), strengthening the tie between fundamentals and price.

Our results might be early evidence of investors pricing in expected future cash flows or utility even if not present yet - similar to a growth stock that pays no dividend but investors expect it will monetize eventually. The challenge is, unlike stocks, token holders can't always force profit distribution. This means fundamentals' impact could at times decouple if narrative shifts (for instance, if suddenly investors only care about governance power or something not proportional to usage).

So far, however, the usage metrics remain a focal point likely because they are the best proxy for network value.

Future Work

Some ideas for future research include introducing higher-frequency checkpoints by capturing fundamentals at hourly or daily UTC closes. Re-run our ex-post models on these snapshots against same-interval returns and chart how the incremental R^2 decays from hour-0 out to day-7, week-4 and longer time frames. The resulting decay curves will show, in real-time, how fast different fundamentals are being priced in, pinning down the true assimilation lag for each type of fundamental news. In this research design, we chose a subset of time frames that have shown distinct patterns across a wider range of time frames in earlier iterations.

Further, incorporating broader macro indicators (interest rates, liquidity indices) directly could help see how much of token returns they explain vs fundamentals. Even though BTC and ETH likely capture those macro signals quite well since they are usually the first to be affected by macro liquidity flows. Finally, investigating differences across subsectors of DeFi (DEX vs lending vs staking) could be worthwhile. While we included sub-sector as a feature to take these differences into account, which improved model performance, we did not analyze or visualize them to a greater extent. Picking individual sub-segments would reduce the number of projects and generalizability, which is the reason why we decided to pick a broader set for this study.

6. Conclusion

Do fundamentals (increasingly) drive DeFi valuations?

Across four years of rolling out-of-sample tests, we find a clear trajectory: fundamentals increasingly drive DeFi token returns, especially at longer horizons and recently also in tougher market regimes. In windows that start after January 2024, a fundamentals-only model now beats a market-only baseline by +8.66 pp R^2 and by +12.05 pp R^2 in windows after mid-2024 at the 6-month horizon – roughly doubling the ~+4.1 pp average recorded over the full 2021–25 sample.

Horizon	Typical incremental Pearson R^2 (from Jan 2024)
1 M	~ −0.73 pp - market beta dominates
3 M	~ +2.12 pp - fundamentals add modest, steady lift
6 M	~ +8.66 pp - fundamentals dominate

Best fundamentals-based model vs market-only (absolute Pearson R^2 uplift, pp, means from Jan 2024). 1M/3M: Market+fundamentals; 6M: Fundamentals-only.

These figures mirror an information-diffusion curve: beta explains more in the first month (−0.73 pp uplift), fundamentals pick up signal by three months (+2.12 pp), and become decisive by six months (+8.66 pp on average from Jan-2024, +12.05 pp from mid-2024 windows).

Regime is the accelerant

Recent data (post-Jan 2024) show positive 6M uplifts across all regimes (FO medians): Bull +9.1 pp (n=9), flat +8.4 pp (n=6), bear +7.1 pp (n=4). In bear periods before, fundamentals were rather lagging, while now markets reward projects that retain TVL/users and generate fees even in down trends (caveat: recent periods were mostly bullish or flat).

Why the combined model lags fundamentals-only

At 6M, the market+fundamentals variant is still positive (+6.00 pp mean uplift, Jan-2024 onward) but trails fundamentals-only (+8.66 pp). The combined model retains a solid rank-ordering edge (Spearman +1.4 pp, Jan-2024 onward), whereas fundamentals-only delivers the higher magnitude accuracy – driven by strong outlier projects.

Market-efficiency lens

The gap between short- and long-horizon uplifts implies that DeFi markets absorb fundamental news slowly. Even with block-level transparency we observe a multi-month repricing window, likely due to liquidity frictions, analytical challenges, and behavioral biases, but especially also rational confirmation: short-term KPI changes can be noisy or reversible, so investors wait for persistence. In that sense, the 6-month horizon is where durable trends separate from noise.

Implications

For investors: Alpha lies in spotting accelerating onchain KPIs (TVL, fees, revenue, broad usage) months before consensus (since there are significant time lags in pricing of fundamentals), while separating unsustainable spikes from durable trends.

For founders: Demonstrable, durable economics matter more than TVL growth alone. Protocols that convert usage into revenue are repriced to the greatest extent.

Overall, DeFi markets appear to be maturing: fundamentals increasingly matter at 6M and even bears show positive uplifts post-2024. That said, the period lacks a prolonged 2022-style capitulation. As more data accrues, we will reassess the robustness of the results.

About the authors

Felix Machart

Felix is a Research Partner at Greenfield. He joined the firm on day one as Head of Research. Felix has led many of Greenfield's research efforts, e.g., on the state of blockchain governance. Before joining Greenfield, he was an independent researcher in the space and an investment manager at Axel Springer Plug & Play. Felix holds a double degree, Master of Science from WU Wien and Master of Int. from Queen's University.

Mateusz Dominiak

Mateusz is a Data Scientist with experience in time series forecasting, recommender systems and ad-networks performance targeting. He's working on aggregating raw crypto data to surface insights to the team in the form of both dashboards and ML models. SQLmagician.

About Greenfield Capital

Greenfield Capital is Europe's institutional-grade digital asset investment firm. Since 2018, we have been fully regulated, investing in digital assets and blockchain companies, and providing investors with the full spectrum of exposure to the space. With dedicated domain teams and the largest crypto investment bench in Europe, Greenfield has delivered superior capital returns with its first and second crypto venture funds. In 2021, Greenfield launched its third fund, one of the largest dedicated crypto venture funds in Europe (€135M). Greenfield's portfolio includes NEAR, 1inch, Arcium, Centrifuge, Gattaca, PEAQ, Safe, DRESSX, and Layer3, among others.

Important Information

Appendix

Appendix A

Data-set – The projects in the sample are listed and a table detailing the individual features, their inclusion rationale and data source is provided. We did not include any features that contain token incentives since they are, in turn, dependent on the token's valuation, which we are measuring (leaking the target).

aave, acala, aerodrome, aevo, apex, avantis, balancer, bananagun, benqi_finance, bluefin, centrifuge, cetus, compound, convex, curve, deepbook, dodo, drift, dydx, dydx_v4, eigenpie, enzyme, ethena, etherfi, fluid, frax, fraxswap, gains-network, gmx, goldfinch, haedal, holdstation, hydration, hyperliquid, injective, jito, jupiter, kamino, karura, ktx_finance, level-finance, lido, lifinity, liquity, maker, maple, marinade, moonwell, morpho, mux, myx, navi, ondo, orca, osmosis, pancakeswap, pendle, perpetual-protocol, quickswap, rabbit-x, raydium, ref_finance, renzo_protocol, reserve, rocketpool, scallop, spark, stader, suilend, sushiswap, synthetix, syrup, trader_joe, uniswap, usual, venus, vertex

Table A1: Fundamental KPIs used in the analysis and their theoretical impact on valuations

KPI	Description	Why it should impact valuation
Daily active user (DAU) growth	Number of unique users interacting with the protocol daily (source: Artemis)	Indicates usage and user demand; more users imply greater utility and potential value accrual
Total value locked (TVL) growth	Capital deposited into a protocol (source: Artemis)	Higher TVL signals trust, liquidity depth, and utility; supports economic activity and scale
Daily transactions growth	Number of executed transactions (source: Artemis)	Reflects protocol activity and usage intensity; higher transaction volume may indicate stickiness
Protocol fee growth	Fees paid by users for accessing protocol services (source: Artemis)	Strong proxy for monetization and revenue generation; supports token value capture mechanisms
Protocol revenue growth	Net income from operations, often after fee-sharing (source: Artemis)	Demonstrates financial sustainability; can support long-term tokenholder incentives
BTC price growth	The price increase of the largest cryptoasset by market cap	Historically all cryptoassets have been traded against Bitcoin while later on continuing to exhibit high levels of correlations to the price of BTC
ETH price growth	Price increase of the 2nd largest cryptoasset by market cap that powers the L1 with the most significant DeFi ecosystem	Ether powers the largest L1 by market cap and by DeFi TVL, while also a significant portion of DeFi TVL and collateral is denominated in Ether

Appendix B

Model performance by horizon and regime. The tables below report the mean out-of-sample Pearson R^2 for each model variant, broken down by market regime, for 1-month, 3-month, and 6-month prediction horizons. The boxplots below show the respective quartiles (incl. medians) per horizon and regime. Note that the 6M prediction horizon boxplots are shown in Figure 14 in the main text.
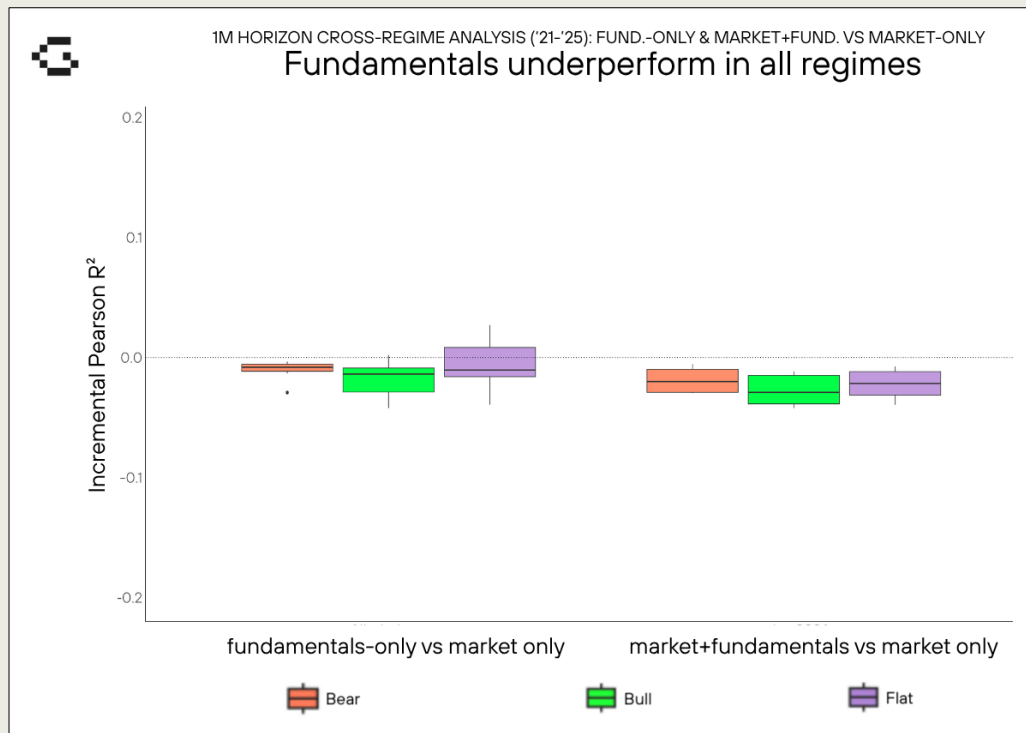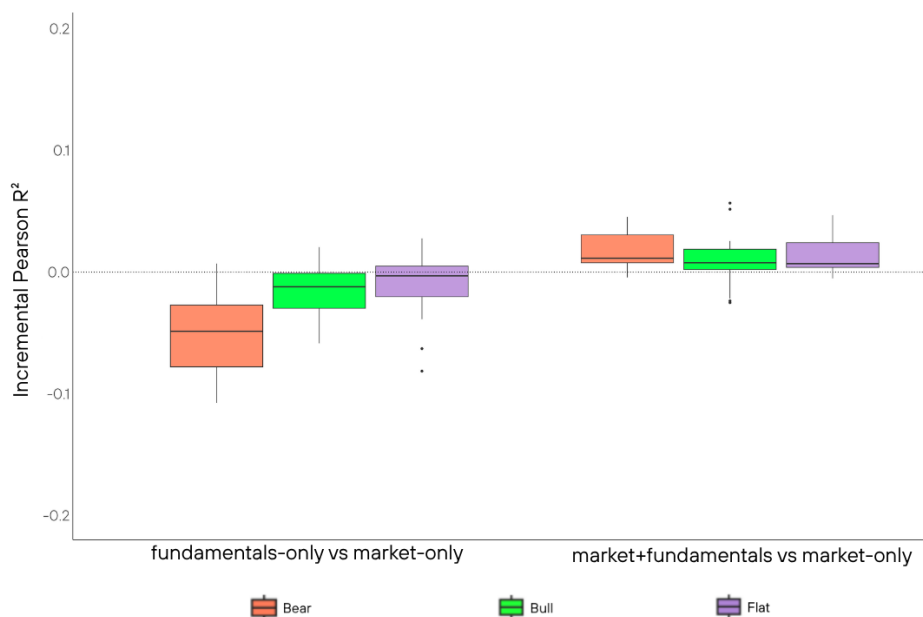

Table B1: 1-month horizon average Pearson R^2 (2021–2025).

Model	All periods	Bull regimes	Flat regimes	Bear regimes
Market-only	0.9504	0.9518	0.9571	0.9421
Fundamentals-only	0.9380	0.9343	0.9567	0.9306
Market+fundamentals	0.9491	0.9481	0.9604	0.9421
Market+followers	0.9536	0.9528	0.9614	0.9483
Last valuation (naïve)	0.9349	0.9308	0.9508	0.9305

3M HORIZON CROSS-REGIME ANALYSIS ('21-'25): FUND.-ONLY & MARKET+FUND. VS MARKET-ONLY

Fundamentals add signal to market beta on avg. in all regimes

6M HORIZON: FUNDAMENTALS-ONLY VS MARKET-ONLY

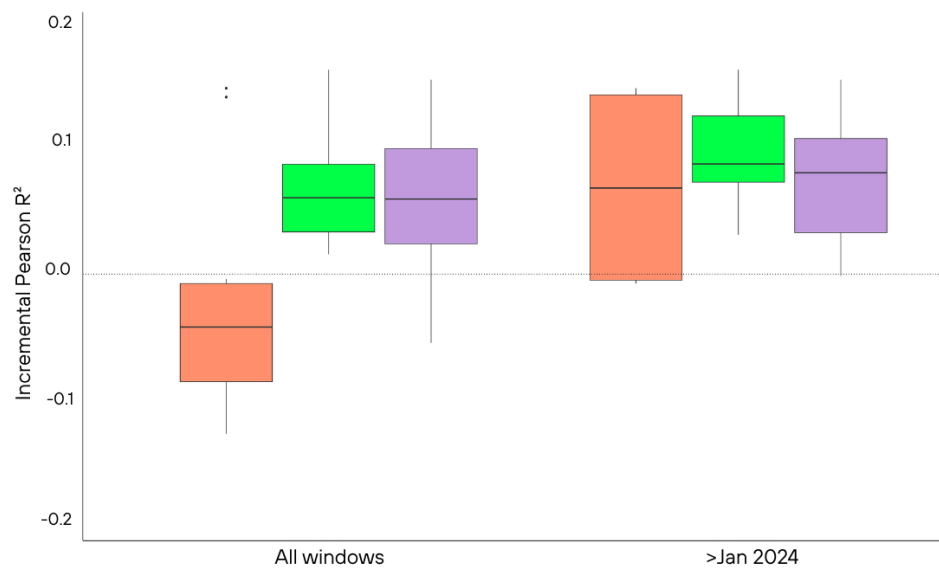Since '24, fundamentals outperform even in bearish periods

Table B2: 3-month horizon average Pearson R² (2021–2025)

Model	All Periods	Bull Regimes	Flat Regimes	Bear Regimes
Market-only	0.8497	0.8634	0.8567	0.8145
Fundamentals-only	0.8263	0.8499	0.8447	0.7611
Market+fundamentals	0.8627	0.8759	0.8699	0.8290
Market+followers	0.8457	0.8578	0.8590	0.8084
Last valuation (naïve)	0.8046	0.8100	0.8352	0.7684

Table B3: 6-month horizon average Pearson R² (2021–2025)

Model	All periods	Bull regimes	Flat regimes	Bear regimes
Market-only	0.7161	0.7439	0.6881	0.6768
Fundamentals-only	0.7541	0.8116	0.7524	0.6424
Market+fundamentals	0.7562	0.7964	0.7261	0.6941
Market+followers	0.7242	0.7475	0.7142	0.6829
Last valuation (naïve)	0.7174	0.7365	0.7375	0.6665

Appendix C

Means and medians for fundamental-only (FO) and market+fundamental (MF) absolute percentage point uplifts in Pearson R², as well as Spearman R²

Table C1: Absolute Pearson R² uplifts (pp)

Horizon	Window set	FO Mean	FO Median	MF Mean	MF Median
1M	All	−1.23	−1.15	−0.13	0.08
1M	Jan 2024+	−2.42	−2.82	−0.73	−1.31
1M	Jul 2024+	−2.99	−2.96	−1.25	−1.6
3M	All	−2.28	−1.54	1.3	0.88
3M	Jan 2024+	−1.95	−1.99	2.12	2.89
3M	Jul 2024+	−2.94	−2.95	1.82	2.89
6M	All	4.08	4.55	4.05	3.46
6M	Jan 2024+	8.66	9.09	6.0	5.55
6M	Jul 2024+	12.05	11.41	7.23	8.91

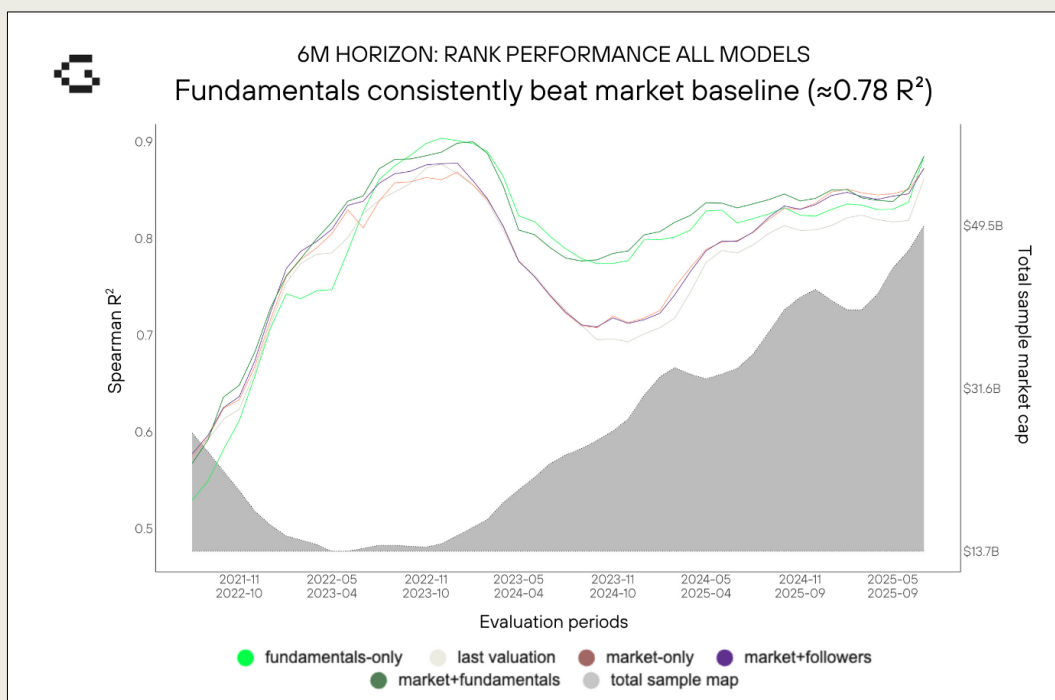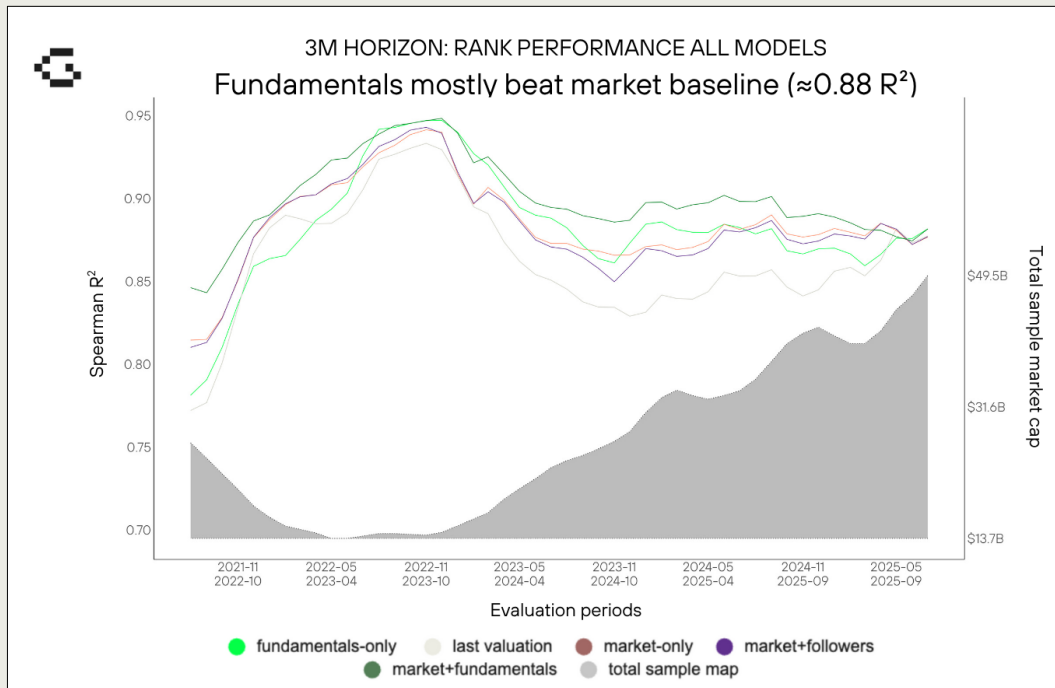**Table C2:** Absolute Spearman R² uplifts (pp)

Horizon	Window set	FO Mean	FO Median	MF Mean	MF Median
1M	All	−0.44	−0.26	0.03	0.02
1M	Jan 2024+	−0.45	−0.62	0.04	−0.02
1M	Jul 2024+	−0.53	−0.66	−0.05	−0.1
3M	All	−0.2	0.06	1.49	1.49
3M	Jan 2024+	−0.24	−0.48	1.24	1.25
3M	Jul 2024+	−0.77	−0.86	0.71	0.69
6M	All	1.47	1.71	2.81	2.39
6M	Jan 2024+	1.37	0.55	2.56	1.5
6M	Jul 2024+	−0.45	−1.27	0.84	0.5

1M HORIZON: RANK PERFORMANCE ALL MODELS
It's hard to beat a strong market baseline (≈0.97 R²)

3M HORIZON: RANK PERFORMANCE ALL MODELS
Fundamentals mostly beat market baseline (≈0.88 R²)

6M HORIZON: RANK PERFORMANCE ALL MODELS
Fundamentals consistently beat market baseline (≈0.78 R²)
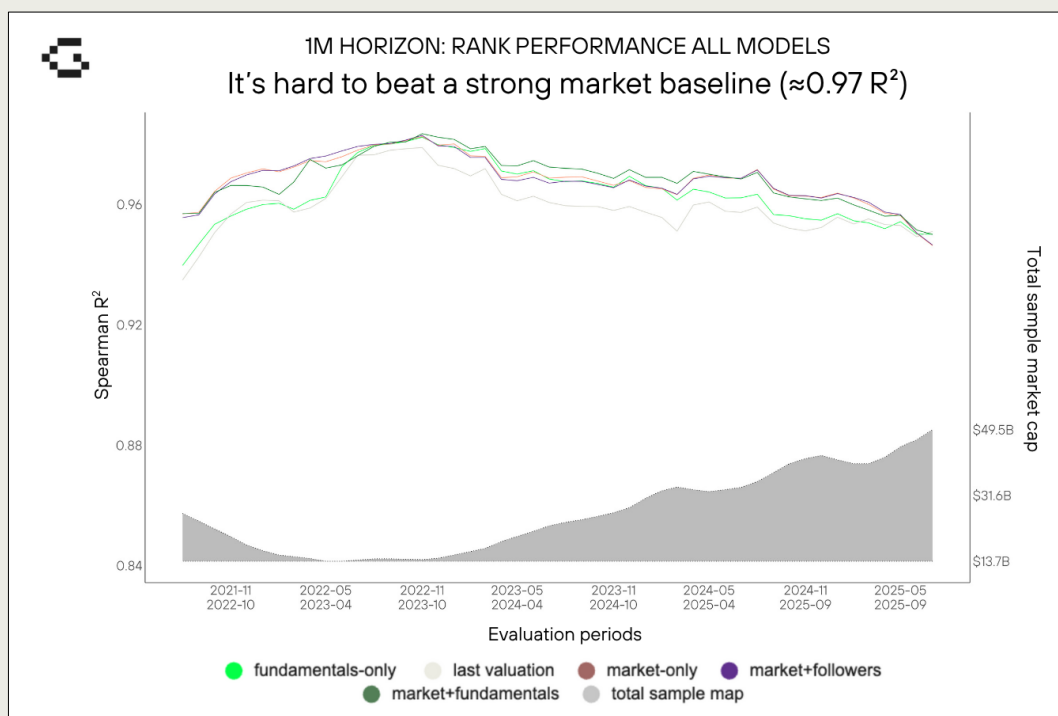
Appendix D: 6-month absolute uplifts in Pearson R² of market+fundamentals vs market+followers

Appendix E

Table E1: Top 10 feature importances by horizon. The table below lists the average normalized importance (IncNodePurity%) of the top features in the random forest for each horizon, sorted by the 6-month horizon ranking for all time windows.

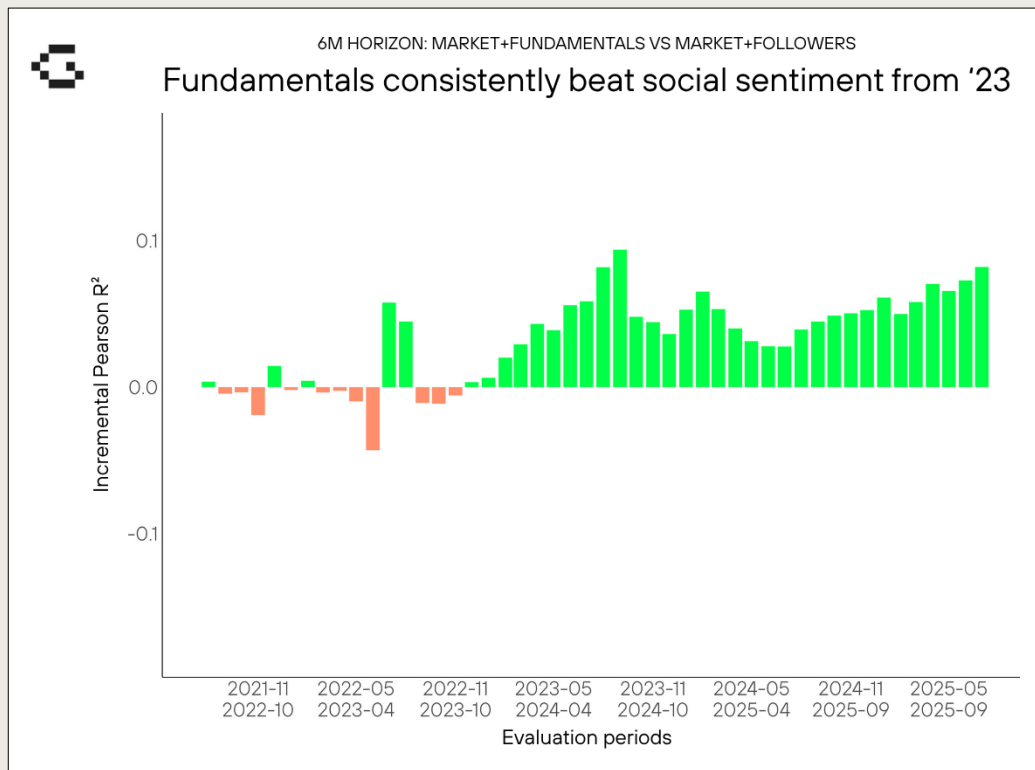| Feature (Growth rate)	Avg importance (1M)	Avg importance (3M)	Avg importance (6M)
Ethereum price (ETH)	10.56%	13.38%	14.41%
Bitcoin price (BTC)	10.57%	12.39%	13.89%
Total Value Locked (TVL)	13.87%	12.48%	12.90%
Daily active users (DAU)	9.94%	9.40%	10.44%
Protocol fees	9.82%	9.05%	10.25%
Protocol revenue	10.95%	9.83%	9.79%
Daily transactions	10.23%	9.22%	9.72%
DEX trading volume	8.32%	7.51%	7.18%
Sub-segment (protocol vertical)	0.57%	2.56%	6.13%
Net treasury value	6.94%	5.93%	5.28%

Table E2: Top 10 feature importances by horizon 2024+. The table below lists the average normalized importance (IncNodePurity%) of the top features in the random forest for each horizon, sorted by the 6-month horizon ranking for all time windows starting from January 2024.

Feature (Growth rate)	Avg importance (1M)	Avg importance (3M)	Avg importance (6M)
Total Value Locked (TVL)	14.67%	13.53%	13.30%
Protocol fees	11.46%	11.44%	13.07%
Protocol revenue	14.23%	12.91%	11.95%
Bitcoin price (BTC)	9.68%	11.81%	11.73%
Daily active users (DAU)	10.86%	10.49%	10.62%
Ethereum price (ETH)	9.53%	11.00%	10.52%
Daily transactions	10.85%	9.99%	9.57%
DEX trading volume	10.47%	10.00%	9.38%
Net treasury value	7.88%	7.00%	5.88%
Sub-segment (protocol vertical)	0.37%	1.82%	3.96%

Table E3: 6-month feature importances – fundamentals-onlymodel (KPI-onlyview). Averages of per window normalized importances; This KPI-only view excludes the sub-segment variable, since it captures categorical differences across DeFi verticals and respective feature importance interactions (e.g., lending vs DEX) rather than a directly measurable onchain fundamental. Omitting it keeps the feature importance pie focused on economic drivers of valuation growth rather than structural classification effects; sums per window = 100% after exclusion.

Feature Growth Rate	All Windows	Jan 2024 Onward
TVL	21.7%	19.7%
Protocol fees	15.8%	19.2%
Protocol revenue	13.9%	15.7%
Daily active users (DAU)	16.3%	13.9%
Daily transactions	15.1%	12.4%
DEX trading volume	10.2%	11.8%
Net treasury value	7.1%	7.3%