



WHITEPAPER

Version 1.2

Multi-Strategy Crypto Portfolio

Regime-Based Capital Allocation Framework for Optimized Risk-Adjusted Returns

Technical Overview

Disclaimer

Informational purposes only.

This paper does not constitute financial advice.

No guarantees, warranties or representations are made.

The model may be adjusted, modified or re-designed at any time.

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ABSTRACT

This document outlines a comprehensive suite of crypto trading strategies explicitly engineered around a regime-based capital allocation framework that dynamically adjusts exposures across arbitrage, directional momentum, and yield farming strategies in response to market conditions. All major allocation, leverage, and risk decisions are conditional on a binary regime classification, making regime detection the primary driver of portfolio behavior across the cycle. By conditioning every major allocation decision on a systematic risk-on / risk-off signal, the portfolio aims to deliver consistent carry in adverse regimes while retaining controlled participation in upside momentum during bull markets.

Regime-Based Portfolio Switching

Directional risk-only when the regime is "Risk-On"; Arbitrage and Yield Farming always working.



RISK-OFF: Arbitrage + Yield Farming as core engines; Directional inactive.

RISK-ON: Directional as core engine; Arbitrage + Yield Farming as stabilizers.

** For illustrative purposes only.*



HIGHLIGHTS

- **Complimentary and Adaptive** Crypto Strategies
- 256% 5-year Cumulative returns.
- 32% 2025 CAGR.
- 2.09 Daily Sharpe over 5 years.
- <7% Max Drawdown over 5 years.
- 40-60%+ APY in Risk-On regime with ~11% annualised volatility and ~4-6% max drawdown.
- ~20% APY in Risk-Off regime with less than ~7.5% volatility and max drawdown <4%.
- 30%+ full 5-year cycle APY: full-market-cycle return target with less than 9% annualised volatility and <7% max drawdown.
- ~20% volatility target: directional sleeve operates under an approximate 20% annualised volatility constraint for controlled risk.
- **Regime detection engine** - 2 regimes: binary Risk-On / Risk-Off engine dynamically drives allocation, leverage, and risk decisions across the portfolio.
- **3 Pillars:** integrated *delta-neutral arbitrage*, *directional momentum*, and *DeFi yield farming* as core strategy categories.

PERFORMANCE

Period	Sharpe Ratio	Sortino Ratio	Calmar Ratio	CAGR (%)	Total Return (%)	Ann. Volatility (%)	Max Drawdown (%)
2021	3.05	6.30	18.12	47.61%	47.54%	10.33%	-3.73%
2022	1.35	1.68	1.61	4.63%	4.61%	2.33%	-2.88%
2023	1.82	3.24	5.72	21.63%	21.55%	7.57%	-3.78%
2024	2.31	4.20	7.13	43.83%	43.80%	11.14%	-6.15%
2025	1.81	3.27	4.58	32.26%	31.14%	10.66%	-6.82%
2021-2025	2.09	3.72	4.44	30.32%	256.96%	8.92%	-6.82%

Table 1: Yearly and aggregated 5-year performance results.



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1. REGIME-BASED PORTFOLIO CONSTRUCTION

The core design principle of the portfolio is that strategy selection, capital allocation, and risk limits are all subordinated to a binary regime classification: Risk-Off (bear) and Risk-On (bull). This regime engine governs not only top-down capital splits across strategy categories, but also whether certain strategies (notably directional momentum) are permitted to be active at all.

Regime-Based Portfolio Architecture

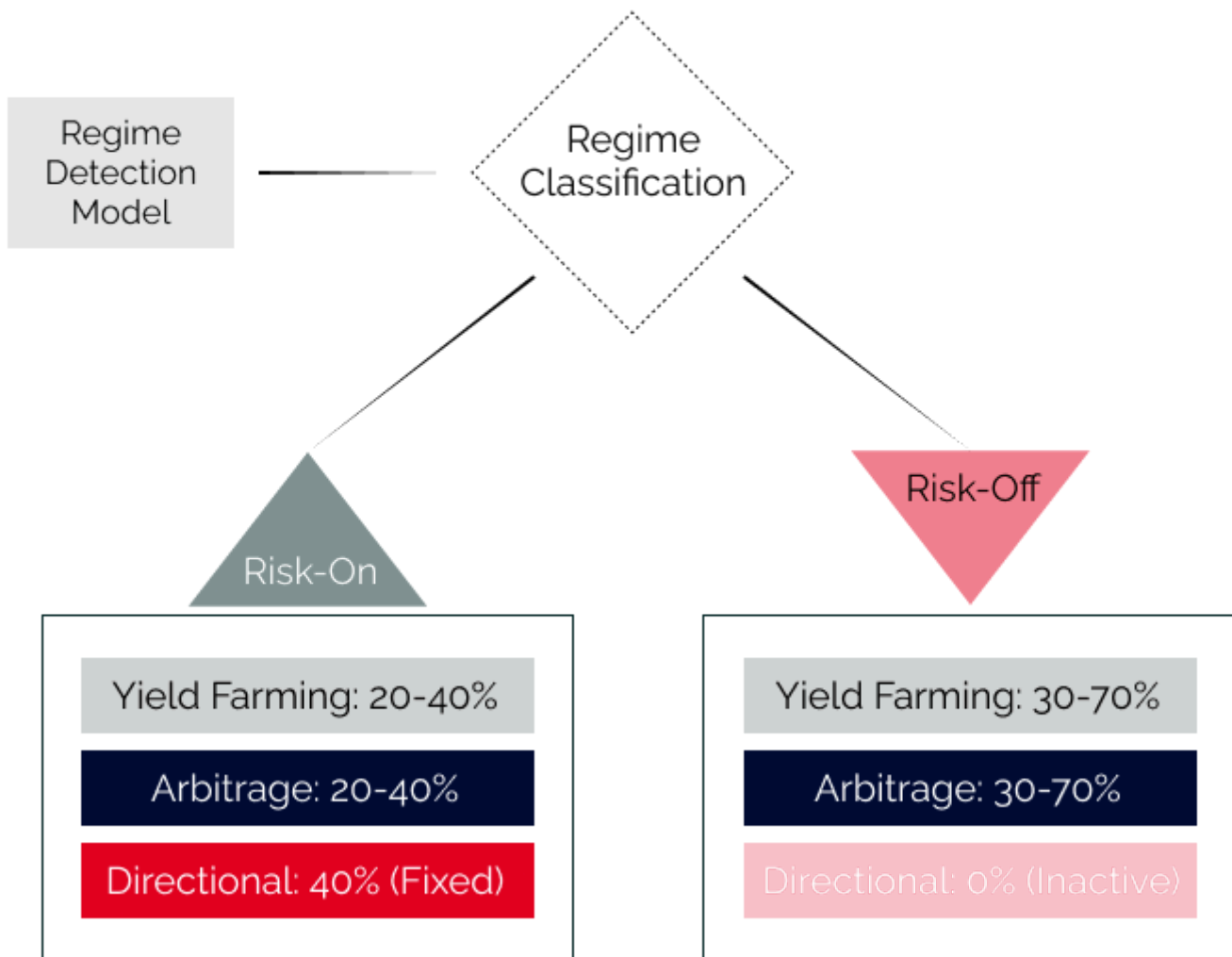


Figure 1: Top-level portfolio architecture demonstrating Risk-On / Risk-Off strategies.

1.1 Regime-Based Investment Philosophy

The portfolio adopts a regime-based investment philosophy, which starts from the premise that the investment environment is not static, and therefore portfolio allocations should adapt as underlying conditions change. Academic and practitioner research on regime-based and regime-switching allocation shows that building portfolios conditional on distinct market states can improve



risk-adjusted returns and reduce drawdowns relative to static or purely tactical approaches. In this framework, the objective is not to time short-term noise, but to structurally differentiate between prolonged risk-on and risk-off environments and align exposures with those states.

A regime-based approach is particularly well suited to crypto markets, where volatility, liquidity conditions, and cross-asset correlations tend to cluster in identifiable phases. By conditioning capital allocation on these phases, the portfolio aims to systematically increase exposure to return-seeking strategies in favorable regimes and pivot into market-neutral and yield strategies when conditions deteriorate, rather than relying on discretionary judgment or ad hoc risk reduction.

1.2 Regime Signals and Design Space (High-Level)

While the exact specification of the regime detection model is proprietary, it falls within a well-established design space that combines price trend and market risk indicators. In practice, many institutional regime frameworks rely on moving-average relationships (e.g., price relative to a 120–200 day trend), volatility measures, and breadth or momentum confirmation across assets to classify environments as risk-on or risk-off. This framework leverages that general paradigm by using BTC trend as a primary state variable to determine whether directional strategies should be active or fully deactivated.

Importantly, the regime model is used as a structural constraint on the portfolio, not merely as an overlay signal. Once a regime is identified, capital is re-optimized conditional to that state, with a secondary risk management layer that separates allocation bands, leverage limits, and budgets for Risk-On and Risk-Off environments. This aligns the portfolio with the broader literature on regime-based strategic allocation, where the main performance benefit comes from building regime-specific portfolios and combining them over time as regimes change.

1.3 Regime Detection Model

The regime detection model uses Bitcoin's medium-term trend as a proxy for overall crypto market risk sentiment, supplemented by cross-asset momentum conditions.

- **Risk-Off (Regime 0 – Bear):** BTC trades below a defined trend threshold (e.g. 120-day moving average) with weak or negative momentum across the investable universe.
- **Risk-On (Regime 1 – Bull):** BTC trades above the trend threshold with broad-based positive and accelerating momentum.

In practical terms, this model acts as a switch that determines whether the portfolio emphasizes capital preservation and market neutrality (Regime 0) or activates controlled directional exposure (Regime 1).

1.4 Regime-Driven Allocation Rules

1.4.1 Bear Market Regime (Risk-Off – Regime 0)

In Risk-Off environments, the portfolio fully deactivates the directional sleeve and reallocates capital exclusively to market-neutral and yield strategies.

- **Directional Momentum:** 0% allocation (no net beta).



- **Arbitrage strategies:** 30–70% of portfolio capital, depending on the richness and stability of funding and basis spreads.
- **Yield farming strategies:** 30–70% of portfolio capital, focused on robust, defensively constructed yield sources.

Objective: Preserve capital and generate stable returns in the 8–20% APY range primarily from funding-rate arbitrage and DeFi yield, with very low realized volatility (approximately 1–5% annualized).

1.4.2 Bull Market Regime (Risk-On – Regime 1)

In Risk-On conditions, the regime model authorizes directional risk and enforces a fixed allocation to the momentum strategy while retaining a majority allocation to market-neutral and yield components.

- **Directional Momentum:** Fixed at 40% of portfolio capital, subject to a 20% target volatility constraint within the sleeve.
- **Arbitrage strategies:** 20–40% of capital.
- **Yield farming strategies:** 20–40% of capital.
- **Constraints:** Minimum 20% allocation to each of arbitrage and yield farming, maximum 40% to either.

Objective: Capture significant upside during bull markets while moderating portfolio-level volatility to approximately 12–18% annualized and maintaining a substantial base of market-neutral yield.

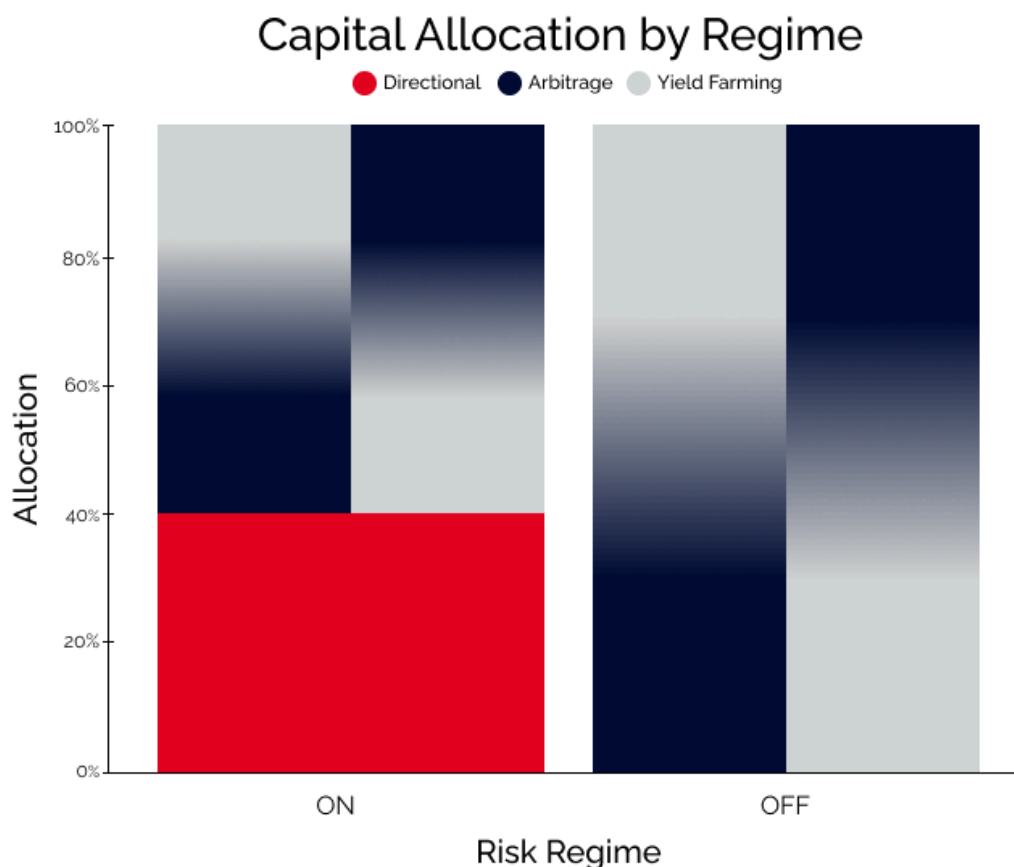


Figure 2: Capital allocation by regime demonstrates the fixed and variable sleeves under different risk regimes.



1.4 Dynamic Rebalancing Around Regimes

Rebalancing is explicitly tied to regime changes and the evolving attractiveness of arbitrage and yield opportunities.

- **Regime switches:** Immediate top-down reallocation when the model transitions between Risk-Off and Risk-On.
- **Ongoing adjustments:**
 - **Directional sleeve:** Rebalanced frequently in Risk-On regimes to keep risk aligned with the volatility target.
 - **Arbitrage and yield:** Adjusted on a lower frequency and opportunistically as funding spreads, APYs, and risk conditions evolve.

This ensures that regime classification is the primary driver of capital flows, while within each regime the portfolio flexibly reallocates between neutral carry and DeFi yield sources.



2. STRATEGY CATEGORIES

Each strategy category is defined and managed with explicit reference to its function in Risk-On versus Risk-Off environments, rather than as a static sleeve. All three pillars (arbitrage, directional momentum, and yield farming) are sized and activated based on their marginal contribution to the portfolio within the prevailing regime.

Strategy	Risk-On	Risk-Off
Directional	Core Engine	Deactivated
Arbitrage	Stabilizer	Core Engine
Yield	Stabilizer	Core Engine

Table 2: Strategy sleeves present a different value proposition under different risk regimes.

- **Arbitrage Strategies**
 - Role in Risk-Off: Core capital sink and main return driver, often at the upper end of the 30–70% allocation band.
 - Role in Risk-On: Stable carry component that complements directional risk, typically 20–40% of capital.
- **Directional Momentum Strategy**
 - Role in Risk-Off: Fully inactive; capital reallocated to arbitrage and yield farming.
 - Role in Risk-On: Dedicated 40% allocation to monetize regime-confirmed momentum while governed by volatility constraints.
- **Yield Farming Strategies**
 - Role in Risk-Off: Co-anchor with arbitrage for defensive yield generation, typically sharing the 30–70% band.
 - Role in Risk-On: Income and diversification layer (20–40%) that stabilizes portfolio risk against directional volatility.

Category	Market Exposure	Primary Objective
Arbitrage	No	Capture funding rate differentials
Directional	Long-only beta Exposure	Capture momentum during bull markets
Yield Farming	No	Generate consistent yield from DeFi protocols

Table 3: Description of each sleeve's primary objective and market exposure.



3. ARBITRAGE STRATEGIES

Arbitrage is the regime-agnostic return engine that naturally scales up as a core driver in the Risk-Off market and remains a key stabilizer in Risk-On periods. Its delta-neutral nature makes it central to the portfolio's ability to earn yield when directional exposure is disabled by the regime model. Below are some of the arbitrage strategies employed.

3.1 Cross-Exchange Funding Rate Arbitrage

In both regimes, this strategy monetizes funding spread differentials between decentralized exchanges through matched, and modestly-leveraged, long and short perpetual positions. Its delta-neutral construction allows for easy scalability and rebalance, while providing the necessary stable carry and volatility reduction when required.

3.2 Hedged Funding Rate Arbitrage Using Fixed-Rate Overlays

This approach targets regime uncertainty in funding markets by converting variable funding on the short leg into a fixed rate through yield units on certain decentralized protocols. It's particularly attractive around transitions or in unstable regimes where funding volatility is elevated but directional conviction remains low. Importantly, it also supports longer holding periods in Risk-Off states by stabilizing expected returns.

3.3 Basis Trading Using Collateralized Loans

Basis trading locks in the differential between spot and futures markets, using collateralized borrowing to structure delta-neutral positions. In a bear market this is used selectively where term structure remains favorable despite weak spot trends. During an upwards trending market it complements directional exposure by adding structurally independent carry from the futures basis.



4. YIELD FARMING STRATEGIES

Yield farming provides a regime-stable income layer whose relative weight flexes with the regime while remaining central to the portfolio's defensive and income characteristics. It supports both capital preservation in Risk-Off and volatility smoothing in Risk-On. Below are some of the yield farming strategies employed.

4.1 Leveraged Stablecoin Looping

Looping strategies on yield-bearing stablecoins are especially important in Risk-Off, where they help replace foregone directional upside with enhanced carry. During these periods it is emphasized as a key source of amplified but controlled yield when the portfolio is fully market-neutral. When in Risk-On mode, leveraged stablecoin looping maintains a meaningful but somewhat lower share of capital, balancing directional exposure with stable APY streams.

4.2 Liquidity Provision

AMM liquidity provision is used to earn trading fees and incentives, with pool selection tailored to the prevailing regime. In different regimes, a secondary layer of distribution mechanics defines the pools that will be utilized. In a Risk-Off market there is focus on conservative, high-liquidity pools (e.g., stable pairs) with attractive fee-to-volatility characteristics, and this is modified in Risk-On periods to include pools with higher volume and volatility if compensated by stronger fee and incentive economics.

4.3 Fixed-Yield Principal Token Positions

Fixed-yield Principal Token (PT) positions align well with both regimes as they provide predictable return profiles independent of short-term price action. This approach enhances capital preservation with locked-in yields during downturn periods and also offers a stabilizing anchor that reduces reliance on realized momentum for achieving target returns when the Risk-On regime is engaged.



5. DIRECTIONAL STRATEGY

The directional sleeve is a momentum-based, long-only strategy that is activated only when the regime engine classifies the market as Risk-On. In practice, Bitcoin's medium-term trend is used as a proxy for overall crypto risk sentiment: when BTC trades above its trend and a consensus of windows signals an uptrend, the regime flips to Risk-On and the directional portfolio is allowed to hold long positions; when BTC falls below trend, the regime switches to Risk-Off and the sleeve is fully deactivated, holding 100% cash so capital can be redeployed into arbitrage and yield farming.

Within Risk-On regimes, the strategy builds its universe from the most liquid assets and scores them using a volatility-normalised momentum signal that emphasises both strength and acceleration. Multi-horizon rates of change are scaled by their own volatility and combined into a composite momentum measure, from which a "momentum slope" is computed to capture whether momentum is strengthening or fading. These momentum-slope signals feed an optimisation engine that maximises expected return subject to strict constraints: weights are long-only with per-asset caps (e.g. 15%), and a 20% volatility target is imposed via the covariance matrix so that net exposure typically sits around 40–50% rather than going fully long.

The result is a concentrated but risk-controlled portfolio of up to five high-conviction assets, with typical position sizes in the 5–10% range and the remainder of capital left in cash to support arbitrage and yield strategies. The design explicitly accepts that momentum can reverse or whipsaw, and that the volatility cap may cause underperformance in exuberant bull phases, in exchange for materially reduced drawdowns and tighter integration with the regime-based allocation framework that governs the overall portfolio.

5.1 Activation Logic and Market States

The momentum strategy is only permitted to deploy capital in Risk-On regimes, as defined by the BTC trend and supporting momentum signals. The Risk-On regime engages when Bitcoin (BTC) is in an uptrend with strong momentum, and this leads to strategy activation of long positions in high-conviction assets, capped at a 40% portfolio allocation. The Risk-Off which indicates a BTC downtrend and weak momentum leads the strategy to disengage 100% from the directional sleeve (net market exposure is effectively zero) and, instead, moves funds to Arbitrage and Yield Farming strategies according to weightings the secondary layer mechanisms calculate.

5.2 Signal Design Supporting Regime Logic

Momentum signals (including multi-horizon returns and momentum slope) are volatility-adjusted and used both to select assets and to validate the Risk-On classification. When signals weaken broadly, this deterioration tends to feed back into the regime engine, pushing the portfolio back towards Risk-Off and effectively switching off directional exposure. When signals strengthen, they reinforce Risk-On conditions and justify maintaining the directional allocation under strict volatility targeting.

5.3 Portfolio Construction and Constraints Under Risk-On

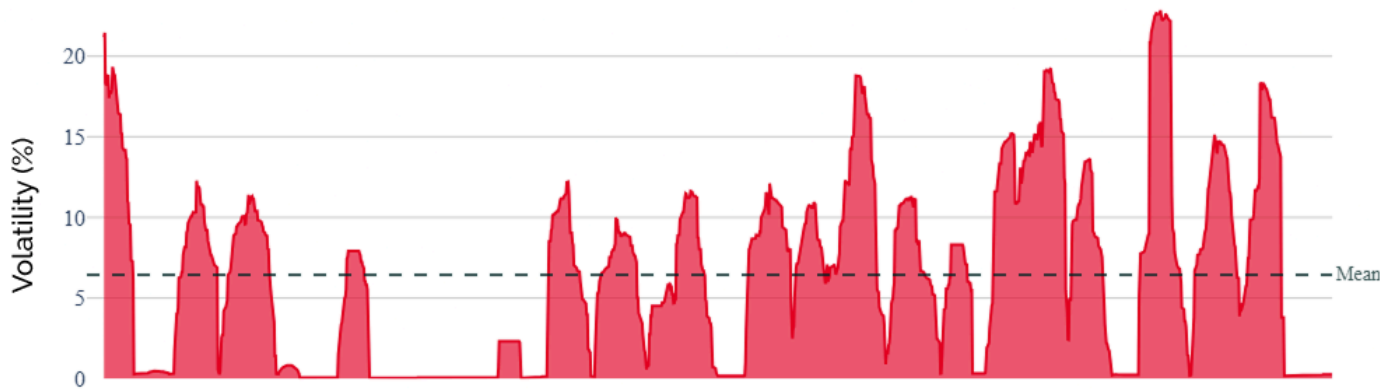
Within the 40% directional allocation, optimization aligns with the regime's risk budget. Volatility targeting at approximately 20% annualized ensures that even in Risk-On states, the directional sleeve's risk is controlled. Coupled with the stabilizing effects of Arbitrage and Yield Farming, more consistent results are expected. Typical characteristics of the directional logic during a Risk-On regime include



minimal idle cash, limited number of positions, and capped per-asset weights to avoid concentration. Only highly liquid and battle-tested assets are considered in the investment universe.

Portfolio Volatility and Net Exposure

30-Day Rolling Annualized Volatility (%)



Net Exposure Over Time

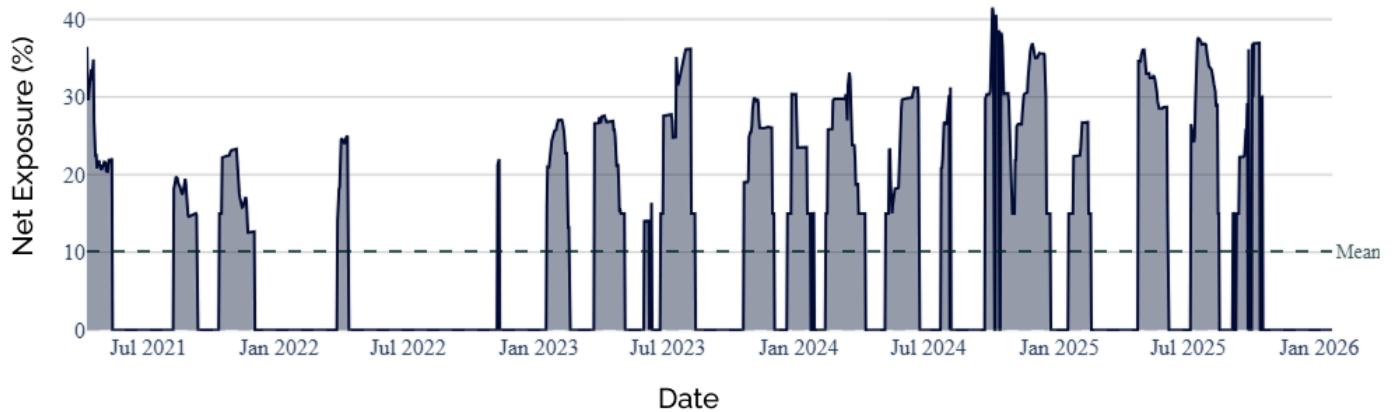


Figure 3: Comparison of the portfolio's volatility and net exposure over time.



6. RISK MANAGEMENT AND GOVERNANCE AS REGIME ENFORCEMENT

Risk management is structured to reinforce the regime-based architecture, ensuring that leverage, exposure, and concentration automatically tighten when conditions deteriorate. The control framework is designed so that risk budgets are conditional on regime state rather than static across the cycle.

6.1 Regime-Aligned Leverage and Exposure

- **Arbitrage strategies:** Leverage caps (maximum set to 4x) are calibrated such that, in Risk-Off regimes, the portfolio can scale neutral carry without excessive tail risk.
- **Yield Farming strategies:** Loan-to-Value (LTV) buffers and conservative loop depths are particularly emphasized in Risk-Off periods to protect capital in stressed environments.
- **Directional strategy:** Zero leverage and strict volatility targeting ensure that in Risk-On regimes, incremental risk remains deliberate and bounded.

6.2 Drawdown Controls and Diversification Limits

Stop-loss rules and diversification caps operate as guardrails that can force de-risking even within a given regime. Hard drawdown thresholds on individual strategies (e.g. max must be no more than -10%) can trigger position reductions independent of the overarching regime signal. Protocol and pool caps ensure that regime correctness does not override prudent diversification.

6.3 Regime Statistics as a Structural Risk Constraint

Beyond defining allocation bands, the regime engine also shapes the realised path of risk through the frequency, balance, and duration of Risk-On and Risk-Off states. Over the 2021–2025 sample, the model generated a finite number of regime switches rather than constantly flipping, with regimes typically persisting for weeks to months at a time rather than days. This behaviour is intentional: it reduces whipsaw risk and transaction costs, and ensures that risk budgets are adjusted only when there is statistically meaningful evidence that market conditions have changed.

The historical regime mix (see below) shows that time is deliberately diversified between Risk-On and Risk-Off states, with neither regime dominating the entire period. A meaningful share of the sample is spent in Risk-Off, during which the directional sleeve is fully disabled and capital is concentrated in arbitrage and yield farming; the remainder is spent in Risk-On, where the directional strategy is allowed to operate within its fixed 40% allocation and 20% volatility target. This balance of time in each state is as important as per-regime performance: it demonstrates that the system is capable of stepping back from risk, not just scaling into it.

Period	Regime 0: Risk-Off			Regime 1: Risk-On			Changes
	Active Days	Percentage of Period	Average Duration (Days)	Active Days	Percentage of Period	Average Duration (Days)	
2021	114	31.2%	57.0	251	68.8%	125.5	4



2022	347	95.1%	115.7	18	4.9%	9.0	5
2023	83	22.7%	16.6	282	77.3%	56.4	10
2024	82	22.4%	13.7	284	77.6%	40.6	13
2025	149	40.8%	18.6	216	59.2%	27.0	16

Table 4: Breakdown by year of the regimes' change and duration activity.

Average regime durations provide an additional structural constraint on governance. Longer, stable Risk-Off stretches enforce prolonged periods of capital preservation and neutral carry when market conditions warrant it, while multi-week or multi-month Risk-On regimes give the directional sleeve enough runway to compound momentum without forcing constant reallocations. Governance can therefore be framed not only in terms of point-in-time limits (leverage caps, LTV buffers, stop-losses, and protocol concentrations), but also in terms of how long the portfolio is expected to operate under each risk budget before the next state change. Together, the observed number of regime changes, the share of time in each state, and the average regime duration make the regime model a hard structural overlay on risk management: it dictates when risk may be added or must be removed, and for how long, rather than leaving those decisions to discretionary judgment.



7. TECHNICAL INFRASTRUCTURE & EXECUTION

A key part of the monitoring and regime feedback loop, is the technical stack that encompasses real-time dashboards, automated alerts and actions, tracking for profit and loss (PnL), volatility, drawdowns, and health factors. This creates a feedback that can prompt regime re-evaluation or intra-regime de-risking.

Liquidity buffers of approximately 5–10% enable rapid rebalancing in response to regime changes without forced liquidations. Alerts on funding spikes, de-pegs, or volatility shocks help determine whether the portfolio should lean more heavily into arbitrage and fixed-yield strategies characteristic of Risk-Off behavior.

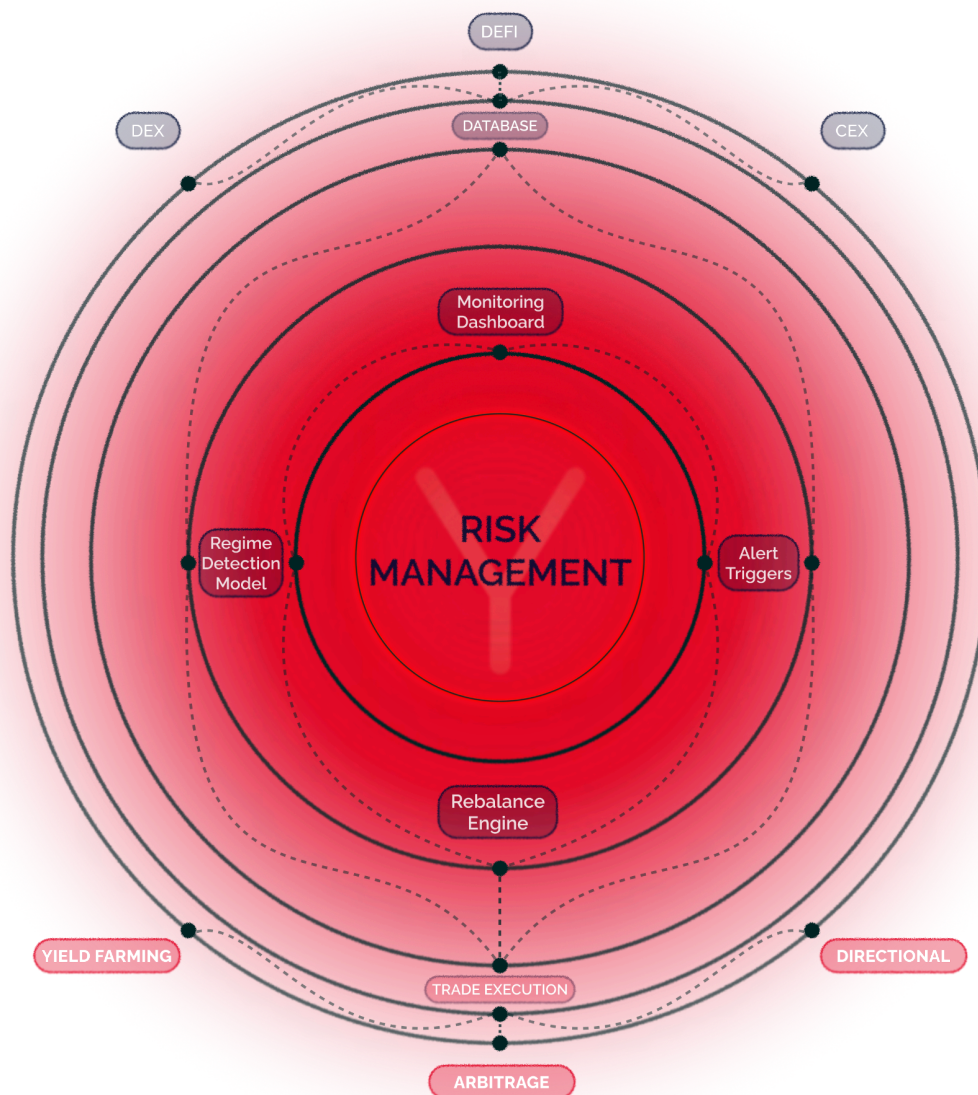


Figure 4: Technical infrastructure of the Yo-Yo model.



7.1 Trade Execution

Trade execution is organised into three specialised pipelines aligned with the regime-based design. The arbitrage stack runs continuously to maintain delta-neutral exposure across exchanges, using a central database and risk engine to monitor spreads and automatically de-risk when conditions deteriorate. The yield farming stack deploys capital into vetted DeFi protocols via parameterised rules (caps, loop depths, collateral buffers), with rewards harvested and compounded on a schedule while all on-chain actions are recorded centrally. The directional stack operates on a lower-frequency, daily cycle; it ingests market data, generates a target portfolio, and executes only the required delta trades, limiting turnover and costs. All three pipelines feed a unified state store, creating a full audit trail for reconciliation, performance analysis, and governance.

7.1.1 Arbitrage Strategy: Delta-Neutral Execution Stack

The arbitrage execution pipeline is designed to maintain a strictly delta-neutral profile while continuously validating the integrity of the spread across connected venues.

- **Continuous position synchronization**
The system ingests live position and price data from Exchange A (long leg) and Exchange B (short leg) in parallel, ensuring that gross exposures remain size-matched and that net market exposure is effectively neutral at all times.
- **Centralized data ingestion and state store**
All raw fills, funding, and position updates are streamed into a central database, which serves as the canonical state of the arbitrage book. This single source of truth underpins downstream risk calculations, PnL attribution, and reconciliation.
- **Risk and metric analysis layer**
A dedicated processing engine consumes the database feed to evaluate the “health” of each arbitrage instance. It monitors spread behavior, leg slippage, funding differentials, inventory imbalances, and exchange-specific risk indicators, ensuring the strategy operates only within predefined profitability and safety bands.
- **Automated safety protocols and control actions**
When the risk layer detects anomalies—such as leg desynchronisation, unexpected spread compression, or venue instability—it triggers safety actions. These may include tightening position limits, partial or full leg unwind, temporary trade suspension on a venue, or escalation to human operators.
- **High-frequency monitoring loop**
Metrics snapshots are generated on a rolling basis (e.g., every two minutes), capturing leg exposures, realized and unrealized PnL, spread quality, funding rates, and health factors. These snapshots feed a dedicated Monitoring & Alerting block that tracks both absolute thresholds and rate-of-change conditions.
- **Multi-channel alerting**
When a risk threshold is breached, the alerting layer dispatches real-time notifications over multiple channels (such as Slack and WhatsApp), enabling immediate human intervention where required. Alerts are enriched with contextual data—affected exchanges, legs, and recommended safety actions—to accelerate decision-making.



7.1.2 Yield Farming Strategy: Execution and Lifecycle

The yield farming sleeve is executed through a dedicated pipeline that focuses on capital-efficient yield generation while tightly controlling protocol, liquidity, and leverage risk. It complements the arbitrage and directional sleeves by providing a regime-stable income layer that can scale up in Risk-Off markets and act as a volatility dampener in Risk-On regimes.

- **Opportunity discovery and pool selection**

The process begins with a screening engine that continuously evaluates candidate pools and protocols across DeFi venues. It tracks APY, fee-to-volatility ratios, historical liquidity depth, smart-contract maturity, and governance risk signals. Only pools that satisfy conservative whitelisting criteria (liquidity, track record, audit status, and oracle robustness) are eligible for deployment.

- **Position construction by strategy type**

Once targets are selected, the execution layer constructs positions according to the chosen yield strategy:

- For leveraged stablecoin looping, the system supplies approved collateral assets, borrows against them within pre-set LTV limits, swaps into additional yield-bearing tokens, and re-supplies collateral until the desired loop depth is reached.
- For liquidity provision, it provides assets into AMM pools using sizing rules that reflect regime state (e.g., preference for stable pairs and deep liquidity in Risk-Off, more volume- and incentive-rich pools in Risk-On).
- For fixed-yield principal tokens, the system executes purchases of PTs at target discounts and maturities, locking in implied yields that fit the portfolio's duration and risk parameters.

- **Parameterised deployment and safeguards**

Every action in the yield pipeline is governed by parameter sets tied to the risk framework: maximum per-protocol and per-pool allocations, maximum loop depth, minimum collateral buffers over liquidation thresholds, and allowed asset types. The execution engine enforces these constraints on-chain or via integrated DeFi front ends, preventing accidental over-concentration or excessive leverage.

- **Ongoing yield and health monitoring**

After deployment, each position streams state data (APY, accrued rewards, pool TVL, utilization, collateral ratios, peg status for stablecoins) into the central database. A monitoring layer computes derived health metrics such as effective net APY after fees, liquidation distance, incentive decay, and protocol-specific risk flags. Positions that drift outside their expected bands are automatically queued for partial deleveraging, pool rotation, or full unwind.

- **Reward harvesting and compounding**

At scheduled intervals, the system harvests farming rewards and interest accruals, then routes them through a compounding policy: claim, swap (if necessary), and re-deploy into the same or newly selected pools, or return them to the portfolio's liquidity buffer. This mechanism keeps capital productive while respecting the portfolio's current regime-driven allocation targets between Yield, Arbitrage, and Directional sleeves.

- **Database synchronisation and auditability**

All yield farming operations—pool entries and exits, collateral adjustments, reward harvests, and compounding events—are recorded in the central database. This creates a complete on-chain/off-chain audit trail that supports performance attribution by protocol and strategy type, as well as post-mortem analysis in the event of adverse market or protocol events.



7.1.3 Directional Strategy: Daily Portfolio Optimisation and Execution

The directional sleeve follows a lower-frequency, batch-oriented pipeline that optimises the portfolio once per day and executes only the required deltas.

- **Scheduled price and signal ingestion**
On a fixed daily schedule, the system fetches comprehensive price histories, order-book data, and any auxiliary inputs from connected exchanges. This dataset forms the raw input to the quantitative signal engine.
- **Portfolio generation via analytical engine**
The data is processed by a proprietary analytics layer that runs the regime-aware, momentum-based models. The output is a target portfolio for the next 24-hour cycle, expressed as desired position sizes and weights across the eligible asset universe.
- **Signal transfer / staging layer**
Before any trades are sent to market, the target portfolio is passed into a transfer layer that acts as a controlled staging environment. This layer validates data integrity, checks for stale or inconsistent signals, and prepares normalized instructions for the execution system.
- **Delta-based execution and rebalancing**
The execution layer computes the difference between current holdings and the new target portfolio, and only the necessary “delta” trades are sent to the exchange. This minimizes turnover, reduces fees and slippage, and avoids unnecessary position churn while still achieving the desired allocation.
- **Database synchronization and audit trail**
Each stage of the daily cycle—inputs, model outputs, deltas, orders, fills, and final positions—is written back to the central database. This creates a complete audit trail that supports performance analysis, post-trade review, and regulatory or risk reporting.
- **Monitoring dashboard (Grafana)**
Aggregated performance metrics, position snapshots, and execution diagnostics are surfaced through a Grafana-based Monitoring Dashboard. Operators can view portfolio health, track tracking error versus target, inspect order and fill statistics, and correlate alerts from the arbitrage stack with behaviour in the directional book, ensuring end-to-end observability of trade execution and strategy performance.

7.2 Monitoring & Alerts

Monitoring and alerts provide the feedback loop that links live execution to risk management. For the arbitrage strategies, the platform generates high-frequency snapshots—capturing leg exposures, PnL, spread behaviour, funding rates, and health metrics—and feeds them into a Monitoring & Alerting layer that runs continuous checks against predefined thresholds and anomaly detectors.

For yield farming strategies, the same layer tracks collateral health factors, LTV buffers, APY stability, liquidity conditions, and de-peg or smart-contract risk indicators to ensure leveraged and non-leveraged positions remain within conservative safety margins. When conditions drift outside safe bounds in either arbitrage or yield farming, the system raises real-time alerts and, where configured, automatically triggers pre-defined safety actions such as position reduction, deleveraging, or venue/pool deactivation.



The directional strategy is monitored at the same central dashboard level, where daily optimisation results, realised deltas, order statistics, and realised performance are visualised alongside arbitrage and yield metrics. A Grafana-based monitoring surface aggregates data from all three stacks, giving operators a unified view of portfolio health, execution quality, regime state, and risk utilisation. Multi-channel notifications (e.g., Slack, WhatsApp) ensure that material events—such as risk breaches, failed rebalances, collateral stress, or unexpected behaviour in any venue or pool—are surfaced immediately to human decision-makers, closing the loop between systematic execution and active oversight.



8. EXPECTED PERFORMANCE

Performance expectations are segmented explicitly by regime so investors can map realized returns to underlying state conditions. Over a full cycle, the blend of time spent in Risk-Off versus Risk-On states drives the realized path of returns and volatility.

- **Risk-On (Bull):**
 - Expected APY: 40%+, combining base yields with momentum-driven appreciation from the 40% directional allocation.
 - Volatility: Approximately 12–18% annualized.
- **Risk-Off (Bear):**
 - Expected APY: 18%, driven by arbitrage carry and DeFi yields.
 - Volatility: Approximately 1–5% annualized, reflecting minimal net beta.
- **Full Cycle:**
 - Target: 30%+ annualized returns with around 10–12% annualized volatility, reflecting the time-weighted mix of Risk-Off and Risk-On states.

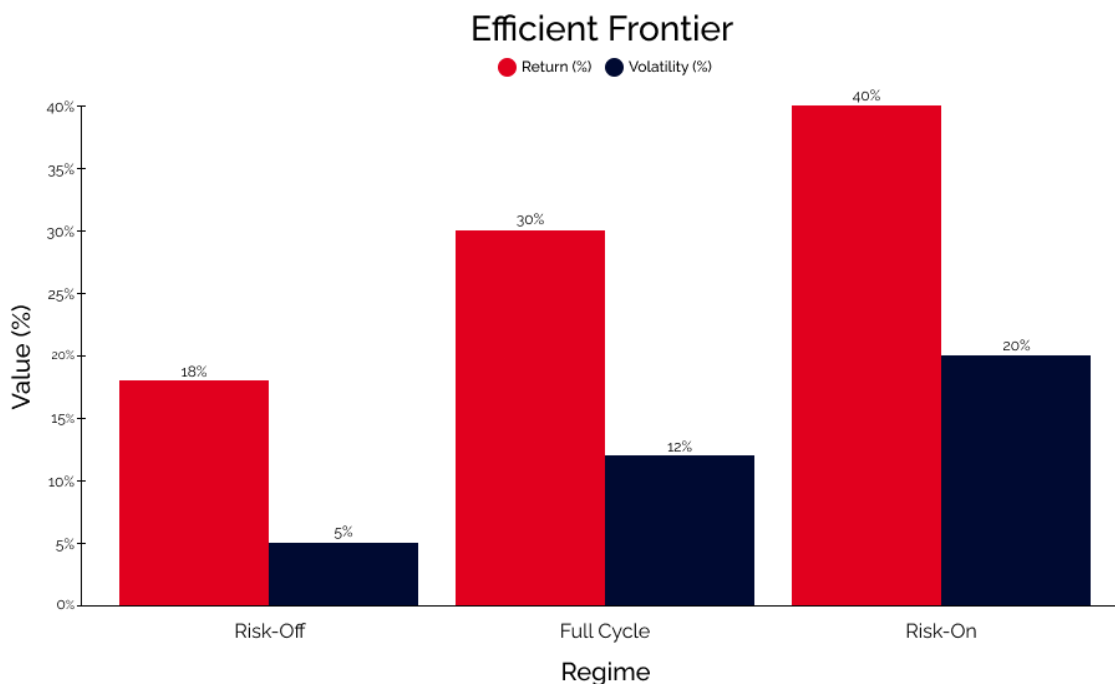


Figure 5: Return and associated volatility by risk regime demonstrates linear risk/reward relationship.

8.1 Backtest Fidelity

The performance figures presented in this section are derived from backtests designed to approximate, as closely as possible, the economics the strategy would encounter in live deployment. For the arbitrage and yield farming pillars, returns are modelled from historical Binance basis-trading data and on-chain lending rates. The directional momentum backtest, which requires the most complex simulation framework, is described in detail below.

The directional backtest simulates a long-only spot portfolio on Binance. Every trade incurs a 10 basis-point transaction fee on the full notional value at execution, matching Binance's standard taker



fee tier. Importantly, these costs are not deducted post-hoc: the portfolio optimiser is parameterised with the same buy and sell cost rates, so its objective function explicitly penalises unnecessary turnover and produces weight trajectories that already price in the drag of rebalancing.

Position sizing is governed by the 20% annualised volatility target and 15% maximum weight per asset described in Section 5, both enforced as hard constraints inside the optimiser. The BTC-trend regime filter determines when the strategy is invested versus holding 100% cash. When capital is “uninvested”, it earns a time-varying yield calibrated to a blend of historical DeFi yield-farming and CeFi basis-arbitrage returns, reflecting the opportunity cost of idle stablecoin capital that would realistically be deployed in those strategies. This yield accrues only on the truly undeployed portion of capital, the complement of the net directional exposure, avoiding any double-counting with the returns of the directional positions themselves.

The universe is further constrained by volume-based filters that ensure the strategy only allocates to assets with sufficient exchange liquidity to absorb the modelled trade sizes, without material market impact. Together, these layers (cost-aware optimisation, realistic idle-capital yields, volatility-targeted sizing, per-asset caps, and liquidity-filtered universe selection) ensure the backtest P&L closely approximates the returns the directional sleeve would realise in production.

8.2 Results

8.2.1 Performance Analysis

The historical performance of the Multi-Strategy Crypto Portfolio in the 2021-2025 period demonstrates a robust capacity to deliver superior risk-adjusted returns by dynamically adapting to shifting market conditions. The portfolio’s architecture effectively balances the capital preservation during downturns with the need for growth during bull markets, resulting in a consistent upward equity trajectory as shown below.

Period	Sharpe Ratio	Sortino Ratio	Calmar Ratio	CAGR (%)	Total Return (%)	Ann. Volatility (%)	Max Drawdown (%)
2021	3.05	6.30	18.12	47.61%	47.54%	10.33%	-3.73%
2022	1.35	1.68	1.61	4.63%	4.61%	2.33%	-2.88%
2023	1.82	3.24	5.72	21.63%	21.55%	7.57%	-3.78%
2024	2.31	4.20	7.13	43.83%	43.80%	11.14%	-6.15%
2025	1.81	3.27	4.58	32.26%	31.14%	10.66%	-6.82%
2021-2025	2.09	3.72	4.44	30.32%	256.96%	8.92%	-6.82%

Table 5: Yearly and aggregated 5-year performance results.

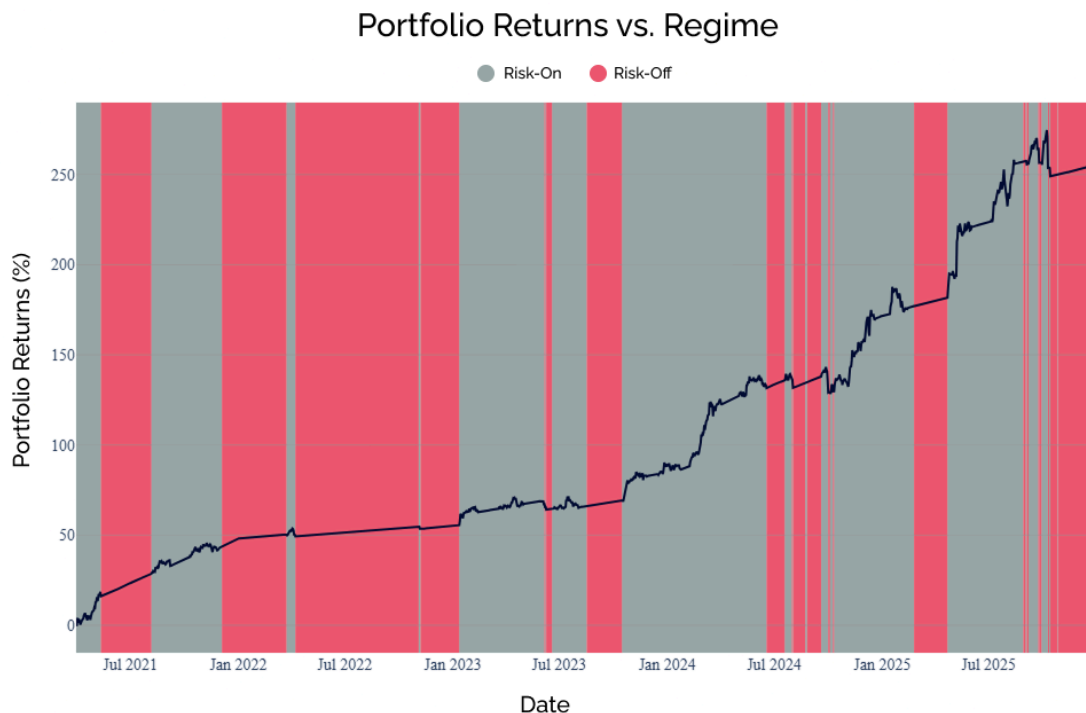


Figure 6: Return by detected Risk-On (grey) and Risk-Off (red) regimes.

A key driver of the performance is the Regime Driven Allocation engine. The dynamic allocation allows for asymmetric returns capture:

- **Risk-On:** during identified bullish regimes, the portfolio maximizes market exposure to capture upside volatility. Notable examples include the Risk-On period ending in late 2023, which yielded 38.3%, and the mid-2025 rally, contributing +25.6%.
- **Risk-Off:** during Risk-Off regimes, the strategy pivots to defensive positioning allocating to market neutral strategies. Returns during these periods remain positive while the general market is going down. Examples of these are the 4.6% return in early 2022, and the 2.6% return in late 2024.

Figure 10 (below) shows the Yearly CAGR decomposed by strategy type. It highlights the structural alpha generated by combining uncorrelated return streams and illustrates how the portfolio's total return is constructed from the three complementary strategies. The layered architecture helps to smooth volatility and ensure consistent compounding across disparate market cycles.

- **Directional:** acts as the primary source of capital appreciation during Risk-On periods. By capturing upside volatility and directional momentum, it provides the bulk of the performance during bullish phases.
- **Arbitrage:** functions as a stabilizer. It balances the portfolio by generating returns that are largely uncorrelated with market direction. In Risk-On periods, it provides a steady baseline of performance, ensuring that the overall portfolio outperforms purely passive benchmarks. On the other hand, in Risk-Off periods, it is designed to scale and capture inefficiencies often present during periods of market stress, providing defensive hedge that dampens drawdown.
- **Yield Farming:** serves as the portfolio's foundation for capital preservation and continuous compounding. By focusing on low-risk, income-generating opportunities, yield farming



strategies ensure that capital remains productive even when directional exposure is minimal. In addition, it lowers overall portfolio volatility by generating consistent returns independent of price action and keeping the equity curve moving upward while waiting for the next regime shift.

CAGR Contribution per Strategy

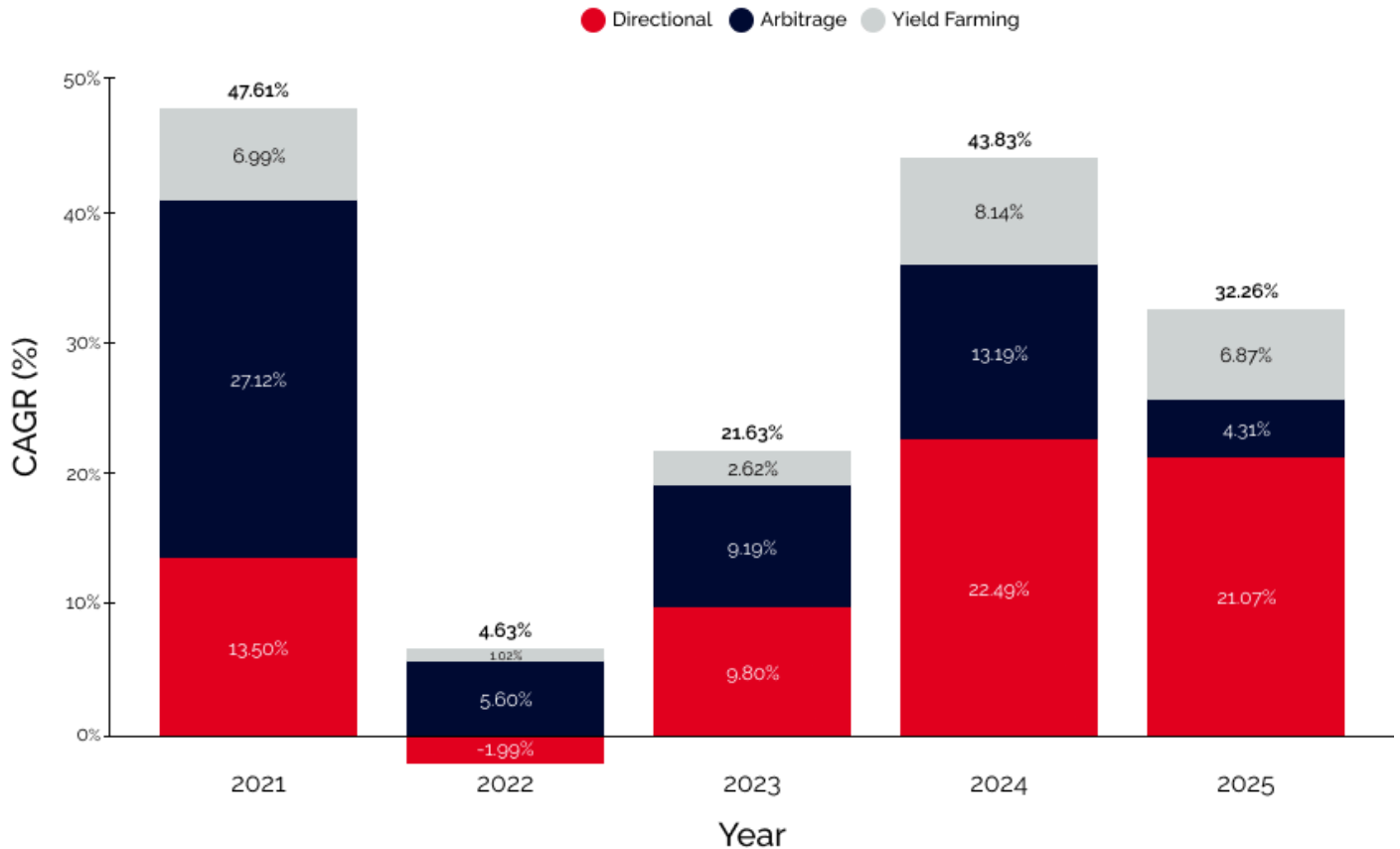


Figure 7: Yearly CAGR breakdown demonstrates the structural alpha per strategy.

The synergy between these three strategies results in a barbell risk profile; the Yield Farming and Arbitrage components provide a defensive floor that mitigates downside risk during Risk-Off regimes, while the Directional component allows for controlled participation in Risk-On periods. This setup is responsible for the portfolio's stability and its ability to recover quickly from the minor drawdowns, as observed in the Cumulative Returns and Drawdown chart below.



Cumulative Returns and Drawdown Analysis

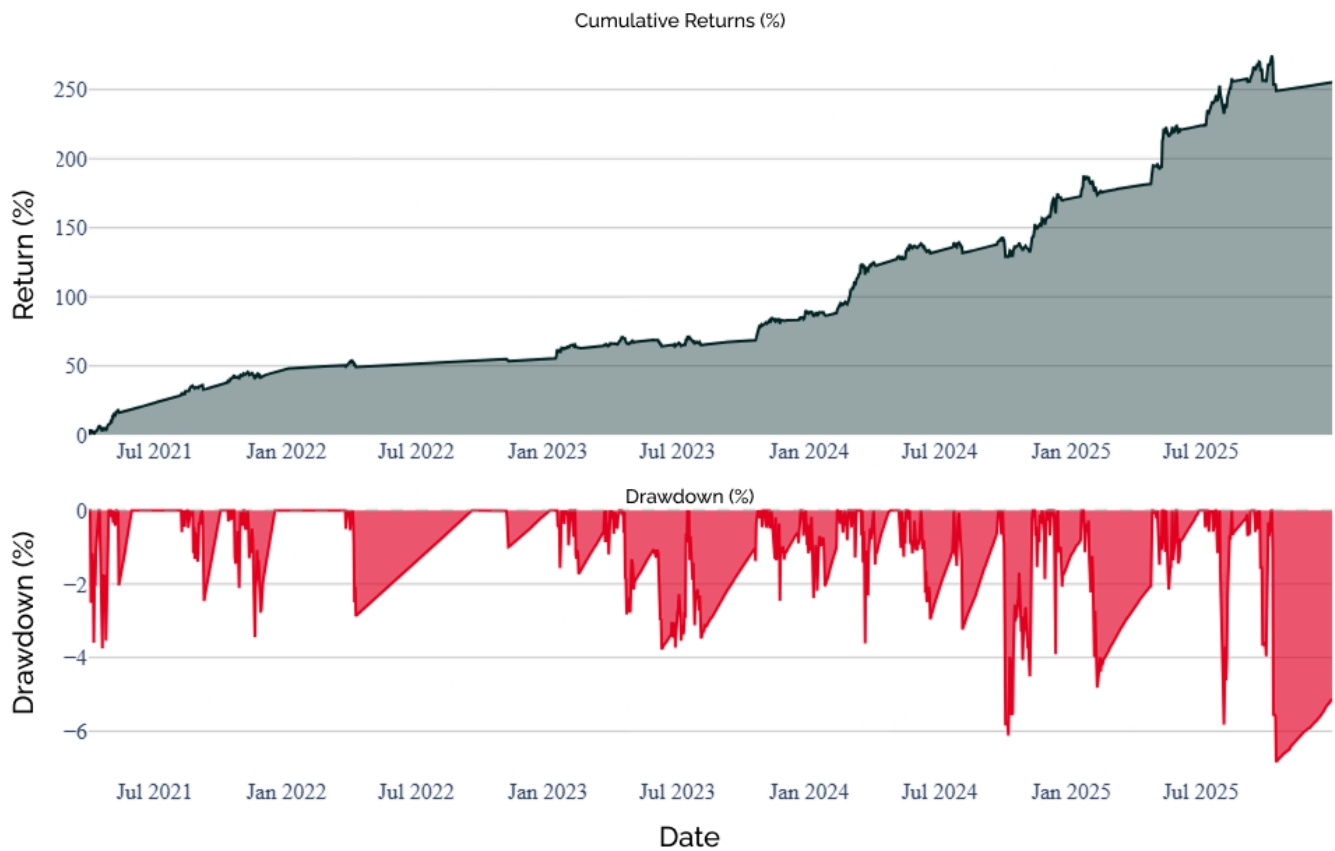


Figure 8: Cumulative returns and maximum drawdown over time.

As shown above, the portfolio is not immune to volatility, but drawdowns are tightly constrained. The maximum drawdown detected over the analyzed period is lower than 7% (late 2025) but most years was sub 4%, significantly outperforming the broader crypto market's historical volatility. The underwater periods are brief, with swift recoveries to new equity highs.

The 30-day rolling volatility chart below confirms the portfolio actively manages risk exposure correctly. The volatility frequently drops to near-zero during market stress periods and is generally capped below 20%, even during peak market volatility. Overall, the multi-strategy crypto portfolio averages a 6-7% 30-days rolling volatility, considerably low for crypto market standards.



30-Day Rolling Annualized Volatility (%)

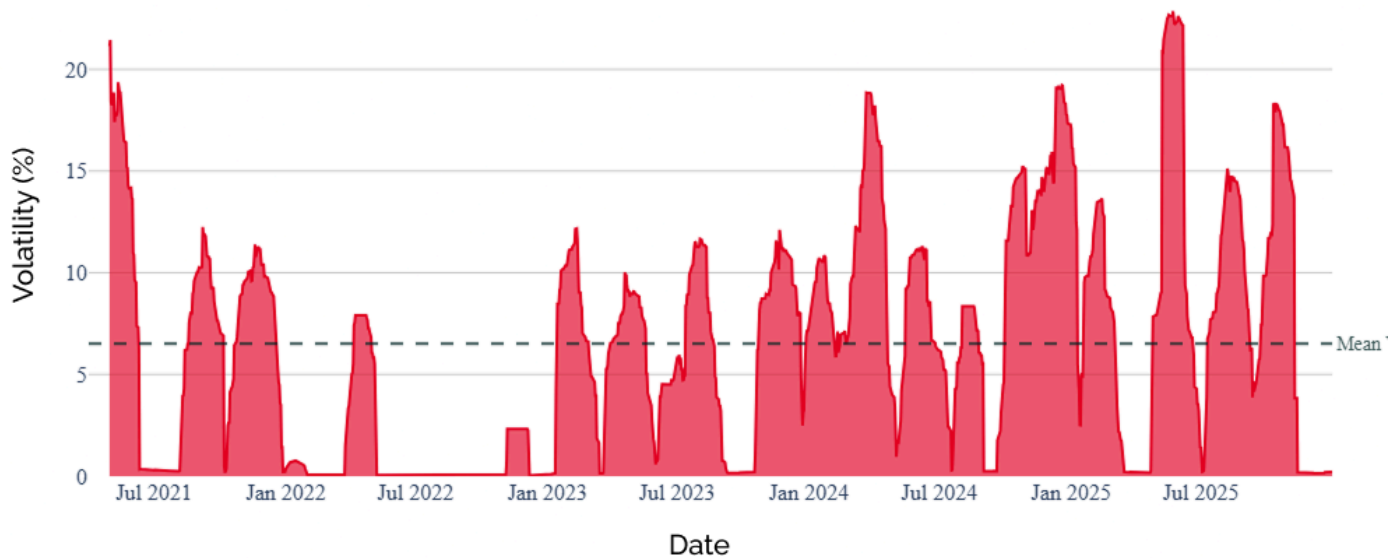


Figure 9: 30-day rolling volatility demonstrates correct active risk management.

8.3 Stress Testing and Robustness Analysis: Directional Strategy

To assess the directional strategy, specifically, under conditions not observed in the historical period, synthetic forward-looking price paths were generated for a hypothetical 2026 calendar year under two stylised macro environments: a sustained bull market and a prolonged bear market. The objective is to verify that the regime engine, momentum signal, and portfolio construction rules behave as designed when exposed to market conditions that differ materially from the 2021–2025 historical period.

8.3.1 Simulation Design

Synthetic daily log-returns are constructed per asset using a Geometric Brownian Motion framework calibrated to each token's historical volatility. Cross-asset and cross-volume correlations are preserved via the Iman–Conover method, ensuring that the dependence structure of the investable universe remains realistic even though the level and direction of returns are shifted by scenario-specific drift and volatility multipliers. The bull scenario applies an upward drift bias with compressed volatility, while the bear scenario applies a negative drift with elevated volatility, producing price paths that are structurally plausible but deliberately distinct from the historical period.

These simulations evaluate the directional momentum sleeve in isolation. Arbitrage and yield farming strategies were not simulated, so the results below reflect only the regime-gated momentum component described in Section 5, without the carry and stabilisation contributions of the other two pillars.



8.3.2 Bull Scenario

Under sustained bullish conditions the regime engine correctly classifies approximately 76% of trading days as Risk-On, with an average Risk-On duration of roughly 23 days—long enough to allow the momentum sleeve to compound without excessive whipsaw. The directional strategy delivers a CAGR of approximately 44% with a Sharpe ratio above 2.0, a Sortino ratio near 3.8, and a maximum drawdown contained below 10%. As expected, the equity curve is flat during the Risk-Off windows scattered across the year and advances in steps during sustained Risk-On phases.

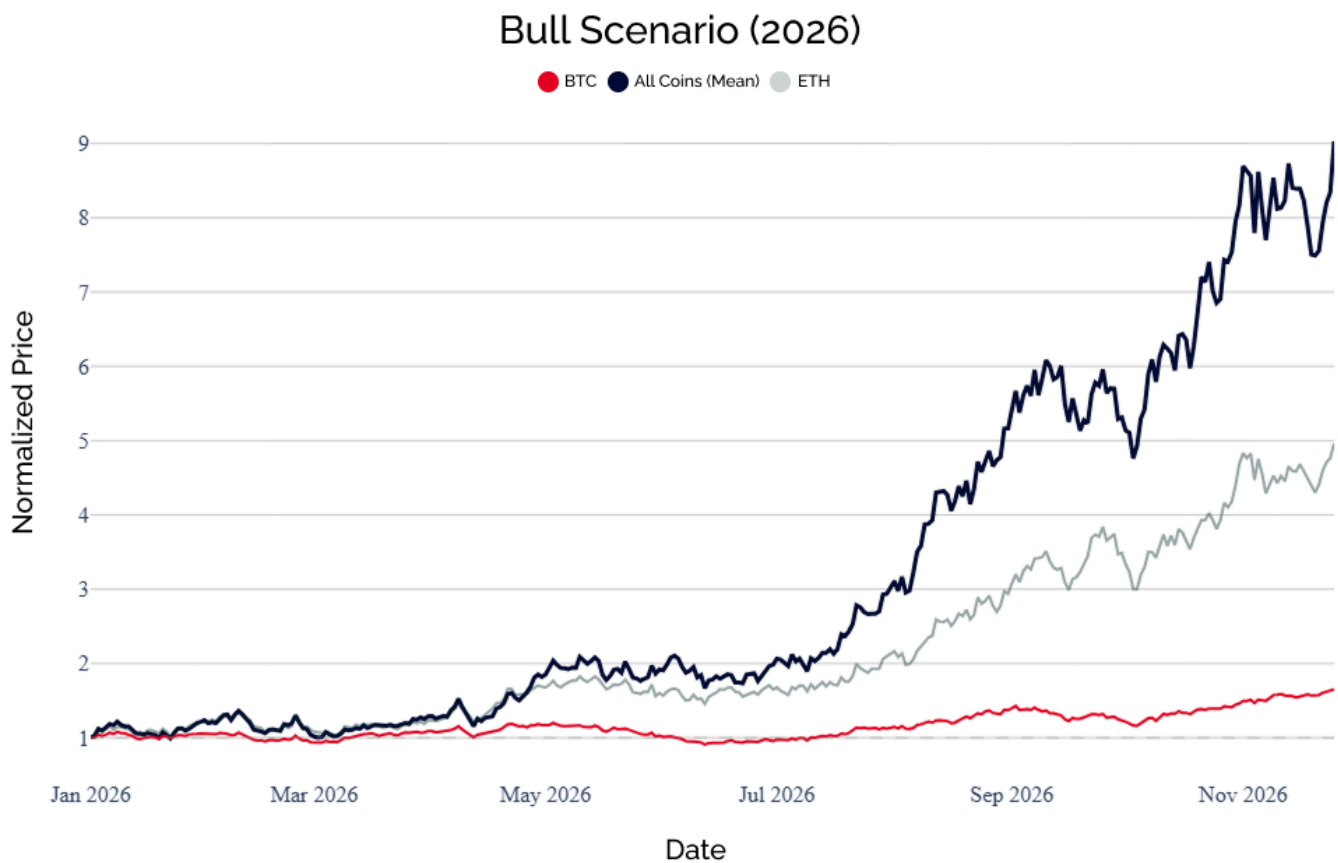


Figure 10: Normalised synthetic price paths for the bull scenario (2026).



Portfolio Returns vs. Regime (Bull)

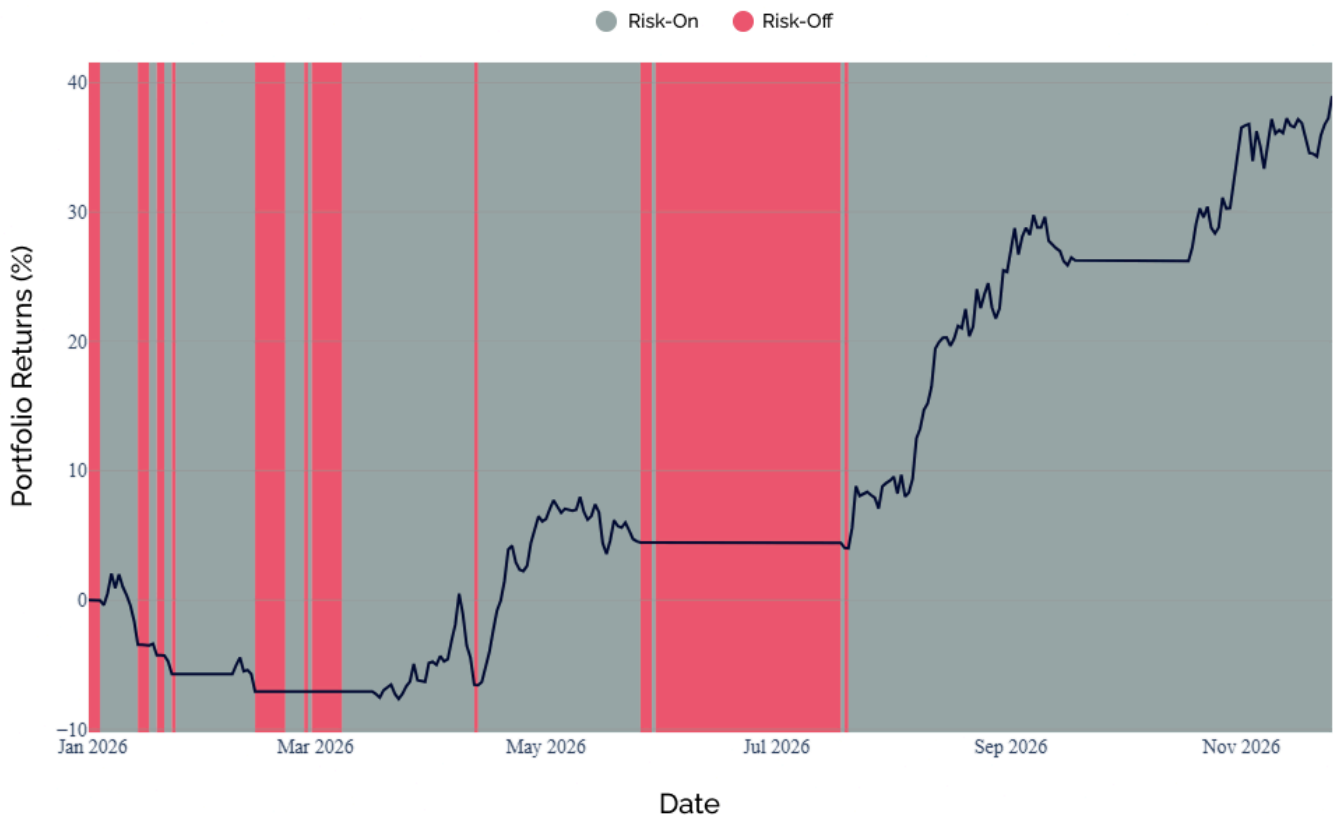


Figure 11: Portfolio cumulative returns vs. regime in the bull scenario (2026).

8.3.3 Bear Scenario

In the bear environment, the regime engine spends over 82% of the year in Risk-Off, with an average Risk-Off duration of 45 days, effectively keeping the directional sleeve disabled for prolonged stretches. When brief Risk-On windows do appear, the strategy captures modest gains before regime deterioration shuts it back down. The result is a small positive return of approximately 3.6% with a maximum drawdown of roughly 5%, annualised volatility near 7%, and a Sharpe ratio of 0.44. Critically, the strategy avoids compounding losses during the sustained drawdown that affects the underlying market, where BTC and the average altcoin decline substantially over the year.

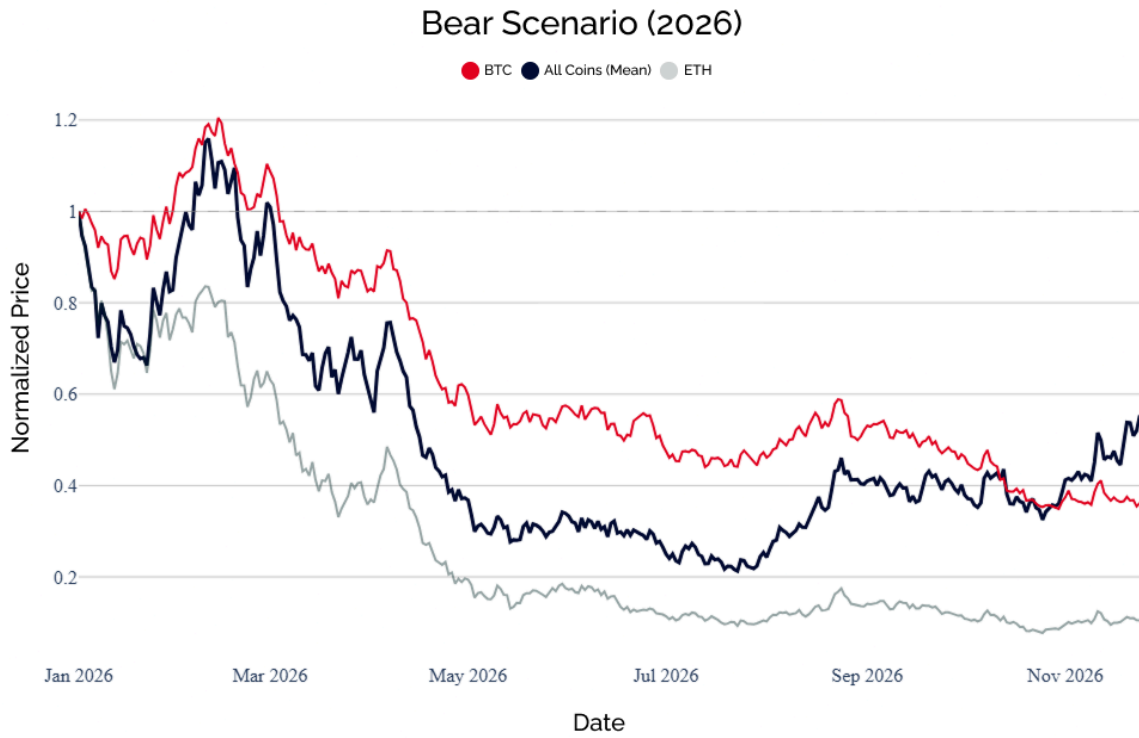


Figure 12: Normalized synthetic price paths for the bear scenario (2026).

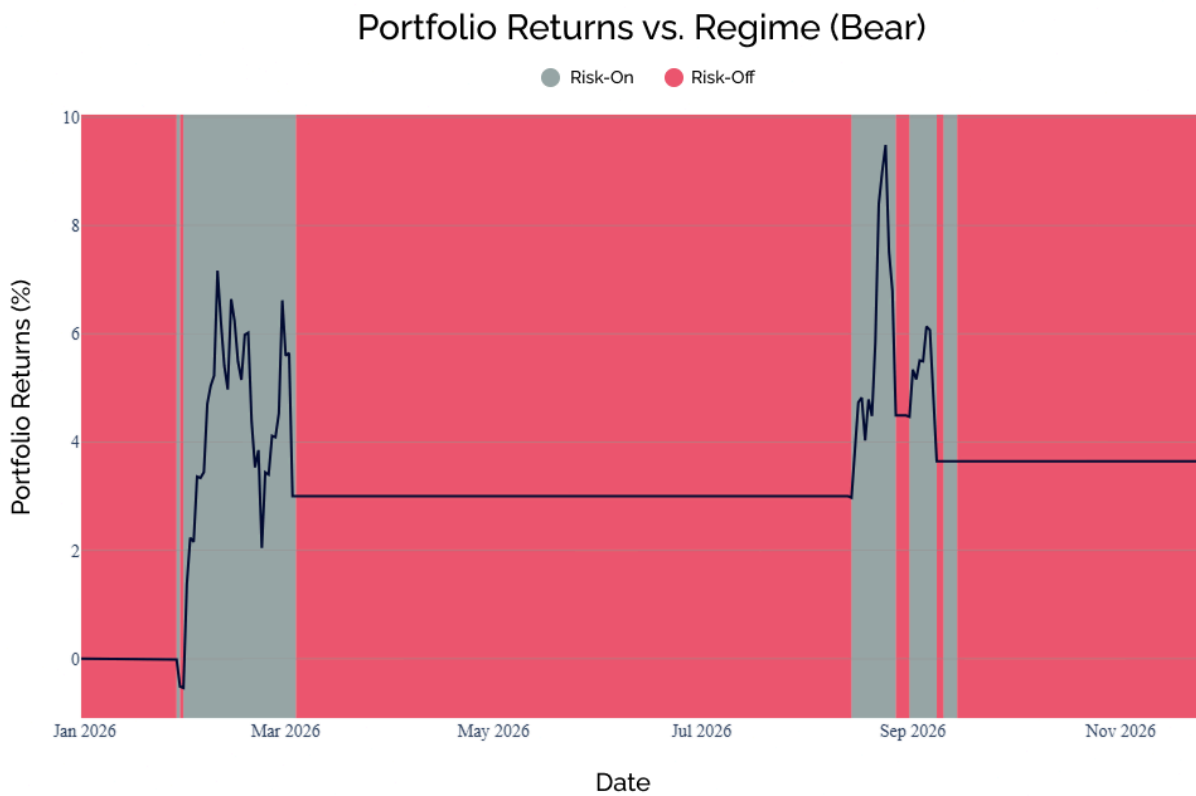


Figure 13: Portfolio cumulative returns vs. regime in the bear scenario (2026).



8.3.4 Summary

Scenario	Cumulative Return	CAGR (%)	Sharpe	Calmar	Max Drawdown	Risk-On (%)	Regime Changes
Bull	38.97%	44.10%	2.08	4.64	-9.48%	76.00%	21
Bear	3.64%	4.05%	0.44	0.75	-5.33%	17.90%	10

Table 6: Summary performance figures for both the bull and bear scenarios.

These results confirm the asymmetric behaviour embedded in the directional strategy's design. In favourable conditions, the regime engine remains engaged long enough for momentum to compound into meaningful returns. In adverse conditions, the engine defaults to prolonged inactivity, preserving capital and limiting drawdowns to a fraction of the underlying market decline. In both cases, the strategy's risk controls (volatility targeting, per-asset caps, and regime gating) operate as intended on price dynamics that were not present in the historical period.



9. CONCLUSION

This multi-strategy crypto portfolio is, by design, a regime-first architecture in which every major decision, whether strategy activation, capital allocation, leverage, or risk constraints, is conditioned on a transparent Risk-On or Risk-Off classification. By foregrounding regime-based construction and embedding it across Arbitrage, Directional, and Yield Farming strategies, the framework seeks to systematize de-risking in adverse markets while deploying controlled, volatility-targeted exposure when bull trends are statistically confirmed.

Over the 2021–2025 test window, the portfolio has demonstrated headline performance consistent with this design: a full-cycle CAGR of approximately 30%, with sub-9% annualised volatility and a maximum drawdown below 7%, materially lower than typical crypto market benchmarks. Within regimes, the architecture targets 40–60%+ annualised returns in Risk-On states at ~11% volatility and ~4–6% max drawdown, and approximately 20% annualised returns in Risk-Off environments with less than ~7.5% volatility and max drawdown under 4%. These figures highlight the framework’s ability to compound at equity-like rates while operating within a comparatively conservative risk envelope for the underlying asset class.

The robustness of the approach stems from its diversification across three uncorrelated, technically complex strategy pillars and its insistence on strict, regime-aligned risk controls. Capital is spread across non-trivial derivatives and DeFi instruments, including leveraged perp arbitrage, basis trades, fixed-yield primitives, and regime-activated momentum. This multi-layered construction, combined with leverage caps, LTV buffers, hard stop-loss thresholds, protocol and pool concentration limits, and persistent liquidity reserves, materially reduces idiosyncratic risk at both the strategy and portfolio levels.

Finally, a proprietary, real-time dashboarding stack closes the loop between design and execution by continuously surfacing regime state, allocation bands, high simulation to real world correlation, performance attribution, volatility, and drawdown metrics to operators and stakeholders. This monitoring and alerting infrastructure enables fast response to regime shifts, funding spikes, de-pegs, and other stress events, reinforcing the systematic nature of the framework and helping to keep realized outcomes aligned with the intended risk/return profile across market cycles.



VERSION UPDATES

Version 1.1 (24 February 2026)

- Minor fixes including the below section numbering change and any follow-on section numbering changes.
- Added section 8.2 on Stress Testing and Robustness Analysis.

Version 1.2 (16 March 2026)

- Minor fixes including the below section numbering change and any follow-on section numbering changes.
- Replaced figure in Abstract section.
- Replace Portfolio Volatility and Net Exposure chart (Fig. 3 in section 5.3) to be more clear with an adjusted y-axis.
- Added Section 8.1 on Backtest Fidelity.
- Changed granularity to two decimal places for CAGR Contribution per Strategy chart (Fig. 7 in section 8.2.1).
- Update to incorrectly displayed performance figures for CAGR in 2021.
- Addition of Version Updates section.



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