PFTUI RESEARCH REPORT

A Rules-Based Portfolio: Backtest Results

November 24, 2026

pftui portfolio lab

Research · not investment advice

A four-asset, long-only portfolio (BTC, S&P 500, Nasdaq 100, gold) with per-asset trend exits to cash, referred to as v4. This report gives its backtest results to 2026-11-20, the alternatives tested against it, and where it underperforms. Method and definitions are on page 7. Objective used to select the rules: maximise Calmar (CAGR / max drawdown) subject to portfolio max drawdown ≤ 25%.

22.5%	-11.0%	2.19	23.0% / -77%
v4 CAGR, 2015–2026, median of 7 start dates	v4 max drawdown, worst of 7 start dates	v4 Calmar ratio, median of 7 start dates	same mix, buy and hold: CAGR / max DD (Calmar 0.38)

BTC · target 25%
Exit to cash when the daily CyberBands state turns bearish. Re-enter when it is bullish and BTC has 2 consecutive closes above its 200d SMA.

S&P 500, Nasdaq 100
Exit to cash after 2 consecutive closes below the 200d SMA. Re-enter after 2 closes above. Equal weights of the remainder.

Gold · untimed
Held throughout. No timing rule tested improved on buy and hold for gold (page 2).

USD · floor 20%
Exit proceeds stay in T-bills until the same asset re-enters. A position is trimmed only when over target and extended above its 200d SMA.

Portfolio NAV and drawdown since 2015



Single path started January 2015 at 20% each in BTC, S&P 500, Nasdaq 100, gold and USD. Buy and hold ends about three times higher than v4 because the unrebalanced mix drifts to mostly BTC; its max drawdown is 77%. v4 ends slightly below quarterly rebalancing with a max drawdown of 11% against 32%. v4 does not maximise return; it has the highest Calmar of the configurations tested.

Standalone timing rules by asset

Each asset alone, 100% long when the rule is in and T-bills when out. Medians over random windows; worst max DD is the deepest across all windows. Win rate is the share of windows with a higher Calmar than buy and hold. "+ 200-day filter": re-entry requires 2 closes above the 200d SMA. Green ◄ marks the rule used in v4, orange the highest median Calmar.

Bitcoin · 2015–2026, n = 300 random 2–5y windows

RULE	MEDIAN CAGR	WORST MAX DD	MEDIAN CALMAR	WIN RATE VS HOLD
Buy and hold	56.8%	83%	0.85	–
200-day SMA, 2 closes	52.9%	64%	1.09	80%
100-day SMA, 2 closes	82.7%	58%	2.13	92%
50-day SMA, 2 closes	68.8%	72%	1.43	86%
CyberBands daily	79.1%	52%	1.70	93%
CyberBands weekly	48.9%	76%	1.10	54%
CyberBands daily + 200-day filter ◄	70.7%	49%	1.78	91%
Bollinger 50-day + 200-day filter	76.2%	36%	2.76	93%
100-day SMA + 200-day filter	77.4%	43%	2.12	93%

Seven of eight rules have a higher Calmar than buy and hold in at least 80% of windows (weekly CyberBands: 54%). The highest scores combine a fast exit with a 200d re-buy filter.

S&P 500 · 1997–2026, n = 300 random 2–10y windows

RULE	MEDIAN CAGR	WORST MAX DD	MEDIAN CALMAR	WIN RATE VS HOLD
Buy and hold	8.2%	56%	0.28	–
200-day SMA, 2 closes ◄	5.3%	21%	0.30	68%
100-day SMA, 2 closes	4.3%	40%	0.26	50%
50-day SMA, 2 closes	1.3%	44%	0.06	34%
CyberBands daily	1.5%	30%	0.08	27%
CyberBands weekly	4.6%	23%	0.27	66%
CyberBands daily + 200-day filter	1.8%	20%	0.11	37%
Bollinger 50-day + 200-day filter	2.1%	20%	0.16	44%
100-day SMA + 200-day filter	4.1%	22%	0.26	68%

No rule has a higher CAGR than buy and hold. The 200d SMA gives up about 3 points of CAGR and reduces worst max DD from 57% to 21%.

Nasdaq 100 · 1997–2026, n = 300 random 2–10y windows

RULE	MEDIAN CAGR	WORST MAX DD	MEDIAN CALMAR	WIN RATE VS HOLD
Buy and hold	11.4%	83%	0.41	–
200-day SMA, 2 closes ◄	7.6%	48%	0.27	52%
100-day SMA, 2 closes	7.0%	53%	0.27	57%
50-day SMA, 2 closes	5.3%	35%	0.22	35%
CyberBands daily	6.6%	36%	0.29	49%
CyberBands weekly	9.0%	36%	0.41	52%
CyberBands daily + 200-day filter	6.0%	34%	0.28	51%
Bollinger 50-day + 200-day filter	4.5%	34%	0.24	55%
100-day SMA + 200-day filter	5.4%	57%	0.18	41%

No rule has a higher CAGR than buy and hold. Worst max DD: 83% buy and hold, 48% 200d SMA, 36% weekly CyberBands.

Gold · 2002–2026, n = 300 random 2–10y windows

RULE	MEDIAN CAGR	WORST MAX DD	MEDIAN CALMAR	WIN RATE VS HOLD
Buy and hold ◄	10.0%	44%	0.46	–
200-day SMA, 2 closes	6.5%	35%	0.26	31%
100-day SMA, 2 closes	3.8%	44%	0.16	6%
50-day SMA, 2 closes	2.4%	40%	0.10	15%
CyberBands daily	3.0%	36%	0.13	10%
CyberBands weekly	7.7%	31%	0.37	46%
CyberBands daily + 200-day filter	2.1%	42%	0.08	7%
Bollinger 50-day + 200-day filter	3.4%	35%	0.16	18%
100-day SMA + 200-day filter	3.2%	45%	0.15	6%

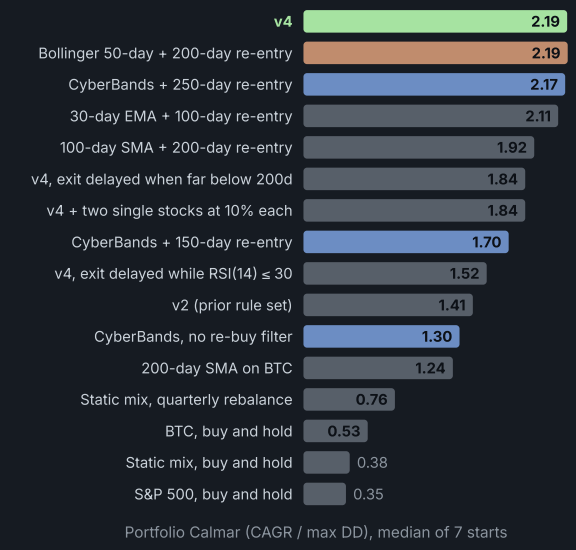
No rule matches buy and hold on CAGR or Calmar. Weekly CyberBands is closest.

Findings. Results are asset-specific: daily CyberBands ranks near the top on BTC and near the bottom on the S&P 500 and gold. On the S&P 500, Nasdaq 100 and gold, buy and hold has the highest CAGR of every rule tested; timing lowers max drawdown at a cost in return. BTC is the only asset where timing improved both CAGR and drawdown. The asset-level case for timing equities is therefore risk reduction only.

Alternatives tested at portfolio level

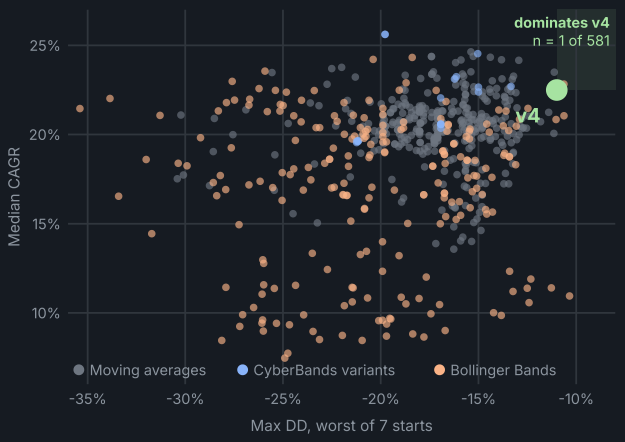
Each bar or point is the v4 portfolio with one element changed. 2015–2026, 7 start dates.

Calmar ratio by variant



Portfolio Calmar (CAGR / max DD), median of 7 starts

581 alternative rules for the BTC position



Each point replaces only the BTC rule: SMA and EMA 10–300d with 1–3 confirming closes, MA crossovers, CyberBands on 2/3/5-day bars and four Bollinger rule types, each with and without a re-buy filter. The shaded region dominates v4 on both median CAGR and worst max DD. One rule lies in it (Bollinger 50d, 1.5σ, with the 200d filter), by 0.3 points of CAGR and 0.4 points of drawdown, and neighbouring Bollinger lengths score 1.1–1.7 on Calmar.

Test log

Green: led to a rule change. Grey: no change.

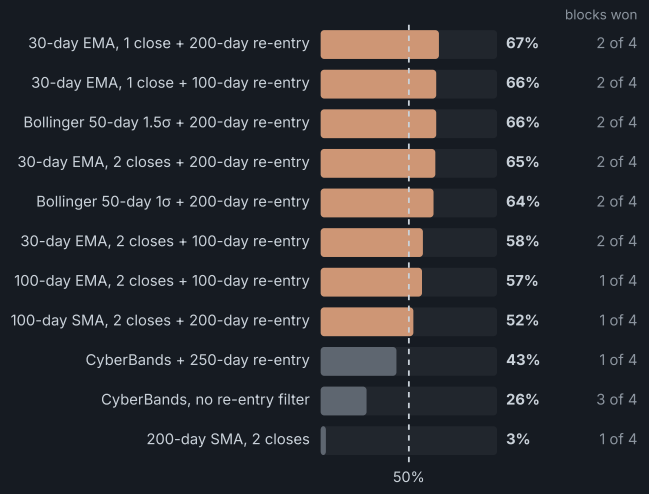
1	One rule applied to all assets (2,820 runs) ✓ Exit rule dominates; daily evaluation	2	Full vs half exit ✓ Full exit	3	Per-asset rule assignment ✓ BTC: CyberBands. Equities: 200d SMA
4	Portfolio-level filters, drawdown brake × Rarely binding	5	SPY/NDX relative-strength tilt × Lower Calmar	6	Faster equity re-entry (weekly RSI) × Lower Calmar
7	SMA length and confirmation sensitivity ✓ 200d, 2 closes	8	Weinstein stage analysis × No gain over 200d SMA	9	Per asset, per calendar year × Consistent with round 3
10	Weekly MAs, bar sizes, trailing stops ✓ BTC re-buy filter added	11	Zone DCA, threshold rebalancing × Lower Calmar than trend exits	12	Monthly RSI DCA × Lower Calmar than trend exits
13	Trim rules, deployment of idle cash ✓ Trim only when overextended	14	Gold timing rules, cash floor ✓ 20% floor; gold untimed	15	1973–2026 ex-BTC, bear-market windows × Max DD 21.5%
16	Single stocks and a sector ETF × BTC rule does not transfer	17	Delayed exit when oversold × Lower Calmar	18	581 rules for the BTC position × 5 equivalent, none higher
19	Nine rules per asset, standalone × Asset-specific results	20	CyberBands on 1h–12h bars × Daily highest	21	432 rebalancing methods × None above USD proceeds
22	Leverage, mean reversion, seasonality × Only leverage exceeds hold CAGR	23	Random 1–4y windows, distribution × Narrower P10–P90 than hold	24	42 asymmetric SMA exit / entry pairs × None best in both samples
25	BTC target weight, 15–70% × CAGR and max DD rise together	26	532 static mixes, 4 rebalance frequencies × None above v4 under 25% max DD	27	Constrained search (simulator), 300 configs × Two candidates
28	Candidates re-run in the lab engine × Only the weight change holds				

Findings. Most of the improvement comes from the re-buy filter, not the exit signal. Requiring 2 closes above the 200d SMA before re-entry raises portfolio Calmar from 1.30 to 2.19 for daily CyberBands and from 1.40 to 1.92 for a 100d SMA. 20d and 50d averages trade up to 33 times a year with drawdowns comparable to buy and hold.

Robustness: subperiods and out-of-sample history

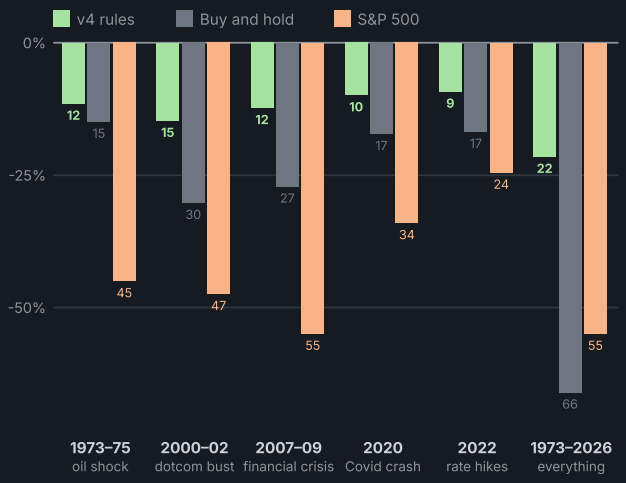
The seven start dates share one end date and overlap heavily. The tests below use non-overlapping blocks, random windows and the 1973–2026 ex-BTC sample.

Closest alternative BTC rules, n = 200 random 2–5y windows



Bar: share of windows in which the alternative has a higher Calmar than v4. Right: the same comparison on four non-overlapping blocks (2015–17, 2018–20, 2021–23, 2024–26). Five alternatives beat v4 in about two thirds of windows and in 2 of 4 blocks, with worst max DD within 2 points of v4's (-11.5%). The windows overlap and come from one 12-year BTC history, so this does not separate them from v4.

Max drawdown by bear market, 1973–2026 ex-BTC (out-of-sample)



The equity and cash rules, with gold held, on 53 years not used to choose them. Portfolio max DD is 9–15% in each bear-market window. Full period: CAGR 9.8%, max DD 21.5%, against 10.3% and 66% for buy and hold of the same mix. Gold before 2000 is monthly data, so drawdowns in that period are understated.

v4 by non-overlapping 3-year block

Block	CAGR	Max DD
2015–17	**37.9%**	-10.6%
2018–20 (BTC bear, Covid)	**26.2%**	-11.0%
2021–23 (2022 bear)	**16.7%**	-9.5%
2024–26	**14.0%**	-12.0%

CAGR declines from 38% to 14% across the four blocks; max DD is 9.5–12% in each. The return is not stationary; the drawdown has been.

Limitations

- Underperforms buy and hold in sustained bull markets: by 2–11 points of CAGR in the 1980s and 1990s windows.
- One 12-year BTC history, about three market cycles. Parameter differences of this size are not distinguishable from noise.
- Five alternative BTC rules are not distinguishable from v4's on this sample. Turnover differs: 5.6 trades a year for v4, 12–17 for the 30d EMA rules.
- No taxes, slippage or capacity constraints; every signal is assumed executed at the next close.
- Single stocks and late execution of an exit are not covered.

Summary. Of 581 BTC rules and 432 rebalancing methods, none has a materially higher Calmar than v4 and five BTC rules are equivalent to it. All of the equivalent rules share one structure: a fast exit with a slow-average re-entry filter. Variants with a higher CAGR exist (pages 5 to 7); each has a larger max drawdown.

Rebalancing methods

Per-asset timing rules are held at v4. Only the allocation layer changes: where exit proceeds go, how target weights are set, and when positions are trimmed. 432 configurations (216 ex-BTC), simulated with the same execution and cost assumptions; the simulator reproduces the engine's buy-and-hold NAV exactly.

	2015–2026 INCL. BTC (7 STARTS; N = 200 WINDOWS)					1973–2026 EX-BTC (N = 300)		
REBALANCING METHOD	CAGR	MAX DD	CALMAR	TRADES / YR	WIN RATE VS V4	CAGR	MAX DD	WIN RATE VS V4
Exit proceeds held in USD (v4)	22.0%	10.6%	**2.20**	19	–	9.3%	21%	–
Proceeds redistributed pro rata, cap 1.5× target, ex-gold	22.7%	11.6%	**1.96**	31	60%	9.2%	22%	33%
Same, including gold	23.6%	12.8%	**1.85**	38	62%	9.4%	23%	21%
USD proceeds, trim band +10 pts	23.5%	13.4%	**2.00**	14	38%	9.9%	22%	54%
USD proceeds, no trimming	26.5%	16.3%	**1.78**	13	20%	9.6%	32%	20%
Volatility target 10% (60d ex-ante)	15.5%	8.0%	**1.93**	35	26%	8.8%	21%	69%
Top 2 by 3/6/12m momentum, monthly	16.0%	16.0%	**1.04**	21	4%	10.4%	28%	23%
Momentum / volatility weights, monthly	15.5%	15.9%	**1.03**	34	6%	10.6%	22%	33%
Inverse-volatility weights (60d), monthly	12.4%	12.4%	**1.04**	26	2%	8.5%	19%	30%
Static weights, no timing rules	22.7%	35.5%	**0.64**	18	4%	10.1%	42%	39%

Win rate: share of random windows with a higher Calmar than v4 (2–5y windows incl. BTC, 2–10y ex-BTC). Redistributing exit proceeds beats v4 in about 60% of windows incl. BTC and in 21–33% ex-BTC. Risk-based weighting (inverse volatility, momentum / volatility) underweights BTC, which contributed most of the return in this sample. These methods may sell gold; v4 does not.

CyberBands bar size, BTC rule

	Calmar	CAGR	max DD	trades / yr
Daily (v4)	2.19	22.5%	11.0%	6
12 hours	1.42	18.7%	14.8%	12
8 hours	1.25	17.7%	14.2%	16
6 hours	1.29	17.9%	15.0%	21
4 hours	0.93	15.7%	17.2%	32
2 hours	0.89	16.0%	18.0%	45
1 hours	0.92	13.7%	15.1%	61

Bar: portfolio Calmar

v4's BTC rule with CyberBands computed on 1h–12h bars (Bitstamp hourly data, UTC-aligned). A Python port of the indicator reproduces all 117 daily state changes of the native implementation. Shorter bars change state 2 to 10 times as often and all score lower.

Contribution of the equity exit rule

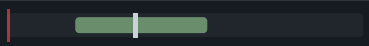
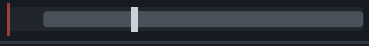
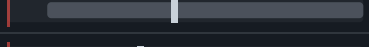
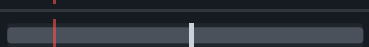
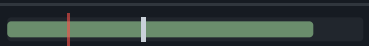
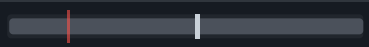
PORTFOLIO	2015–26 CAGR	MAX DD	1973–2026 CAGR	MAX DD
v4	22.5%	11%	9.8%	22%
v4, equities untimed	21.7%	16%	11.1%	40%
v4, no exits at all	22.6%	35%	–	–
Static mix, quarterly rebalance	24.3%	32%	9.8%	38%
Static mix, buy and hold	23.0%	77%	10.3%	66%

Removing the equity exits changes portfolio CAGR by −0.8 to +1.3 points and raises max DD from 11% to 16% (2015–2026) and from 22% to 40% (1973–2026).

Findings. The trim rule has more effect than the choice of rebalancing method. No trimming adds about 4.5 points of CAGR incl. BTC and raises max DD from 11% to 16%; ex-BTC over 1973–2026 it raises max DD to 32% with no gain in CAGR. A 10% volatility target beats v4 in 69% of ex-BTC windows and in 26% incl. BTC, where it costs 6.5 points of CAGR. Other methods change CAGR by about a point or less.

Distribution of outcomes over random 1–4 year windows

Each window starts in cash on a random date, applies the rule daily and ends 1 to 4 years later. n = 1,000 windows per asset and 400 for the portfolio. Windows overlap.

		P10 CAGR	P50 CAGR	P90 CAGR	P10–P90 OF CAGR (TICK = P50, RED LINE = 0)	SHARE CAGR < 0	MEDIAN MAX DD	WORST MAX DD
Portfolio incl. BTC, 2015–2026	**v4**	15.1%	**28.1%**	45.0%		1%	10%	12%
	Buy and hold	8.0%	**28.0%**	80.1%		6%	29%	78%
Portfolio ex-BTC, 1973–2026	**v4**	2.4%	**8.7%**	18.9%		5%	9%	22%
	Buy and hold	2.3%	**9.7%**	20.9%		7%	12%	46%
BTC	**v4 rule**	20.6%	**76.0%**	190.9%		1%	36%	48%
	Buy and hold	0.0%	**61.6%**	207.4%		10%	65%	83%
S&P 500	**200d SMA**	-0.1%	**10.0%**	22.6%		10%	13%	33%
	Buy and hold	-3.1%	**12.9%**	25.5%		13%	19%	55%
Nasdaq 100	**200d SMA**	-2.3%	**10.0%**	31.8%		14%	20%	48%
	Buy and hold	-5.0%	**14.8%**	33.8%		14%	23%	83%
Gold	**200d SMA**	-5.5%	**7.0%**	23.2%		29%	17%	33%
	Buy and hold	-5.3%	**12.1%**	27.8%		18%	19%	42%

Incl. BTC, v4's median CAGR equals buy and hold (28%) with a narrower distribution: P10 15% against 8%, P90 45% against 80%, and negative CAGR in 1% of windows against 6%. On the S&P 500 and Nasdaq 100 the 200d SMA has a median CAGR 3 to 5 points below buy and hold and a worst max DD 22 to 35 points smaller. On gold the 200d SMA has a lower median and a higher share of losing windows (29% against 18%).

Rules with a higher CAGR than buy and hold

	S&P 500		NASDAQ 100		GOLD	
RULE (IN / OUT)	CAGR	MAX DD	CAGR	MAX DD	CAGR	MAX DD
Buy and hold	10.8%	55%	12.1%	83%	10.7%	44%
200d SMA, long / cash	9.5%	33%	11.6%	48%	8.1%	35%
200d SMA, 1.5× / cash	**11.1%**	47%	**13.8%**	66%	10.2%	50%
200d SMA, 2× / cash	**12.1%**	59%	**15.1%**	79%	**11.6%**	63%
200d SMA, 1.5× / 1×	**12.3%**	59%	**14.2%**	88%	**12.7%**	56%
Constant 2× leverage	**12.7%**	88%	**12.6%**	99%	**15.4%**	75%
Volatility-scaled, max 2×	8.4%	35%	10.3%	43%	9.4%	54%
Long Nov–Apr only	9.1%	35%	10.0%	67%	7.7%	27%

Full-period CAGR and max DD, 1973–2026 (gold from 2001). Green: CAGR above buy and hold. Every such rule has average exposure above 100%, financed at the T-bill rate + 1% with daily reset, and a max DD near or above buy and hold. Volatility scaling, RSI(2) mean reversion and seasonality do not exceed buy and hold.

Asymmetric SMA exit and entry, SPY / NDX rule

	INCL. BTC, 2015–2026			EX-BTC, 1973–2026		
EXIT SMA / ENTRY SMA	CAGR	MAX DD	CALMAR	CAGR	MAX DD	CALMAR
200d / 200d (v4)	22.5%	11.0%	**2.18**	9.8%	21.5%	**0.46**
200d / 100d	21.7%	11.1%	**1.96**	9.9%	18.9%	**0.53**
200d / 50d	22.0%	11.5%	**1.91**	9.7%	22.5%	**0.43**
150d / 200d	22.9%	11.0%	**2.27**	9.8%	19.3%	**0.51**
300d / 200d	22.2%	15.2%	**1.58**	10.4%	18.7%	**0.55**
100d / 100d	21.6%	11.5%	**2.17**	9.5%	21.6%	**0.44**

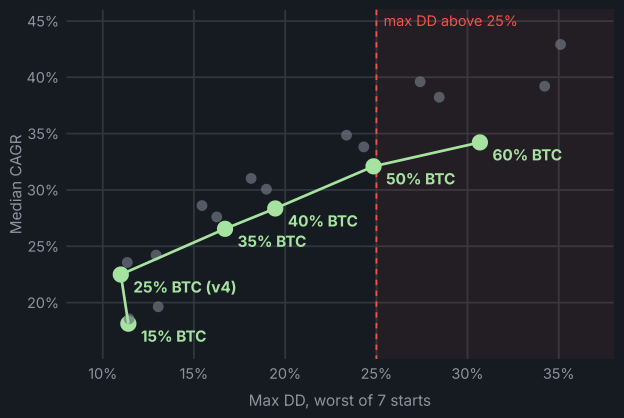
Exit after 2 closes below the first average, re-enter after 2 closes above the second. 42 pairs (exit 50–300d, entry 20–300d). No pair has the highest Calmar in both samples: 150d / 200d is best incl. BTC, 300d / 200d ex-BTC, and each is below v4 in the other sample.

Summary. No tested change raises Calmar. Four changes raise CAGR: no trimming, untimed equities, leverage, and a larger BTC weight (page 7). Each also raises max drawdown, so the choice among them is a choice of risk level, not of rule quality.

BTC target weight: CAGR against max drawdown

v4's rules with only target weights changed: BTC 15–70%, USD floor 20 / 10 / 0%. 2015–2026, 7 start dates.

Median CAGR against worst max DD



Green: 20% cash floor. Grey: 10% and 0% floors. Between a 25% and a 50% BTC target the slope is about one point of CAGR per point of max DD. Above 50% the slope falls and max DD exceeds 25%.

Calendar-year returns by BTC target

YEAR	25% BTC (V4)	35%	40%	50%
2015	+8.8%	+15.4%	+19.0%	+26.0%
2016	+26.2%	+36.8%	+43.6%	+54.0%
2017	+90.2%	+137.9%	+158.4%	+226.0%
2018	+0.0%	-0.7%	-0.9%	-1.5%
2019	+30.6%	+37.2%	+37.0%	+46.4%
2020	+55.2%	+70.6%	+76.1%	+87.7%
2021	+32.3%	+37.0%	+42.2%	+50.7%
2022	-4.3%	-2.5%	-1.9%	-0.5%
2023	+30.6%	+35.0%	+37.7%	+42.4%
2024	+30.5%	+34.2%	+34.2%	+37.2%
2025	+20.2%	+20.1%	+22.0%	+21.6%
2026 to Nov	-3.2%	-2.7%	-3.8%	-2.6%

Portfolio return by calendar year, single path from January 2015, 20% floor. Green: above the 25% portfolio. Red: below. Larger targets lead in 10 or 11 of 12 years; most of the difference arises in 2015–2017 and 2020–2021.

Before and after 2022

	2015–2021		2022–NOV 2026	
BTC TARGET WEIGHT	CAGR	MAX INTRA-YEAR DD	CAGR	MAX INTRA-YEAR DD
25% BTC (v4)	32.1%	10.6%	14.0%	9.8%
35%	42.6%	14.3%	16.0%	12.9%
40%	47.3%	17.7%	16.7%	13.3%
50%	59.1%	20.9%	18.6%	16.7%

A 50% target returned 27 points of CAGR more than 25% in 2015–2021 and 4.6 points more since 2022, with a max intra-year DD about 7 points larger and no advantage in 2025 or 2026.

Findings. BTC weight has the steepest CAGR-per-drawdown trade-off of any change tested, and v4's 25% is the Calmar-maximising weight, not the CAGR-maximising weight under the 25% constraint. The advantage of a larger weight is concentrated before 2022 and has decayed since. It depends on one asset's realised history and cannot be tested out-of-sample. A 50% target reached a 24.8% max DD in-sample against the 25% constraint.

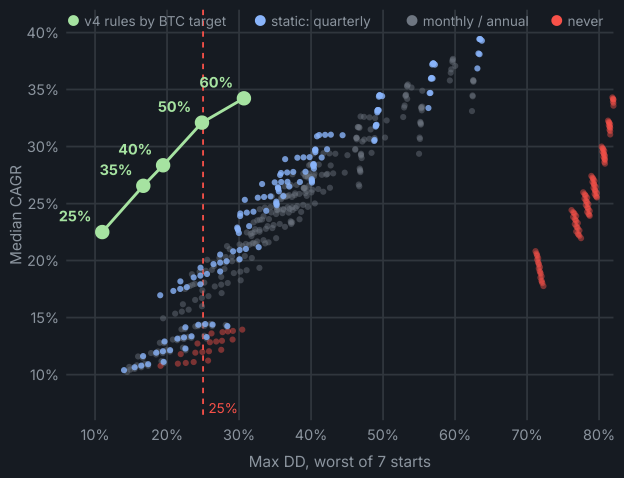
Method and definitions

- **Data.** Daily closes: BTC-USD, SPY, ^NDX, gold futures (GC=F); 3-month T-bill yield as the cash rate. The 1973–2026 tests use the S&P 500 and Nasdaq Composite before the listed series begin, and monthly gold interpolated to daily before 2000.
- **Execution.** Signal at close t, fill at close t+1. Indicators use data to t only; look-ahead invariance is unit-tested.
- **Costs.** 15 bp per trade on BTC and equities, none on gold. Taxes and slippage excluded.
- **Metrics.** CAGR; max drawdown of daily portfolio NAV; Calmar = CAGR / |max DD|.
- **CyberBands.** A Gaussian-smoothed price channel (DEMA 7, Gaussian 4, SMMA 12; bands at +2.5 / −1.8 standard deviations over 30 bars). The state turns bullish on a close above the upper band and bearish on a close below the lower band.
- **Sampling.** 7 start dates (Jan 2015 to Jan 2021) to a common end; non-overlapping 3-year blocks; seeded random windows. Windows overlap, so win rates are descriptive, not significance tests.
- **Selection bias.** v4's parameters were chosen on 2015–2026 (in-sample). 1973–2026 ex-BTC is out-of-sample for the equity and cash rules. Over 1,000 configurations were examined with no multiple-comparison correction; small differences are noise.

Static allocations, and a constrained search

Quarterly rebalancing of an equal-weight mix has a higher CAGR than v4 (24.3% against 22.5%) with a 32% max DD. This page tests whether any static mix does better at v4's level of risk, then searches for the highest CAGR under a 20% max DD.

532 static mixes against v4's rules, 2015–2026



Each point is a static allocation with no timing rules (BTC 0–60%, gold 10–40%, USD 0–30%, equities the remainder) at one rebalancing frequency. Green: v4's rules at BTC targets of 25–60%. No static mix has a higher CAGR than v4 with max DD under 25% (0 of 532; 0 of 80 ex-BTC over 1973–2026).

Rebalancing frequency and the static frontier

REBALANCING FREQUENCY (MEDIAN OF 133 MIXES)	CAGR	MAX DD	CALMAR
Monthly	23.4%	36.2%	**0.64**
Quarterly	26.9%	35.8%	**0.73**
Annual	25.7%	36.9%	**0.70**
Never	24.6%	78.2%	**0.41**

MAX DD BUDGET	BEST STATIC MIX BTC / EQ / GOLD / USD	STATIC CAGR	V4 RULES CAGR
20%	10 / 20 / 40 / 30	17.0%	**26.6%**
25%	10 / 40 / 40 / 10	19.4%	**28.4%**
30%	20 / 30 / 20 / 30	22.9%	**32.1%**
35%	20 / 50 / 30 / 0	26.9%	**34.2%**
40%	25 / 55 / 20 / 0	29.1%	**34.2%**
50%	40 / 35 / 25 / 0	34.5%	**34.2%**

Quarterly is the best frequency; monthly sells BTC while it is still trending. At equal max DD the timing rules add 6 to 10 points of CAGR. Ex-BTC over 1973–2026 the gap closes: best static mix under 25% (30 / 40 / 30, annual) 9.2% and 22.0% max DD, v4 9.8% and 21.5%, with a coin-flip win rate in random windows.

Constrained search: max DD ≤ 20% on every test, USD floor 20%, BTC ≤ 40%, equities ≤ 40%

PORTFOLIO (LAB ENGINE)	CAGR	MAX DD	CALMAR	TRADES / YR	1–4Y P10	1–4Y P50	CAGR 2022+	1973 EX-BTC CAGR	1973 EX-BTC MAX DD	WORST DD ANY TEST	WIN RATE VS V4
v4: BTC 25 / eq 30 / gold 25 / USD 20	22.6%	11.0%	**2.22**	17	12.1%	29.0%	14.2%	8.1%	12.5%	**12.6%**	–
BTC 30 / eq 25 / gold 25 / USD 20	24.8%	13.9%	**2.04**	18	12.4%	31.7%	15.3%	7.7%	13.0%	**14.5%**	95%
BTC 35 / eq 25 / gold 20 / USD 20	26.2%	17.0%	**1.87**	25	13.0%	34.5%	15.8%	7.9%	13.2%	**17.1%**	94%
30 / 25 / 25 / 20, trim at +10 points	24.1%	16.1%	**1.71**	17	12.4%	31.2%	15.2%	7.8%	13.0%	**16.1%**	90%
30 / 25 / 25 / 20, +10 trim, proceeds redistributed (A)	22.0%	12.4%	**1.94**	25	12.5%	28.7%	14.3%	8.0%	14.1%	**14.1%**	40%
35 / 25 / 20 / 20, trim at +10 points	25.8%	17.5%	**1.83**	23	13.0%	33.7%	15.8%	8.0%	13.2%	**17.5%**	92%
35 / 25 / 20 / 20, +10 trim, proceeds redistributed (B)	24.3%	14.9%	**1.87**	33	13.1%	31.3%	15.0%	7.7%	14.1%	**15.1%**	86%
v4 weights, proceeds redistributed	22.5%	10.5%	**2.23**	33	13.7%	29.2%	14.0%	8.1%	13.8%	**13.8%**	40%

A search over 300 configurations in the target-weight simulator proposed two candidates (A, B) combining larger BTC weights, a +10-point trim band and redistribution of exit proceeds, at 27.7% and 29.4% CAGR. Re-run in the lab engine, which keeps v4's buy-only gold rule and already lets winners run, the trim band and redistribution reduce CAGR. Only the weight change survives. "Worst DD any test": 7 starts, four 3-year blocks, 300 random 1–4y windows and 1973–2026 ex-BTC. Win rate: share of 1–4y windows with a higher CAGR than v4.

Findings. The simulator result did not replicate in the engine: its baseline trimmed on tight symmetric bands, so loosening them looked like an improvement that v4's trim rule already has. Within the stated constraints the engine-validated options are v4 with a BTC target of 30% (24.8% CAGR, 14.5% worst DD on any test) or 35% (26.2%, 17.1%), against v4's 22.6% and 12.6%. A 40% target breaches the 20% limit in random windows. The advantage since 2022 is about 1 to 1.6 points of CAGR.