Gold Return Distribution Shape As A Macro-Stress Regime Lens

Why the 252-day structural kurtosis of gold daily returns captures the same macro-stress regimes that drive gold through safe-haven channels; the April 2025 tariff-escalation peak and the April 2026 pre-drawdown trough as signature cases.

David Stendahl · Market Lab Analytics · November 5, 2026

What this signal is

Gold return distributions change shape across macro regimes. During banking crises, sovereign defaults, and geopolitical shocks the daily return distribution develops fat tails: more frequent large-magnitude daily moves than a normal distribution would predict. During quiet regimes returns cluster tightly around the mean.

This signal measures that shape directly. The engine computes 252-day rolling kurtosis of daily gold returns, applies a smoothing filter to separate structural from cyclical components, z-scores on a longer baseline, and bounds through hyperbolic tangent. A composite near plus one is a fat-tailed distribution regime. A composite near minus one is a tight-distribution regime.

The pattern across 36 years: Phase +1 fat-tails state has delivered a mean forward 60-day gold return of plus 1.70 percent against a baseline of plus 0.78 percent. Phase −1 tight-distribution has delivered only plus 0.29 percent. The spread is modest but reliable. The mechanism is coincident, not causal: elevated kurtosis typically accompanies macro-stress regimes (banking crises, sovereign defaults, geopolitical shocks, Fed policy pivots) that drive gold through safe-haven channels. The distribution-shape signal is a statistical signature of those regimes.

On April 17, 2025 the composite reached its series maximum plus 1.0000 during the Trump-Xi tariff-escalation window. Gold daily returns were producing frequent large-magnitude moves. Gold was flat over the subsequent 60 trading days as the signal peaked near a short-term consolidation. On April 21, 2026 the composite reached its series minimum minus 1.0000 as the preceding months had carried tight return distributions. Gold subsequently fell 15.26 percent over the following 60 trading days, the largest single-episode gold drawdown since the 2013 taper tantrum.

Today the composite reads near minus 0.95, in tight-distribution territory. Gold daily returns have been clustering tightly around their mean; the signal is in quiet-regime.

Here is what the engine data says. The Spearman information coefficient of the composite against gold forward 60-day returns is plus 0.13 across 8,963 live-window trading days. State-conditional means: fat-tails plus 1.70 percent; Normal plus 0.65 percent; tight-distribution plus 0.29 percent. The polarity is as-is positive: fat tails equals macro-stress regime equals modestly constructive gold forward edge.

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How the inputs compose

The engine pulls daily gold back-adjusted continuous closes from COMEX (CSI symbol GC_1240BD). Daily returns are computed as log returns. The trailing 252-day (one-year) rolling kurtosis is computed from these daily returns. Kurtosis greater than 3 indicates fat tails (more extreme days than a normal distribution would predict); kurtosis less than 3 indicates thin tails.

A smoothing filter separates the structural kurtosis component from short-term cyclical variation. The structural component captures regime-level distribution-shape shifts; the cyclical component captures short-term volatility bursts.

The structural kurtosis is z-scored on a longer baseline window with 252-day minimum population. The z-score is passed through tanh with scale 1.5 and bounded between minus one and plus one.

The engine also exposes four confirming features: five-day composite velocity, 60-day volatility regime, 60-day correlation with gold daily returns, and 63-day lag-1 autocorrelation.

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What the state-conditional returns have actually done

The gold forward-60-day return baseline (unconditional) is mean plus 0.78 percent, median plus 0.09 percent. Standard deviation 4.33 percent. Percent negative 48.6 percent. State-conditional means below are expressed as edges relative to this baseline.

> **Reference baseline (8,963 gold-aligned forward-60-day windows from November 1990 through November 2026)**
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> Gold forward-60-day return baseline (unconditional): mean plus 0.78 percent, median plus 0.09 percent. Standard deviation 4.33 percent. Percent negative 48.6 percent. Phase 0 source: Z11145 engine parquet joined with COMEX gold back-adjusted continuous closes.

The Fat-tails state (Market_Phase_Int = +1), 2,827 trading days or 31.3 percent of sample, delivered a mean forward 60-day gold return of plus 1.70 percent. That is plus 0.92 percentage points above baseline. The 2008-2009 GFC window, the 2011-2012 European sovereign crisis, the 2020 COVID shock, and the 2025 tariff-escalation window all contribute to the state-day count.

The Normal state (Market_Phase_Int = 0), 1,249 trading days or 13.8 percent of sample, delivered mean plus 0.65 percent. That is minus 0.13 percentage points below baseline. The transition band between fat tails and tight distribution.

The Tight-distribution state (Market_Phase_Int = −1), 4,947 trading days or 54.8 percent of sample, delivered mean plus 0.29 percent. That is minus 0.49 percentage points below baseline. The modal state where gold returns cluster around the mean; quiet regimes dominate the sample.

The spread between fat-tails and tight-distribution forward returns is plus 1.41 percentage points at 60 days. The Spearman information coefficient of the composite against gold forward-60-day returns is plus 0.13 at N 8,963.

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Three cases that frame how to read the signal

Case 1: April 17, 2025 series maximum during Trump-Xi tariff escalation

The spring of 2025 brought escalating tariff rhetoric between the US and China. Gold daily returns responded with frequent large-magnitude moves as headline-driven trading dominated. Structural kurtosis climbed. On April 17 the composite reached its series maximum plus 1.0000.

Gold was at 3,612 dollars per ounce on the back-adjusted continuous. Over the next 60 trading days gold was essentially flat, gaining only 0.06 percent. The signal peaked near a short-term consolidation window where gold had already run and needed time to digest gains.

Case 2: April 21, 2026 series minimum preceded gold 15 percent drawdown

By spring 2026 the preceding months had carried tight distributions. Daily gold returns had been clustering around their mean; structural kurtosis collapsed. On April 21 the composite reached its series minimum minus 1.0000.

Gold was at 4,811 dollars per ounce. Over the next 60 trading days gold fell 15.26 percent to around 4,078 dollars, the largest single-episode drawdown since the 2013 taper tantrum. The tight-distribution reading identified the complacent pre-drawdown regime where gold was due for mean-reverting correction.

Case 3: March 2020 COVID low-kurtosis pre-crash regime

The March 2020 COVID shock arrived at a moment when preceding months had carried tight return distributions. The composite was in moderate-negative territory as the shock hit. Gold had a 60-day forward return of plus 4.74 percent as safe-haven flows dominated and the Fed intervened with emergency rate cuts, QE, and swap lines.

This case demonstrates that the signal is a regime-shape indicator, not a perfect predictor; when macro shocks arrive during low-kurtosis regimes, forward returns can still be positive if the subsequent shock itself triggers safe-haven flows.

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How to use the signal today

This is a macro-regime distribution-shape detector on a 60-day forward horizon. The signal updates daily from the rolling kurtosis computation.

Three best uses.

First, as a regime-identification filter for gold exposure sizing. Fat-tails state has delivered plus 1.70 percent mean fwd 60-day gold return; tight-distribution has delivered plus 0.29 percent. A 1.41-percentage-point spread across 36 years is a reliable supplementary filter.

Second, as a cross-check against direction signals. When fat-tails regime aligns with credit-stress signals and sovereign-stress signals, the macro-stress narrative is multi-channel; conviction is higher.

Third, as a complacency warning. Tight-distribution readings near minus 1.00 have historically preceded both calm continuations and sharp reversals. The 2026 April case demonstrates the reversal risk; readers should treat tight-distribution extremes as moments to pair with other indicators rather than extrapolate forward calmness.

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Methodology notes

The composite is tanh of a z-scored structural kurtosis of daily gold returns on a 252-day rolling window. The 252-day window was chosen to capture one full annual cycle while remaining responsive to new regime shifts; shorter windows amplified short-term volatility bursts, longer windows blended multiple regimes.

The structural filter separates the kurtosis series into a slow-moving structural component and a short-term cyclical component. The composite uses the structural component to capture regime-level distribution-shape shifts.

The polarity is as-is positive. Higher composite equals fat tails equals macro-stress regime equals constructive gold forward edge. Full-sample Spearman IC against gold forward 60-day returns is plus 0.13 at N 8,963.

The 1990 start reflects reliable COMEX daily gold return history coverage.

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What this signal does not cover

Four caveats on the signal's reach, each stated plainly.

First, kurtosis is distribution shape, not direction. Elevated kurtosis means frequent large daily moves in either direction. A fat-tails reading does not guarantee gold strength, only indicates macro-regime shifts. Pair with direction signals.

Second, the signal is coincident with macro stress, not predictive of it. The structural kurtosis responds to realized return distributions, not to leading indicators of upcoming stress. A new macro shock that arrives during low-kurtosis regime will produce a fat-tails response only after the shock has unfolded.

Third, regime detection is lagged. The 252-day rolling window means the signal responds slowly to new regimes; a new fat-tails episode will show in the composite over weeks, not days. Short-horizon traders need faster volatility signals.

Fourth, as with any regime-shape signal, the sample window matters. The signal has fired through the 1990s calm period, 2000s bull runs, 2008-2009 GFC, 2020 COVID, and 2022-2026 elevated-

rates regime. The state-conditional pattern reflects these specific regimes; alternative future regimes (sustained deflation, Bretton-Woods-style breakdowns) could produce different patterns.

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