When Winners Stop Winning

Simple and Weighted Market Momentum Fragility Signals for U.S. Equity Left-Tail Risk

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Abstract

This paper studies whether lagged market momentum spreads identify U.S. equity left-tail risk. For the Dow Jones Industrial Average, Nasdaq Composite, and S&P 500, We define 12–1 momentum as the cumulative return from months $t-12$ to $t-2$, skipping $t-1$. We construct two predetermined state variables: a simple quick-minus-slow signal based on simple moving averages of 12–1 momentum and a weighted version that gives greater weight to recent 12–1 momentum observations. Both signals are mechanically determined by the end of month $t-2$, making them early-determined, low-frequency indicators rather than daily trend-following rules. Across markets, negative and fragile states are associated with weaker returns and higher left-tail probabilities. For the S&P 500, the simple fragile state has a 20.7% probability of a monthly loss worse than -5%, versus 6.8% in the strongest state; the weighted fragile state gives a similar 20.4% probability. Moving-average filters remain stronger standalone left-tail classifiers when allowed to use more recent price information. The practical contribution is timing: QS and WQS warning episodes that contain left-tail months begin roughly three to four months before the first left-tail month on average, while the standard 12-month moving-average rule often confirms weakness in the same month. The contribution is therefore not a replacement for moving averages, but an early-determined momentum-deterioration state variable for risk budgeting.

Keywords: momentum, left-tail risk, trend following, risk management, S&P 500, Nasdaq, Dow Jones.

JEL Classification: G11, G12, G17.

Draft. Comments welcome.

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1 Introduction: Winners Do Not Always Lose Quietly

"Momentum is working. The winners are still winners. Why worry?"

The trouble with this sentence is not that it is always wrong. The trouble is that it is often right until it suddenly becomes expensive. Momentum investors, especially long-only momentum investors, live with a peculiar form of comfort. Their portfolios are usually full of companies and markets that have recently done well. This is comforting because recent winners often keep winning. It is dangerous because the same winners can become crowded, correlated, and fragile precisely when the broad market starts to lose speed.

This paper is about that moment. More specifically, it is about whether market-level momentum-deterioration signals can identify states in which the U.S. equity left tail becomes less forgiving. The baseline signal is deliberately simple. Start with the familiar 12–1 momentum convention. Smooth it over three months to get a quick line. Smooth it over twelve months to get a slow line. Then ask whether the quick line is above or below the slow line. If the quick line is below the slow line, recent market momentum is weaker than its intermediate trend. If the slow line is also below zero, the broader trend is already negative. This is the state we call fragility.

This draft also studies a weighted version of the same idea. The simple version treats the last three 12–1 momentum observations equally when computing the quick line and treats the last twelve observations equally when computing the slow line. The weighted version gives more weight to more recent 12–1 momentum observations. This is not a new anomaly. It is a robustness and implementation variation. If a fragility signal is meant to identify deterioration in market momentum, then a weighted version is natural because the most recent momentum observations should plausibly contain more information about the current state of deterioration or repair.

The answer is yes, but with caveats. The S&P 500 signal is particularly informative. In the full sample with valid signals from December 1929 to April 2026, months with a negative S&P 500 simple *quick-minus-slow* signal have an average return of 0.29%, compared with 1.08% when the signal is non-negative. The probability of a monthly loss worse than -5% rises from 7.68% to 13.68%. The more important state is the joint condition that the quick line is below the slow line and the slow line itself is negative. In that state, the probability of a monthly S&P 500 loss worse than -5% is 20.73%, and the fifth percentile of monthly returns is -11.92%.

The weighted version gives a similar but slightly different picture. The simple sign split is not uniformly stronger under weighted smoothing. However, the weighted fragile state remains economically meaningful: for the S&P 500, WQuick $<$ WSlow and WSlow < 0 has a 20.41% probability of a monthly loss worse than -5%. In the common three-market sample, when all three markets are in the weighted fragile state, the S&P 500 has a 26.53% probability of a monthly loss worse than -5% and a 10.20% probability of a monthly

loss worse than -10%. That number is economically large, but it is based on only 49 observations and must be treated as exploratory.

The main challenge is not whether the raw pattern exists. The challenge is how to interpret it. Simple moving-average rules are powerful trend filters. In incremental logit tests, moving-average indicators dominate the simple QS dummy when the moving-average state is allowed to use price information through the immediately preceding month. This paper therefore does not claim that QS replaces moving averages. The stronger claim is more modest: QS is an early-determined momentum-deterioration state variable. It is mechanically fixed by the end of month $t-2$, whereas conventional monthly moving-average filters are usually updated through month $t-1$, and daily moving-average filters can change every trading day.

The central claim is therefore modest: simple and weighted quick-minus-slow signals do not predict crashes; they identify when the market's momentum structure has deteriorated enough that the downside distribution has historically become less forgiving.

2 The Popular Wisdom: "Just Own the Winners"

> *"The winners are winning because the market is telling you something. Listen to the market."*

Momentum is a serious anomaly, not a slogan. Jegadeesh and Titman (1993) show that buying past winners and selling past losers generates strong intermediate-horizon returns. Asness, Moskowitz, and Pedersen (2013) show that value and momentum are pervasive across markets. Moskowitz, Ooi, and Pedersen (2012) show that time-series momentum appears in many liquid asset classes. These findings are not the enemy of this paper. They are the reason this paper exists.

For long-only investors, the relevant risk is not identical to the classic long-short momentum crash of Daniel and Moskowitz (2016). A long-short momentum factor can suffer badly when past losers rebound sharply. A long-only momentum investor may not be short the losers, but still owns equity beta and often owns the parts of the market where optimism has been rewarded. During market stress, correlations rise and diversification becomes more aspirational than actual. The portfolio may still contain yesterday's winners, but yesterday's winners are still long equities.

This distinction motivates a market-level risk indicator. The question is not whether the signal can choose the best individual stocks. It cannot, and does not try to. The question is whether the market environment is friendly or hostile to being aggressively long momentum-like winners. In other words, the signal belongs to the exposure-control layer, not the stock-selection layer.

3 Related Literature and Repositioning

This paper is related to four strands of literature.

First, it relates to cross-sectional momentum and momentum crashes. Jegadeesh and Titman (1993) document intermediate-horizon return continuation. Daniel and Moskowitz (2016) show that momentum strategies can suffer severe crashes, especially after market downturns followed by sharp rebounds. Their framework is central for understanding why momentum risk is time-varying. My paper differs by focusing on a market-level state variable for left-tail risk rather than the crash mechanics of a fully formed long-short momentum portfolio.

Second, it relates to market states and momentum profits. Cooper, Gutierrez, and Hameed (2004) show that momentum profits depend on whether the market has previously been in an up or down state. That paper is close in spirit: both papers ask whether the broad market state matters for momentum-related returns. The present paper differs in its state definition. Instead of using a broad up/down market classification, We study whether the market's own intermediate momentum structure is deteriorating or repairing.

Third, it relates to volatility-managed and risk-managed momentum. Barroso and Santa-Clara (2015) show that momentum has moments: managing the volatility of momentum can materially improve its performance. Moreira and Muir (2017) provide a broader volatility-managed portfolio framework. This paper is not a volatility-scaling paper, but it is naturally complementary. If volatility scaling answers "how much risk should be taken given realized volatility?", quick-minus-slow asks whether the market momentum structure is deteriorating before or during a left-tail-prone state.

Fourth, it relates to trend following, moving averages, and dual momentum. Faber (2007) studies a ten-month moving-average timing model across asset classes, while Hurst, Ooi, and Pedersen (2017) document long-run evidence on trend-following investing. Antonacci (2012) emphasizes the combination of relative and absolute momentum. The present paper does not claim to dominate these approaches. Moving averages remain powerful and simple trend filters. The contribution here is narrower: predetermined momentum-deterioration state variables that can be known before the immediately preceding month is observed and that help distinguish deterioration from repair.

4 The Math, Because There Has to Be Some

"Signals are intuitive. Surely the reader can infer what quick and slow mean."

No. The reader should not infer it. A signal that cannot be replicated is not research; it is decoration. Let P_t be the market price level at the end of month t, and let

$$R_t = \frac{P_t}{P_{t-1}} - 1$$

be the monthly price return. The 12–1 momentum value used at the beginning of month t is

$$\mathrm{MOM}_t = \prod_{j=2}^{12}(1 + R_{t-j}) - 1.$$

This is the cumulative return from $t-12$ through $t-2$. It deliberately skips $t-1$, following the conventional 12–1 momentum construction. The skip month avoids short-term reversal effects and keeps the timing clean.

The simple quick and slow lines are

$$\mathrm{Quick}_t^{SMA} = \frac{1}{3}\sum_{k=0}^{2}\mathrm{MOM}_{t-k}, \qquad \mathrm{Slow}_t^{SMA} = \frac{1}{12}\sum_{k=0}^{11}\mathrm{MOM}_{t-k},$$

and the simple spread is

$$QS_t^{SMA} = \mathrm{Quick}_t^{SMA} - \mathrm{Slow}_t^{SMA}.$$

The weighted version gives more weight to the most recent 12–1 momentum observations:

$$\mathrm{Quick}_t^{WMA} = \frac{3\mathrm{MOM}_t + 2\mathrm{MOM}_{t-1} + 1\mathrm{MOM}_{t-2}}{6},$$

$$\mathrm{Slow}_t^{WMA} = \frac{\sum_{k=0}^{11}(12-k)\mathrm{MOM}_{t-k}}{\sum_{k=0}^{11}(12-k)} = \frac{\sum_{k=0}^{11}(12-k)\mathrm{MOM}_{t-k}}{78},$$

and

$$QS_t^{WMA} = \mathrm{Quick}_t^{WMA} - \mathrm{Slow}_t^{WMA}.$$

The weighted version is not introduced to search for a better-looking backtest. It is introduced because the economic question is about deterioration and repair. If the most recent intermediate momentum observations contain more information about whether deterioration is ongoing, then a weighted smoother is a natural robustness check. The simple version treats each lookback observation equally; the weighted version asks whether the same left-tail pattern survives when recent momentum receives more emphasis.

The timing convention is the key. The month-t signal is formed using returns through month $t-2$ inside each 12–1 momentum value and smoothed over previously observable momentum values. It does not use the return realized during month t. In fact, because the 12–1 momentum value skips month $t-1$, the month-t signal is mechanically determined by the end of month $t-2$. This is true for both the simple and weighted versions. The investor does not know R_t in advance. The investor only knows the state variable that will be used for month-t risk classification.

We examine three markets: the Dow Jones Industrial Average, the Nasdaq Composite, and the S&P 500. The data are monthly price-index observations from the workbooks. The final May 2026 observations are partial-month values and are excluded from the main

historical tests.

Table 1: Sample Summary

Market	Signal start	End	Obs.	Mean ret.	Vol.	Mean QS	QS p10	QS p90
Dow	1916-12	2026-04	1313	0.61%	5.21%	-0.06%	-13.24%	14.19%
Nasdaq	1973-02	2026-04	639	1.01%	6.05%	-0.00%	-17.72%	18.07%
S&P 500	1929-12	2026-04	1157	0.65%	5.33%	-0.09%	-13.05%	14.45%

Notes: The table uses observations with valid simple quick-minus-slow signals through April 2026. Returns are monthly price returns from the workbooks.

The use of price returns is a limitation, not a secret. For monthly left-tail classification, dividends are unlikely to change the qualitative crash-month inference very much. For final performance comparisons, total returns are the correct object.

5 Economic Interpretation: Why Should These Signals Matter?

"A line crossing another line is not an economic mechanism."

That objection is correct. A mechanical signal only becomes interesting if it can be connected to an economic interpretation. Both simple and weighted quick-minus-slow signals are best understood as second-layer trend variables. A plain moving average asks whether the price level is above or below its own trend. Quick-minus-slow asks a different question: is intermediate market momentum itself improving or deteriorating?

This distinction matters because left-tail risk is not only about whether the market has already fallen below a price trend. It is also about whether the market's prior momentum structure is losing force. When the quick line falls below the slow line, recent intermediate momentum is weaker than its own longer-run momentum trend. In that state, the market may still have a positive expected return, but the distribution can become less forgiving.

The slow line is important because not all decelerations are equally dangerous. If the quick line falls below the slow line while the slow line remains positive, the market may simply be cooling from strength. If the quick line falls below the slow line while the slow line is already negative, the interpretation is different. The market is not merely becoming less strong; it is deteriorating from an already weak intermediate trend. This is why the four-state classification is central to the paper. The fragile state combines momentum deterioration with a negative underlying trend. That combination is more plausibly associated with risk aversion, weaker dip-buying, higher correlations, and less reliable liquidity provision.

The weighted version sharpens this interpretation. In a simple moving average, a 12–1 momentum observation from eleven months ago receives the same weight as the most recent

available 12–1 momentum observation. That is transparent and stable, but it may understate recent deterioration. In a weighted moving average, recent 12–1 momentum receives more influence. If the market is transitioning from repair to breakdown, the weighted signal should respond more to that recent deterioration. If the simple and weighted versions both identify fatter left tails, the result is less likely to be an artifact of one smoothing convention.

For long-only momentum investors, this interpretation is especially relevant. A long-only momentum portfolio can own the best relative winners and still remain exposed to equity beta. It may also be concentrated in the industries and stocks that benefited most from the previous market environment. When broad-market momentum deteriorates, those prior winners can become more correlated, more crowded, and more vulnerable to de-risking.

6 What the Signal Looks Like

Figure 1 plots the three simple quick-minus-slow series from 1990 onward. The signals are related but not identical. A broad-market signal and a technology-heavy signal do not always deteriorate together. When they do, it is worth paying attention.

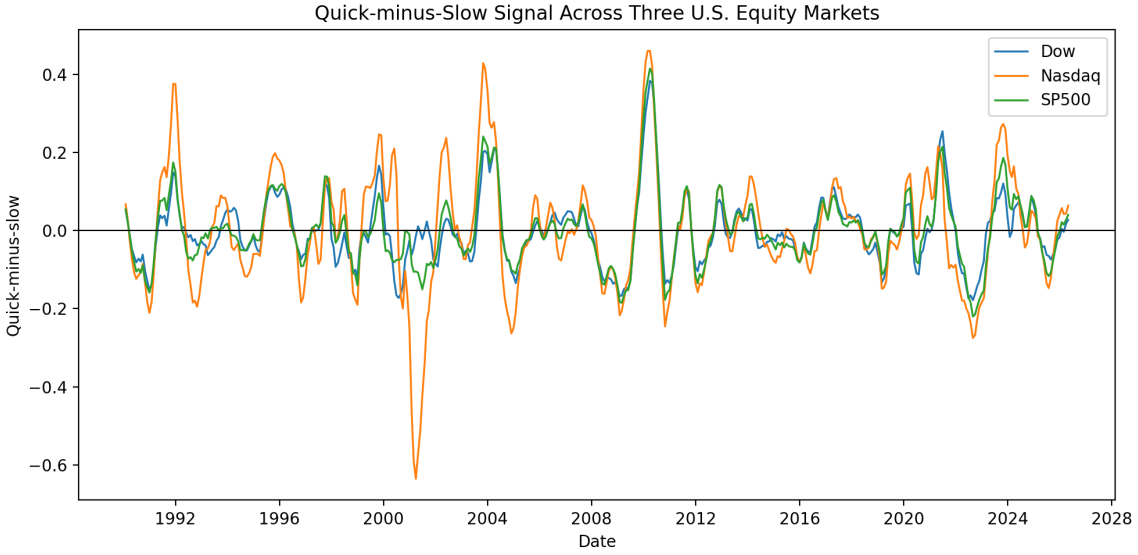

Figure 1: Simple quick-minus-slow signals for the Dow, Nasdaq, and S&P 500. The figure begins in 1990 for readability. Negative values indicate that the quick line is below the slow line.

Figure 2 shows the S&P 500 simple quick and slow lines directly. The worst regimes often occur when the crossing takes place while the slow line is already below zero. A deceleration from strong to less strong is not the same as a deceleration from weak to weaker.

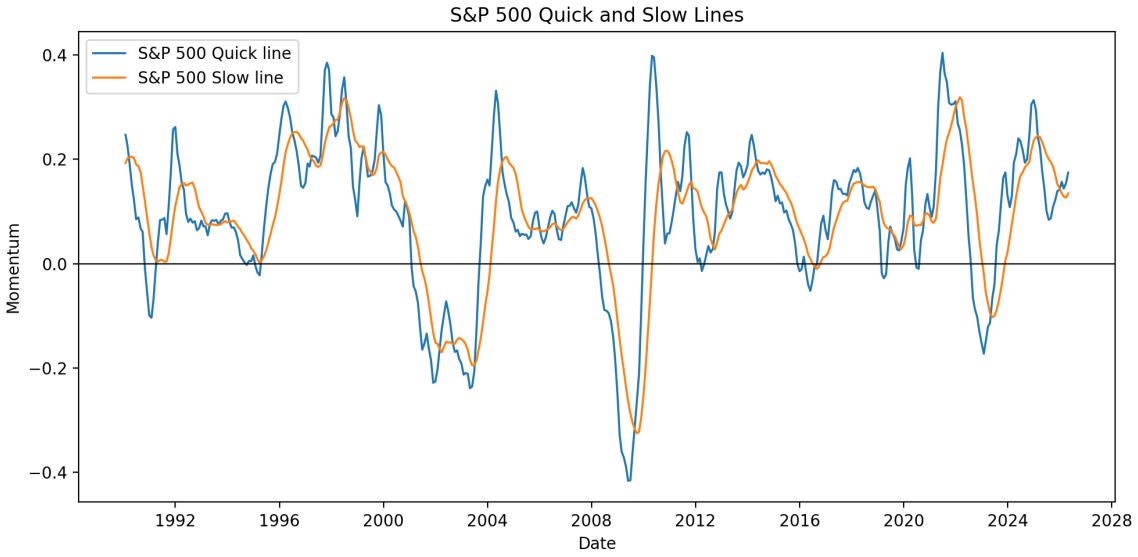

Figure 2: S&P 500 simple quick and slow momentum lines. The most fragile regime occurs when the quick line is below the slow line and the slow line is negative.

7 The First Test: Does Negative Mean Worse?

A negative signal does not imply that the next monthly return is negative on average. Equity markets have a positive unconditional drift. A useful risk indicator does not need to turn the conditional mean negative. It needs to identify a worse distribution.

Table 2: Monthly Returns Conditional on the Sign of Simple Quick-Minus-Slow

Market	State	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
Dow	QS ≥ 0	604	1.01%	9.44%	1.82%	-6.82%
Dow	QS < 0	709	0.26%	12.13%	4.09%	-8.85%
Nasdaq	QS ≥ 0	308	1.20%	12.34%	2.60%	-8.37%
Nasdaq	QS < 0	331	0.84%	14.80%	4.83%	-9.66%
S&P 500	QS ≥ 0	521	1.08%	7.68%	1.73%	-6.86%
S&P 500	QS < 0	636	0.29%	13.68%	3.14%	-8.60%

Notes: State is observed at the beginning of the month. Return is the price return realized during that month. Sample uses observations with valid simple QS signals through April 2026.

8 The Weighted Version: Does Recency Weighting Change the Result?

The weighted version asks whether the same pattern survives when recent 12–1 momentum observations receive greater weight. The weighted signal is not uniformly stronger than the simple signal, but it produces the same qualitative conclusion.

Table 3: Monthly Returns Conditional on the Sign of Weighted Quick-Minus-Slow

Market	State	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
Dow	WQS ≥ 0	608	0.94%	9.21%	1.64%	-6.63%
Dow	WQS < 0	705	0.32%	12.34%	4.26%	-8.99%
Nasdaq	WQS ≥ 0	313	1.32%	11.82%	2.24%	-8.03%
Nasdaq	WQS < 0	326	0.72%	15.34%	5.21%	-10.35%
S&P 500	WQS ≥ 0	513	1.01%	7.99%	1.56%	-6.80%
S&P 500	WQS < 0	644	0.36%	13.35%	3.26%	-8.60%

Notes: WQS is the weighted quick-minus-slow signal. The weighted quick and slow lines use linearly increasing weights on recent 12–1 momentum observations. Returns are monthly price returns.

9 The Better Test: Is the Slow Line Also Sick?

All crosses are not born equal. If the quick line falls below the slow line while the slow line is still positive, the market may simply be cooling. If the quick line falls below the slow line while the slow line is negative, the market is not merely cooling. It is weak and getting weaker.

Table 4: S&P 500 Four-State Fragility Classification: Simple Smoothing

State	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
Quick>Slow, Slow>0	381	0.91%	6.82%	1.57%	-5.87%
Quick<Slow, Slow>0	472	0.35%	11.23%	1.69%	-6.90%
Quick>Slow, Slow<0	140	1.54%	10.00%	2.14%	-6.91%
Quick<Slow, Slow<0	164	0.12%	20.73%	7.32%	-11.92%

Notes: The four states separate trend acceleration/deceleration from the sign of the slow line. The most fragile state combines deceleration with a negative intermediate trend. Sample period: December 1929 to April 2026, using monthly S&P 500 price returns.

Table 5: S&P 500 Four-State Fragility Classification: Weighted Smoothing

State	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
WQuick>WSlow, WSlow>0	384	0.82%	7.29%	1.30%	-6.30%
WQuick<WSlow, WSlow>0	448	0.52%	10.27%	1.79%	-6.76%
WQuick>WSlow, WSlow<0	129	1.59%	10.08%	2.33%	-6.88%
WQuick<WSlow, WSlow<0	196	-0.02%	20.41%	6.63%	-11.49%

Notes: WQuick and WSlow are linearly weighted moving averages of 12–1 momentum. The fragile weighted state combines weighted momentum deterioration with a negative weighted slow line.

The two smoothing conventions tell the same economic story. The most dangerous state is not merely a negative quick-minus-slow spread. It is a negative spread when the underlying

slow line is already negative.

10 Economic and Statistical Size of the Left-Tail Differences

Table 6: Key S&P 500 Left-Tail Probability Differences

Comparison	Event	Difference	Std. error	z-stat.	95% CI
Simple QS<0 minus QS≥ 0	$R \leq -5\%$	6.00%	1.79%	3.35	[2.49%, 9.52%]
Simple QS<0 minus QS≥ 0	$R \leq -10\%$	1.42%	0.90%	1.58	[-0.34%, 3.18%]
Simple fragile minus healthy	$R \leq -5\%$	13.91%	3.42%	4.07	[7.21%, 20.61%]
Simple fragile minus healthy	$R \leq -10\%$	5.74%	2.13%	2.69	[1.57%, 9.92%]
Weighted fragile minus healthy	$R \leq -5\%$	13.12%	3.22%	4.07	[6.81%, 19.43%]
Weighted fragile minus healthy	$R \leq -10\%$	5.33%	1.92%	2.78	[1.57%, 9.09%]

Notes: "Fragile" is defined as quick below slow and slow below zero. "Healthy" is defined as quick above slow and slow above zero. The table reports approximate large-sample standard errors for differences in proportions. The confidence intervals are not adjusted for multiple testing.

11 Forward Returns and Newey-West Inference

Multi-month forward returns overlap. If we compute a six-month return starting in January and another starting in February, five months are shared. Ordinary standard errors pretend otherwise. To avoid this problem, we estimate regressions of forward cumulative returns on a negative-signal indicator and report Newey-West t-statistics with lags equal to the forward horizon minus one. For horizon h,

$$R_{t:t+h-1} = \prod_{j=0}^{h-1}(1 + R_{t+j}) - 1,$$

and the regression is

$$R_{t:t+h-1} = a_h + b_h \mathbf{1}(QS_t < 0) + \varepsilon_{t,h}.$$

Table 7: Forward Returns Conditional on Negative Simple Quick-Minus-Slow

Market	Horizon	Mean if QS<0	Mean if QS≥ 0	Difference	NW t-stat
Dow	1	0.26%	1.01%	-0.75%	-2.62
Dow	3	1.02%	2.84%	-1.82%	-2.64
Dow	6	1.95%	5.88%	-3.93%	-3.07
Dow	12	6.10%	9.94%	-3.85%	-1.64
Nasdaq	1	0.84%	1.20%	-0.37%	-0.77
Nasdaq	3	2.98%	3.27%	-0.28%	-0.24
Nasdaq	6	5.48%	7.48%	-2.00%	-0.92
Nasdaq	12	13.64%	13.21%	0.43%	0.12
S&P 500	1	0.29%	1.08%	-0.79%	-2.55
S&P 500	3	1.11%	3.01%	-1.90%	-2.51
S&P 500	6	2.33%	5.84%	-3.51%	-2.61
S&P 500	12	6.67%	9.90%	-3.23%	-1.34

Notes: Forward returns are cumulative price returns over the stated horizon. The t-statistic is Newey-West with lags equal to horizon minus one.

Table 8: S&P 500 Forward Returns: Simple versus Weighted QS

Signal	Horizon	Mean if signal < 0	Mean if signal ≥ 0	Difference	NW t
Simple QS	1	0.29%	1.08%	-0.79%	-2.55
Simple QS	3	1.11%	3.01%	-1.90%	-2.51
Simple QS	6	2.33%	5.84%	-3.51%	-2.61
Simple QS	12	6.67%	9.90%	-3.23%	-1.34
Weighted QS	1	0.29%	1.09%	-0.79%	-2.57
Weighted QS	3	1.10%	3.04%	-1.95%	-2.56
Weighted QS	6	2.27%	5.97%	-3.71%	-2.75
Weighted QS	12	6.48%	10.17%	-3.69%	-1.52

Notes: Forward returns are cumulative S&P 500 price returns over the stated horizon. Newey-West statistics use lags equal to horizon minus one. The weighted specification uses the same 12–1 momentum input but applies linearly increasing weights to recent momentum observations.

The Newey-West lag choice follows the standard overlapping-return convention: for an h-month forward return, the maximum mechanical overlap is $h-1$ months. This choice is transparent and directly tied to the construction of the dependent variable. A final journal version should also report robustness to data-driven bandwidth choices such as Andrews (1991), especially for the shorter Nasdaq sample.

12 Cross-Market Confirmation: When One Line Whispers and Three Lines Shout

The market is not always one thing. The Dow captures mature blue chips. The Nasdaq captures a growth-heavy part of the market. The S&P 500 captures the broad large-cap benchmark. A fragile signal in one market can be noise. Fragility across several markets is more informative.

Table 9: S&P 500 Outcomes by Number of Negative Simple Market Signals

Negative markets	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
0	234	0.92%	8.12%	1.28%	-6.81%
1	71	1.74%	0.00%	0.00%	-3.24%
2	58	-0.25%	12.07%	1.72%	-6.24%
3	276	0.55%	13.04%	1.81%	-8.44%

Notes: The dependent return is the S&P 500 monthly price return. The count is the number of Dow, Nasdaq, and S&P 500 simple QS signals below zero. Common sample: February 1973 to April 2026.

Table 10: S&P 500 Outcomes by Number of Simple Fragile Markets

Fragile markets	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
0	547	0.83%	8.41%	0.73%	-6.24%
1	28	1.23%	7.14%	3.57%	-7.42%
2	23	-0.94%	21.74%	4.35%	-7.64%
3	41	0.27%	21.95%	7.32%	-10.99%

Notes: A market is fragile when simple QS is below zero and the simple slow line is below zero. The table uses the common three-market sample. Returns are S&P 500 monthly price returns.

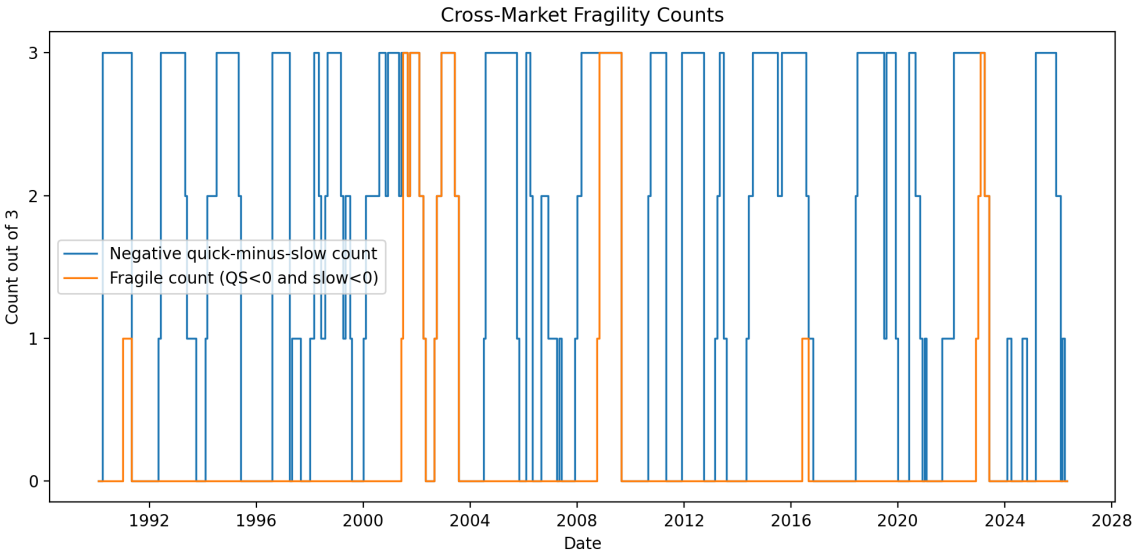

Figure 3: Cross-market negative and fragile counts. The count rises when market weakness broadens across the Dow, Nasdaq, and S&P 500.

Table 11: S&P 500 Outcomes by Number of Weighted Fragile Markets

Weighted fragile markets	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
0	529	0.90%	7.94%	0.76%	-6.13%
1	33	-0.19%	15.15%	0.00%	-8.85%
2	28	1.54%	7.14%	0.00%	-5.52%
3	49	-0.71%	26.53%	10.20%	-11.23%

Notes: A market is weighted-fragile when weighted QS is below zero and the weighted slow line is below zero. The table uses the common three-market sample from February 1973 to April 2026. Returns are S&P 500 monthly price returns.

The weighted cross-market result is economically large, but it is not monotonic. The two-market weighted-fragile state has a lower left-tail probability than both the one-market and three-market states. This is a small-sample warning rather than a result to smooth away: the two-market state contains only 28 observations. The interpretation should therefore focus on the extreme broad-fragility state rather than on a monotonic dose-response relation across all counts.

Table 12: Wilson Confidence Intervals for Weighted Cross-Market Fragility

Weighted fragile markets	Obs.	$P(R \leq -5\%)$	95% CI	$P(R \leq -10\%)$
0	529	7.94%	[5.93%, 10.56%]	0.76%
1	33	15.15%	[6.65%, 30.92%]	0.00%
2	28	7.14%	[1.98%, 22.65%]	0.00%
3	49	26.53%	[16.21%, 40.26%]	10.20%

Notes: Confidence intervals are Wilson score intervals for the probability of a monthly S&P 500 price return below −5%. The non-monotonic two-market row should be interpreted cautiously because it contains only 28 observations.

When all three markets are weighted-fragile, the S&P 500 has a 26.53% probability of a monthly loss worse than −5% and a 10.20% probability of a monthly loss worse than −10%. The Wilson interval for the −5% probability is wide, roughly 16.2% to 40.3%, because there are only 49 observations. This does not prove that the weighted version is superior. It supports the more modest interpretation that left-tail risk is most severe when deterioration is broad across markets and recent momentum observations receive greater emphasis.

13 The Benchmark Problem: What About a Plain Moving Average?

This is the right objection. A new signal must earn its seat at the table. Trend-following and moving-average rules are old, simple, and hard to dismiss. Faber (2007) studies a ten-month moving-average timing model across asset classes. Hurst, Ooi, and Pedersen (2017) document a century of evidence on trend following. If quick-minus-slow cannot beat or complement simple trend filters, it should be treated as a repackaging exercise.

Table 13: S&P 500 Simple Quick-Minus-Slow versus Moving-Average Trend Filters

Rule	State	Obs.	Mean	$P(R \leq -5\%)$	5th pct.
S&P QS	QS ≥ 0	521	1.08%	7.68%	-6.86%
S&P QS	QS < 0	636	0.29%	13.68%	-8.60%
10-month MA	Above trend	782	0.82%	7.03%	-5.87%
10-month MA	Below trend	375	0.29%	19.20%	-10.16%
12-month MA	Above trend	795	0.83%	6.92%	-5.75%
12-month MA	Below trend	362	0.24%	19.89%	-10.15%

Notes: Moving-average filters use the lagged price relative to the lagged moving average. All signals are predetermined with respect to the holding-month return. The moving-average state in this table uses information through month $t-1$, while QS is mechanically determined by the end of month $t-2$.

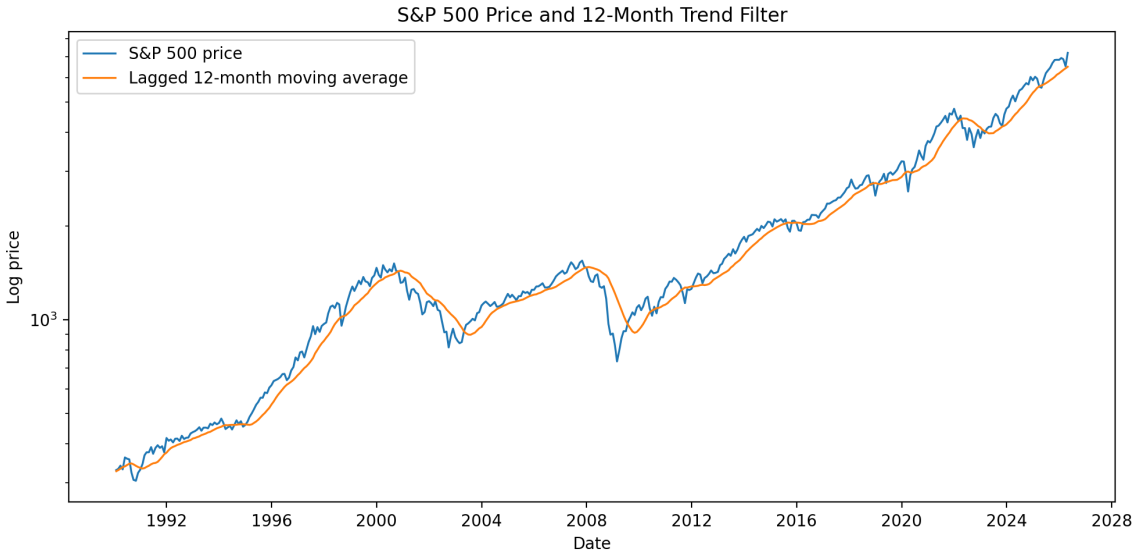

Figure 4: S&P 500 price and lagged 12-month moving average. Moving-average trend filters are natural benchmarks for evaluating whether quick-minus-slow adds information beyond a simple price-level trend rule.

The moving-average filter is a strong left-tail classifier. Below-trend months have roughly a 19% to 20% probability of losing more than 5%, higher than the 13.68% probability associated with merely negative S&P quick-minus-slow. But the comparison is not a defeat for quick-minus-slow. The moving average measures level relative to trend. Quick-minus-slow measures change in momentum relative to momentum trend.

A timing distinction is important. The moving-average benchmark is a strong left-tail classifier, but it is not the same type of signal. A moving-average rule is updated with the most recent price level. In the monthly tests above, the moving-average state uses information through month $t-1$; in daily applications, a 200-day moving average can change with every trading day. By contrast, both simple and weighted quick-minus-slow signals for month t are mechanically determined by the end of month $t-2$, because the underlying 12–1 momentum measure skips month $t-1$.

14 How Early Do the Signals Warn?

The moving-average comparison above evaluates classification strength. It does not fully capture a practical difference between the signals: timing. A 12-month moving-average rule confirms that the price level has already fallen below its trend. By contrast, both the simple and weighted quick-minus-slow signals are determined by the end of month $t-2$ for the month-t holding period. This makes them earlier-determined regime variables.

To measure this timing difference, we define a warning episode as a maximal consecutive block of months in which a signal is active. An episode begins in the first active month after at least one inactive month. It ends in the last active month before the signal becomes

inactive. Thus even a one-month interruption starts a new episode. For QS and WQS, we consider both the negative-spread state and the stricter fragile state. For the moving-average benchmark, the warning state is that the lagged S&P 500 price is below its lagged 12-month moving average.

The table reports warning episodes, not left-tail months. "LT eps." is the number of warning episodes that contain at least one S&P 500 left-tail month, where a left-tail month is defined as $R_t \leq -5\%$. The hit rate is therefore LT episodes/warning episodes. It is not the fraction of all left-tail months captured by the signal. For episodes that contain more than one left-tail month, lead time is measured only to the first left-tail month in that episode.

The timing convention matters. Because the QS and WQS state for month t is known by the end of month $t-2$, we add one month to the episode-based lead time for these signals. For the standard moving-average rule, which uses price information through $t-1$, we do not add this extra month. Thus the lead-time measure asks how early the signal was available before the first left-tail month in that warning episode.

Table 14: Average Warning Lead Time Before S&P 500 Left-Tail Months

Signal	Episodes	LT eps.	Hit rate	Mean lead	Median lead
Simple QS (< 0)	54	29	53.7%	4.14	3.00
Simple fragile	22	11	50.0%	3.09	3.00
Weighted QS (< 0)	69	32	46.4%	4.44	3.00
Weighted fragile	29	14	48.3%	3.00	2.00
12M MA below trend	60	26	43.3%	1.69	0.00

Notes: A warning episode is a maximal consecutive block of active months. LT eps. denotes episodes containing at least one S&P 500 left-tail month, defined as $R_t \leq -5\%$. Hit rate equals LT eps. divided by episodes. QS and WQS lead times include one additional month because month-t signals are known by the end of month $t-2$. The 12M MA rule uses information through month $t-1$.

Table 14 changes the interpretation of the moving-average comparison. The 12-month moving-average rule remains a strong classifier of left-tail states, but it often acts as a confirmation signal. Its median lead time is zero months, meaning that the first left-tail month in many warning episodes occurs in the same holding month in which the below-trend state is first observed.

By contrast, the simple and weighted QS signals tend to warn earlier. The simple QS warning episodes that contain a left-tail month do so after an average lead time of 4.14 months, with a median of 3 months. The weighted QS signal gives a similar average lead time of 4.44 months and a median of 3 months. The stricter fragile states are more selective: they cover fewer warning episodes, but when they do warn, their average lead time is still around three months.

There is a trade-off. Earlier warning does not mean better timing. A signal that warns earlier can also spend more time in a cautious state before a left-tail event arrives, and some

warning episodes never lead to a large loss. The evidence supports a modest conclusion: QS and WQS do not replace moving averages, but they provide earlier, lower-frequency warning states that are useful for risk budgeting and for interpreting whether market weakness is still deteriorating or beginning to repair.

15 Incremental Information: Does Quick-Minus-Slow Add to Moving Averages?

The benchmark comparison above raises the most natural follow-up question: does quick-minus-slow contain information beyond a plain moving-average trend filter? To answer this directly, we estimate simple logit models for monthly S&P 500 left-tail events. The dependent variable equals one if the holding-month S&P 500 price return is less than or equal to -5%:

$$\Pr(R_t \leq -5\%) = \Lambda(a + b_1 X_t + b_2 MA_t),$$

where MA_t is a predetermined indicator that the lagged S&P 500 price is below its lagged moving average.

Table 15: Incremental Logit Tests with Standard Moving-Average Timing

Model	Variable	Coef.	z-stat.	Odds
1	Simple QS (< 0)	0.207	0.93	1.23
1	Below 10M MA, $t-1$	1.060	5.02	2.89
2	Simple QS (< 0)	0.114	0.49	1.12
2	Below 12M MA, $t-1$	1.154	5.28	3.17
3	Simple fragile	0.354	1.44	1.43
3	Below 12M MA, $t-1$	1.086	5.14	2.96
4	Weighted QS (< 0)	-0.029	-0.12	0.97
4	Below 12M MA, $t-1$	1.245	5.61	3.47
5	Weighted fragile	0.309	1.28	1.36
5	Below 12M MA, $t-1$	1.102	5.06	3.01

Notes: The dependent variable equals one when the monthly S&P 500 price return is less than or equal to -5%. The sample contains 1,157 observations from December 1929 to April 2026. The moving-average state uses information through month $t-1$, while QS and WQS are mechanically determined by the end of month $t-2$.

The result is deliberately sobering. Once the moving-average state is included, neither the simple nor weighted QS sign dummy dominates the moving-average classifier. The 10- and 12-month moving-average indicators are stronger binary classifiers of monthly left-tail events.

However, Table 15 gives the moving average one practical advantage: it uses the immediately preceding month. That is a fair way to implement a standard moving-average filter,

but it is not a matched-information-set comparison. Table 16 repeats the same test after forcing the moving-average state to use information only through month $t-2$, the same information cutoff that mechanically determines QS.

Table 16: Incremental Logit Tests with Matched Information Sets

Model	Variable	Coef.	z-stat.	Odds
1	Simple QS (< 0)	0.284	1.24	1.33
1	Below 12M MA, $t-2$	0.731	3.34	2.08
2	Simple fragile	0.506	1.95	1.66
2	Below 12M MA, $t-2$	0.665	3.00	1.94
3	Weighted QS (< 0)	0.189	0.82	1.21
3	Below 12M MA, $t-2$	0.777	3.53	2.18
4	Weighted fragile	0.519	1.95	1.68
4	Below 12M MA, $t-2$	0.603	2.51	1.83

Notes: This table repeats the incremental logit tests after aligning the information set. Both QS and the moving-average state are determined using information no later than month $t-2$. The dependent variable equals one when the monthly S&P 500 price return is less than or equal to -5%.

The matched-information-set test changes the interpretation. The moving-average indicators remain useful, but their coefficients weaken. The simple fragile-state coefficient and the weighted fragile-state coefficient both become more competitive, each with a z-statistic of 1.95 when paired with a 12-month moving-average state computed through $t-2$. This does not overturn the main conclusion: quick-minus-slow still does not replace moving averages. But it does show that the baseline comparison is conservative against QS.

Table 17: S&P 500 Left-Tail Risk: Joint QS and Moving-Average States

Panel	State	Obs.	Mean	$P(R \leq -5\%)$	$P(R \leq -10\%)$	5th pct.
A	QS ≥ 0, above 12-month MA	474	0.97%	6.75%	1.69%	-5.83%
A	QS ≥ 0, below 12-month MA	47	2.22%	17.02%	2.13%	-7.70%
A	QS < 0, above 12-month MA	321	0.63%	7.17%	0.31%	-5.56%
A	QS < 0, below 12-month MA	315	-0.05%	20.32%	6.03%	-10.42%
B	Not fragile, above 12-month MA	762	0.79%	7.22%	0.79%	-5.80%
B	Not fragile, below 12-month MA	231	0.54%	16.45%	4.76%	-8.57%
B	Fragile, above 12-month MA	33	1.73%	0.00%	0.00%	-2.83%
B	Fragile, below 12-month MA	131	-0.28%	25.95%	7.63%	-13.36%

Notes: The moving-average state uses the lagged S&P 500 price relative to its lagged 12-month moving average, using information through month $t-1$. Panel A crosses simple QS sign with the 12-month moving-average state. Panel B crosses the stricter simple fragile state with the same moving-average state.

The more constructive interpretation is that quick-minus-slow is not a replacement for the moving average. It is a different description of market dynamics. A moving average asks whether the price level is below trend. Quick-minus-slow asks whether the market's inter-

mediate momentum is deteriorating or repairing. The joint states should be interpreted with caution because the number of fragile observations is limited.

16 Multiplicity and Inference Discipline

The empirical exercise involves several choices: three markets, several forecast horizons, sign splits, four-state classifications, cross-market counts, moving-average interactions, and two smoothing conventions. This creates a multiple-testing concern. Adding WQS makes the issue more serious, not less serious. The correct response is not to claim that the signal is immune to data mining because it is simple. The correct response is to separate the analysis into primary tests, robustness tests, and exploratory diagnostics.

The primary test in this draft is the S&P 500 left-tail classification associated with the simple QS signal and the simple fragile state. The weighted signal is treated as a robustness check. Cross-market counts, lead-time episodes, moving-average interactions, and longer-horizon forward returns are exploratory or implementation-oriented diagnostics.

Table 18: Inference Hierarchy

Category	Role in the paper
Primary evidence	S&P 500 simple QS and simple fragile-state left-tail probabilities.
Robustness evidence	Weighted QS and weighted fragile-state results using the same 12–1 momentum input.
Implementation evidence	Warning lead time, matched-information-set moving-average tests, and portfolio-style exposure mapping.
Exploratory evidence	Cross-market counts, especially weighted cross-market counts with small cell sizes.

Table 19: Simple Multiplicity Screen for Key S&P 500 Left-Tail Gaps

Comparison	Raw p	Bonferroni p	Interpretation
Simple QS < 0 vs. QS ≥ 0, $R \leq -5\%$	0.001	0.005	Survives
Simple QS < 0 vs. QS ≥ 0, $R \leq -10\%$	0.114	0.684	Suggestive only
Simple fragile vs. healthy, $R \leq -5\%$	< 0.001	< 0.001	Survives
Simple fragile vs. healthy, $R \leq -10\%$	0.007	0.042	Survives
Weighted fragile vs. healthy, $R \leq -5\%$	< 0.001	< 0.001	Survives
Weighted fragile vs. healthy, $R \leq -10\%$	0.005	0.032	Survives

Notes: Raw p-values are based on the approximate large-sample proportion tests in Table 6. Bonferroni p-values multiply the raw p-values by six and truncate at one. This table does not adjust every exploratory statistic in the paper; it only disciplines the main S&P 500 left-tail probability gaps.

The main defense in this draft is therefore not that every table entry is a discovery. It is that the core left-tail pattern appears in the primary S&P 500 test and remains visible

under a weighted smoothing robustness check. A final journal version should pre-specify the primary market, the smoothing convention, the left-tail threshold, the moving-average benchmark, and the out-of-sample evaluation period before testing.

17 Subsamples: Please Do Not Let the 1930s Do All the Work

Table 20: Subsample Robustness: Simple QS

Market	Sample	Obs.	Mean diff	P(-5) if QS<0	P(-5) if QS≥ 0
Dow	Full	1313	-0.75%	12.13%	9.44%
Dow	1950+	916	-0.44%	10.14%	7.02%
Dow	1990+	436	-0.46%	10.00%	8.16%
Nasdaq	Full	639	-0.37%	14.80%	12.34%
Nasdaq	1950+	639	-0.37%	14.80%	12.34%
Nasdaq	1990+	436	-0.38%	17.18%	11.48%
S&P 500	Full	1157	-0.79%	13.68%	7.68%
S&P 500	1950+	916	-0.63%	11.95%	5.07%
S&P 500	1990+	436	-0.54%	13.19%	5.97%

Notes: Mean diff is the mean monthly return after QS<0 minus the mean monthly return after QS≥ 0. P(-5) reports the probability of a monthly return below -5%.

The S&P 500 result does not disappear after 1950 or 1990. The Dow result weakens but remains directionally consistent. The Nasdaq result remains directionally consistent but less sharp on mean returns.

18 The Crisis Episodes: The Signal Is Not a Crystal Ball

Quick-minus-slow is designed to detect trend fragility. It is not designed to predict every sudden shock. The signal does well in many slow-burn market deteriorations: the Great Depression, 2000–2002, the global financial crisis, and parts of 2022. It is less impressive before sudden crashes that occur without much prior trend deterioration. October 1987 is the classic example. A crash driven by portfolio insurance, liquidity, and a sudden break in market microstructure may not be preceded by a negative intermediate momentum spread.

The correct claim is not: "quick-minus-slow predicts crashes." The correct claim is: "quick-minus-slow identifies market states in which the left tail is materially worse." These are not the same claim. The first is too grand. The second is supported by the data.

19 How a Long-Only Momentum Investor Might Use It

The empirical results should not be read as a license for aggressive short-term market timing. A more defensible application is modest exposure control. For a long-only momentum portfolio, the cleanest architecture separates selection from exposure:

Stock selection = cross-sectional momentum among stocks, sectors, or ETFs,

Exposure control = market-level fragility from Dow, Nasdaq, and S&P signals.

Market state	Interpretation	Possible exposure response
Quick > Slow, Slow > 0	Healthy momentum	Full exposure
Quick < Slow, Slow > 0	Decelerating but positive trend	Mild reduction
Quick > Slow, Slow < 0	Repair from weak trend	Partial restoration
Quick < Slow, Slow < 0	Fragile downtrend	Significant reduction
Two or more markets fragile	Broad fragility	Strong risk reduction

For the weighted version, the same mapping can be applied with WQuick and WSlow. The weighted signal may be more responsive to recent deterioration, while the simple signal may be more stable. A conservative implementation could require both the simple and weighted signals to indicate fragility before making large exposure changes.

20 Limitations and Acknowledged Caveats

Several caveats matter before treating these results as a finished research product.

First, the workbooks use price indices rather than total-return indices. For monthly crash classification, dividends are unlikely to overturn the main left-tail results, but a final strategy or asset-allocation paper should replicate the analysis with total-return data.

Second, moving-average trend filters are very hard to beat as binary left-tail classifiers, especially when the moving average is allowed to use information through month $t-1$. The quick-minus-slow signal has its strongest contribution as an early-determined state variable that distinguishes deterioration from repair, not as a standalone replacement for a moving average.

Third, the weighted signal is a natural robustness check, but it is still an additional specification. The weighted results should be interpreted as supporting evidence, not as a separately optimized discovery. The weighted cross-market count is also non-monotonic: the two-market weighted-fragile state is less dangerous than the one-market state in this sample. This is most likely small-sample noise, since the two-market cell has only 28 observations, and it should not be over-interpreted.

Fourth, the cross-market sample is short because the Nasdaq begins in 1971. The three-market evidence is useful for modern robustness, not for a century-long historical claim.

Fifth, the slow-moving nature of the signal is both a feature and a limitation. It is designed to classify deteriorating trend structures, not to forecast every abrupt market decline.

Sixth, the paper does not yet test whether the signal improves an actual long-only momentum portfolio after cash returns, transaction costs, volatility scaling, and turnover are included.

21 Conclusion: When the Market Stops Making Excuses

This paper studies simple and weighted market fragility signals across the Dow, Nasdaq, and S&P 500. Both signals begin with conventional 12–1 momentum, smooth it into quick and slow lines, and study the spread between them. Because the signals are constructed from lagged information and are known by the end of month $t-2$, they can be interpreted as early-determined risk-state variables.

The evidence is strongest for the S&P 500. The simple fragile state has a 20.73% probability of losing more than 5% in a month, compared with 6.82% in the healthiest state. The weighted version produces a similar conclusion: the weighted fragile state has a 20.41% probability of a monthly loss worse than -5%. Cross-market confirmation strengthens the interpretation, especially under the weighted fragile count, where all three markets being fragile is associated with a 26.53% monthly probability of an S&P 500 loss worse than -5%, though that estimate is imprecise.

The evidence does not support a miracle claim. The signal does not forecast every crash. It is weaker for sudden shocks and stronger for trend deterioration. It also does not replace simple moving-average filters. Moving averages are stronger standalone price-level trend classifiers in the baseline tests. However, the episode-based timing evidence shows a different advantage: QS and WQS warning states tend to begin earlier before left-tail months, while the moving average often acts more like a price-level confirmation signal. The more defensible conclusion is that the two signals answer different questions: moving averages confirm price-level trend weakness, while QS identifies momentum-structure deterioration before the immediately preceding month is observed.

The next step is to move from classification to portfolio implementation: total-return data, cash returns, realistic transaction costs, volatility scaling, joint signal rules, and out-of-sample exposure rules. Until then, the right conclusion is modest but meaningful. When winners stop winning, the left tail gets fatter.

The authors used large language model assistance for language editing, organization, and prose refinement. All data collection, empirical analysis, research design, and academic judgments are the authors' own.

A Appendix A: Exact Signal Timing

At the end of month $t-2$, the investor already has all information required to compute the 12–1 momentum value used for the month-t signal. The signal is therefore known before month $t-1$ begins and remains fixed until it is used for the month-t holding period. In the empirical tests, we describe the signal as being observed at the beginning of month t because that is the point at which the holding-month exposure is set. This is a conservative timing convention: the signal uses neither the month-t return nor the month-$t-1$ return.

1. End of month $t-2$: observe prices through P_{t-2} and compute MOM_t, Quick_t, Slow_t, WQuick_t, WSlow_t, QS_t^{SMA}, and QS_t^{WMA}.
2. Month $t-1$: the signal intended for month t is already fixed.
3. Beginning of month t: set risk exposure for month t using the predetermined signal.
4. End of month t: observe R_t and strategy return.

B Appendix B: Planned Extensions and Publication Checklist

1. Replicate the full analysis with total-return data, using CRSP value-weighted market returns or official total-return indices.
2. Report parameter sensitivity for quick windows of 2, 3, 4, and 6 months and slow windows of 9, 12, and 18 months.
3. Report robustness to alternative weighting schemes, including exponential weighting and linearly weighted moving averages with different decay speeds.
4. Extend the left-tail regressions with interaction terms between QS states, moving-average states, realized volatility, and cross-market breadth.
5. Test pre-specified long-only momentum portfolios with and without exposure scaling, including cash returns and realistic transaction costs.
6. Use expanding-window thresholds and out-of-sample exposure rules rather than full-sample thresholds.
7. Report multiplicity-adjusted evidence, including Bonferroni-style familywise checks and false-discovery-rate diagnostics.
8. Report Newey-West robustness using alternative bandwidth choices, including data-driven bandwidth selection.
9. Validate the warning-episode lead-time results out of sample, including alternative definitions of episode termination and left-tail thresholds.

C Appendix C: Bibliographic Notes

This draft is written in a more conversational style than a standard journal article. That is intentional. The style is inspired by market essays that mix arithmetic and rhetoric, most notably Asness (2000). The empirical claims, however, should stand or fall on the tables.

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