

RESEARCH INSIGHT

When markets move together, shocks travel further

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Executive summary



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Large market shocks propagate strongly when common-factor dominance is already high.

Key findings

- Larger shocks are followed by greater cross-market propagation.
- Shock sensitivity rises substantially as pre-shock commonality increases.
- The state-dependent effect becomes more pronounced for larger shocks.

Key metrics

Daily shock events	1,109
Main interaction	1.48
HAC p-value	0.012
Positive robustness tests:	11/11
Period	2010–2026

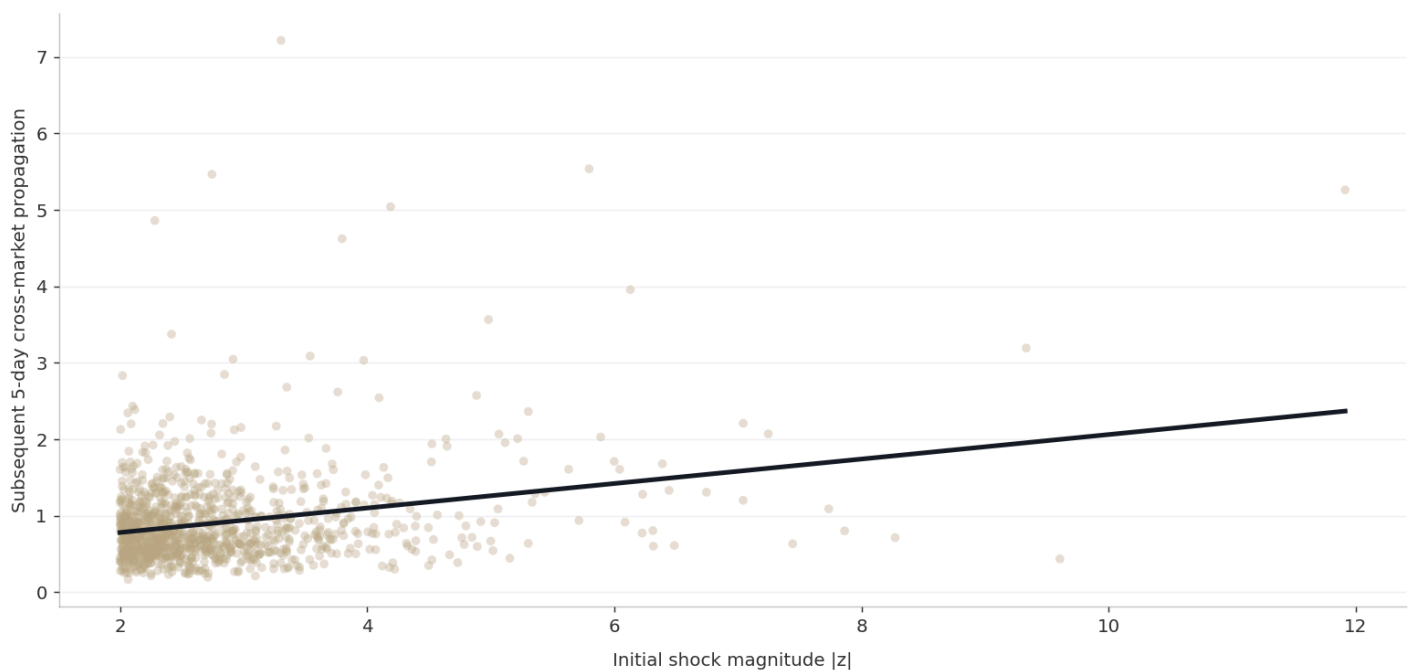
Why it matters

The size of a market move does not determine its consequences alone. The same increase in shock magnitude is associated with greater propagation when markets are already dominated by a common factor.

Larger shocks are followed by greater market propagation

Larger shocks are followed by greater market propagation

Across 1,109 daily shock events, larger initial moves are associated with stronger cross-market propagation over the following five trading days



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Source: Yahoo Finance via yfinance. Author analysis — Laura Brennan

Figure 1. Initial shock magnitude and subsequent five-day cross-market propagation across 1,109 daily shock events.

Larger market shocks are associated with stronger subsequent propagation across the wider system. Across 1,109 daily shock events, the relationship is positive despite substantial dispersion in outcomes. Smaller shocks are usually followed by relatively contained cross-market responses, while the largest events are associated with much wider variation and a higher average level of propagation. Shock magnitude therefore matters, but it does not explain the full response on its own.

Shock sensitivity rises sharply when markets already move together

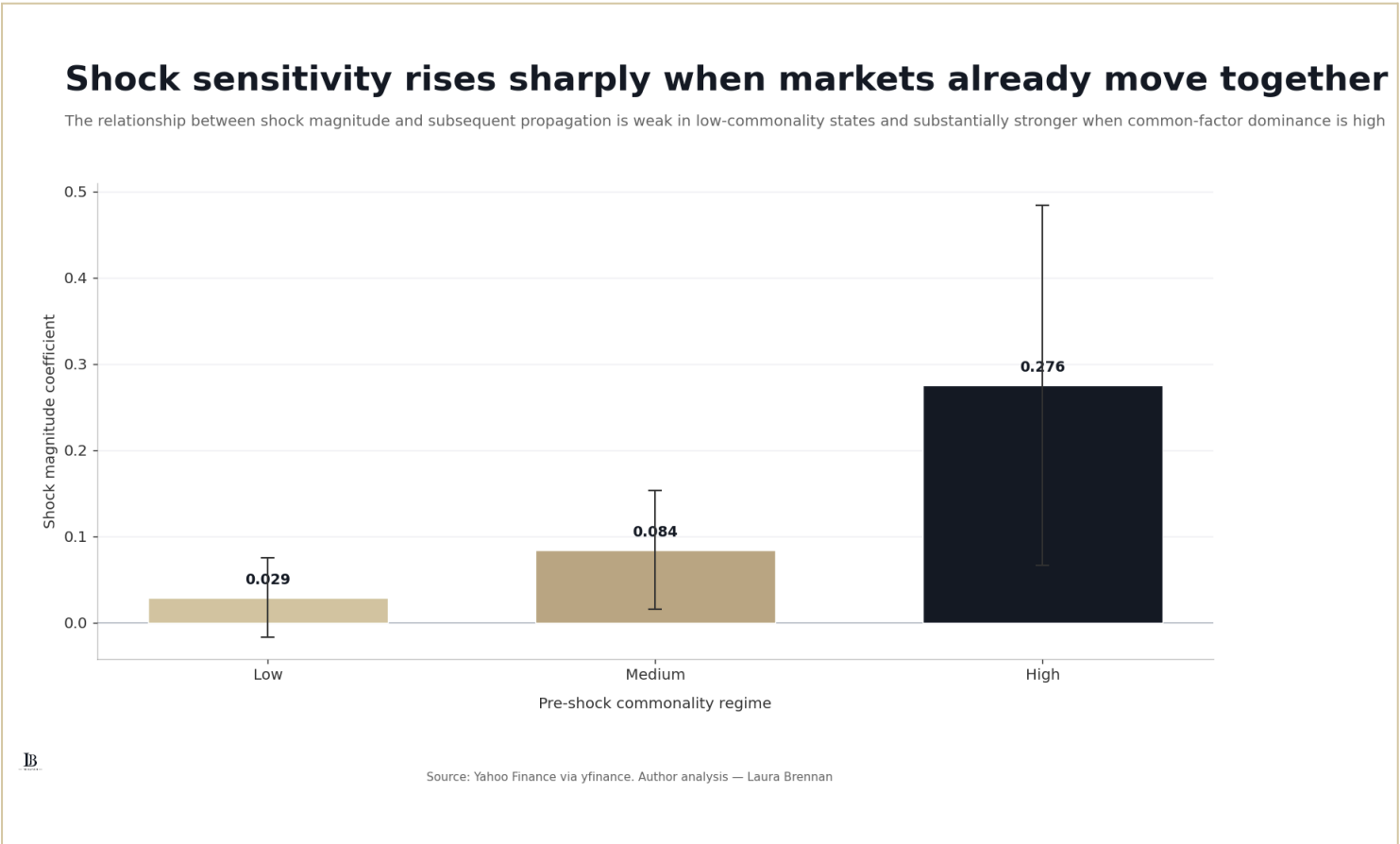


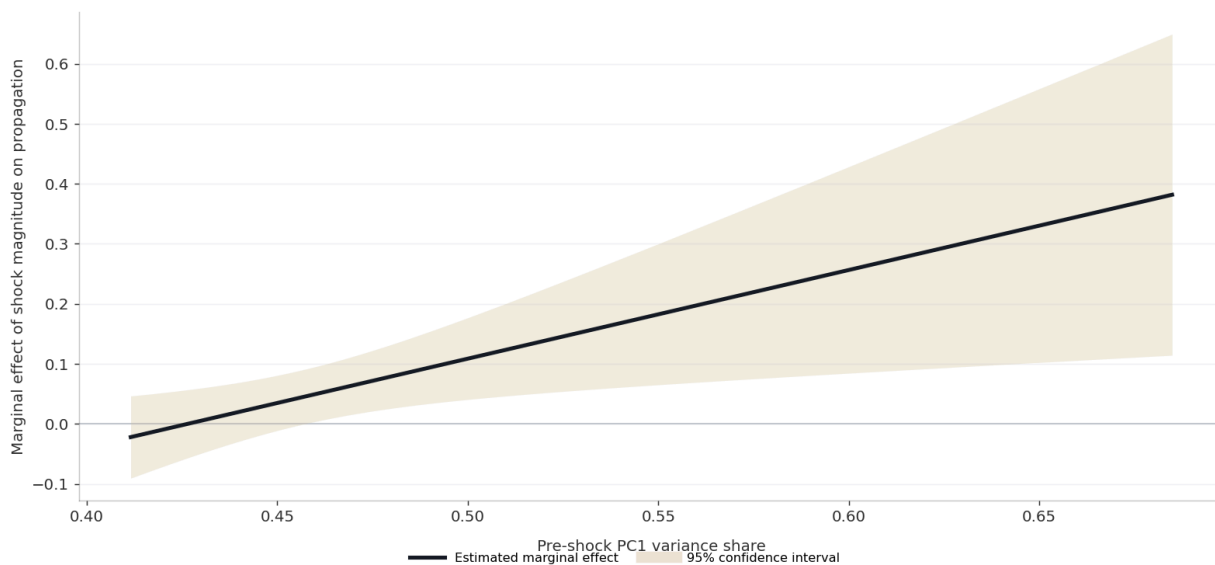
Figure 2. Shock magnitude coefficients across low, medium and high pre-shock commonality regimes.

The effect of shock magnitude changes materially with the market state. In low-commonality periods, the estimated coefficient is just 0.029 and is not statistically distinguishable from zero. It rises to 0.084 in the medium state and to 0.276 when pre-shock commonality is high. The result suggests that larger market moves become much more consequential when common-factor dominance is already elevated. Market structure therefore changes how strongly an initial shock translates into subsequent cross-market propagation.

The propagation effect of a shock strengthens as commonality rises

The propagation effect of a shock strengthens as commonality rises

The estimated sensitivity of subsequent propagation to shock magnitude increases continuously as a larger share of market variation is concentrated in the first principal component



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Source: Yahoo Finance via yfinance. Author analysis — Laura Brennan

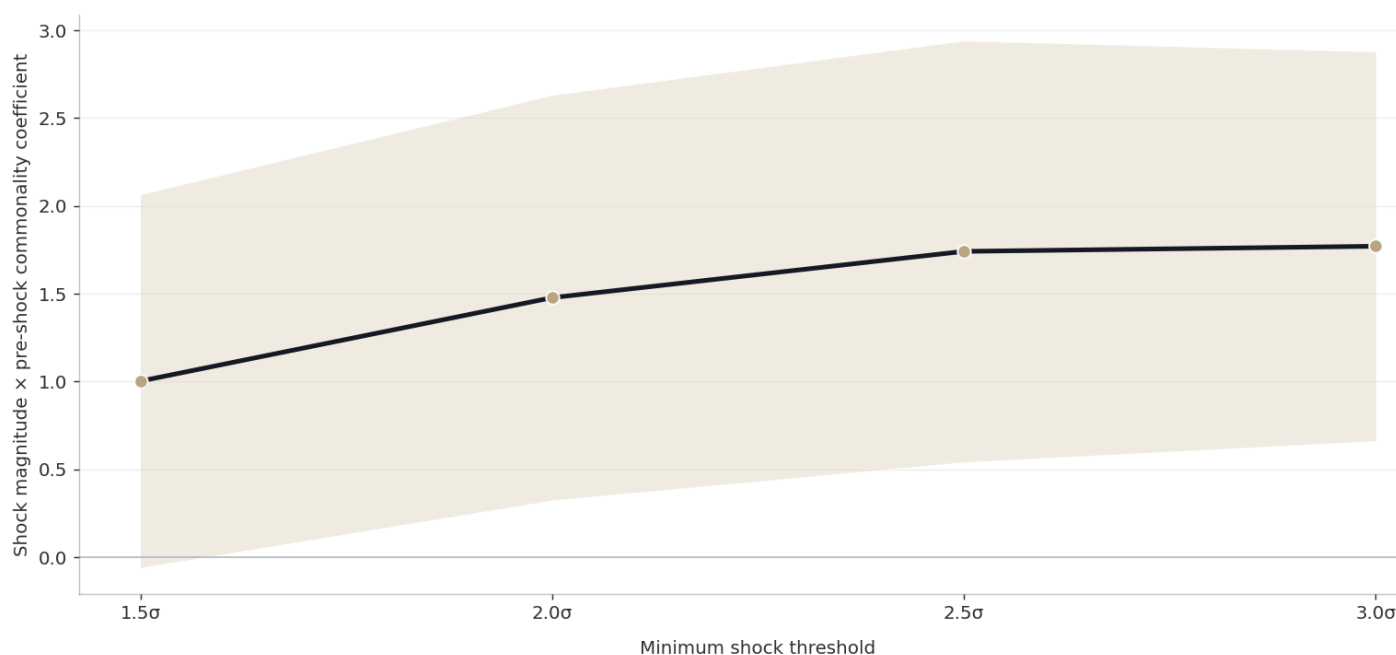
Figure 3. Estimated marginal effect of shock magnitude on subsequent propagation across pre-shock PC1 variance share.

The effect of shock magnitude increases steadily as pre-shock commonality rises. At lower levels of PC1 variance share, the estimated marginal effect is close to zero and the confidence interval includes no effect. As common-factor dominance increases, the relationship strengthens and becomes more clearly positive. By higher-commonality states, an additional increase in shock magnitude is associated with substantially greater subsequent propagation. The result reinforces the regime evidence. Market structure changes how strongly a shock travels through the wider system.

Structural state matters more as shocks become larger

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The interaction between shock magnitude and pre-shock commonality strengthens as the event threshold rises from 1.5σ to 3.0σ



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Source: Yahoo Finance via yfinance. Author analysis — Laura Brennan

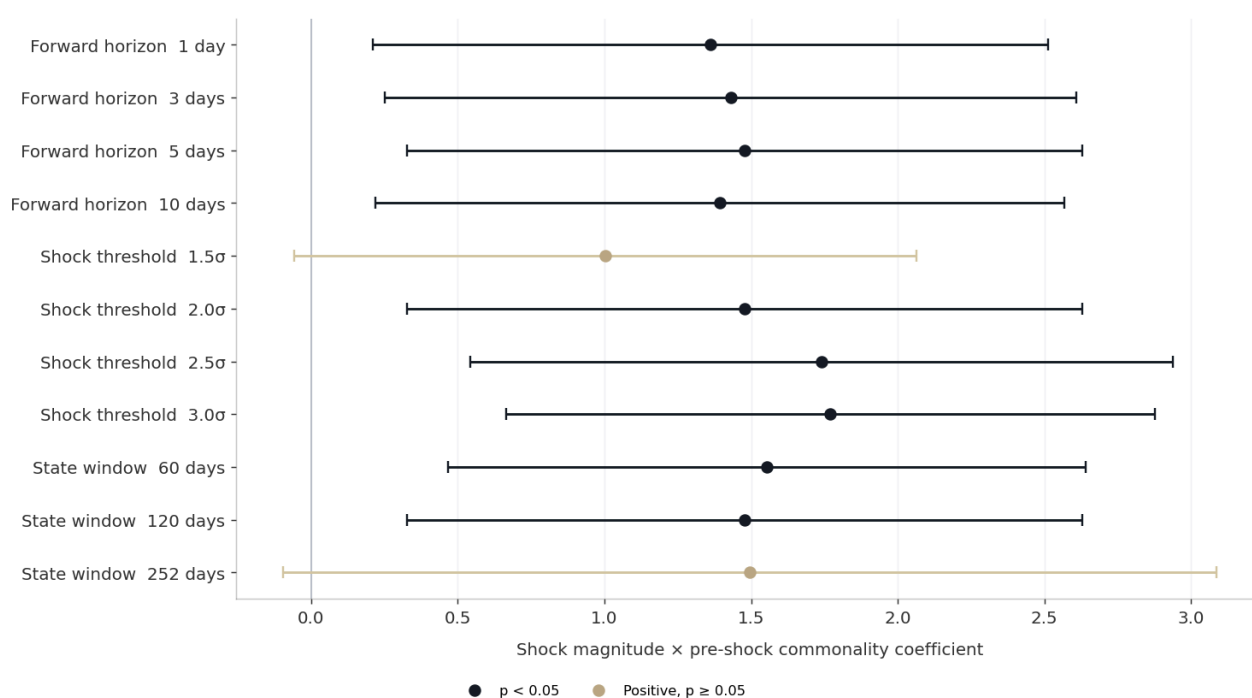
Figure 4. Estimated shock magnitude $\times$ pre-shock commonality interaction across alternative shock thresholds.

The role of market structure becomes more pronounced as larger shocks are isolated. The estimated interaction rises from 1.00 at a 1.5σ threshold to 1.48 at 2.0σ , 1.74 at 2.5σ and 1.77 at 3.0σ . The increase is strongest between the lower thresholds before flattening at the most severe events. This suggests that pre-shock commonality becomes increasingly important as the initial disturbance grows. For larger market moves, the structure already in place plays a greater role in determining how strongly the shock propagates.

The state-dependent shock effect is robust across specifications

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The interaction remains positive in all 11 tests and statistically significant at the 5% level in 9 of 11



Source: Yahoo Finance via yfinance. Author analysis — Laura Brennan

Figure 5. Estimated shock magnitude × pre-shock commonality interaction across alternative horizons, shock thresholds and state windows.

The state-dependent effect remains positive across all 11 alternative specifications. Nine estimates are statistically significant at the 5% level, including every forward-horizon test and the 2.0σ, 2.5σ and 3.0σ shock thresholds. The two weaker results, at a 1.5σ threshold and a 252-day state window, remain positive but are estimated less precisely. The consistency of the coefficient across horizons, thresholds and state definitions suggests that the relationship is not driven by a single modelling choice. Pre-shock commonality repeatedly conditions how strongly larger shocks propagate through the wider market.

Methodology

Data

Sample period

04 January 2010–25 August 2026

Universe

Cross-market instruments represented by liquid ETFs:

- SPY S&P 500
- QQQ NASDAQ
- IWM Russell 2000
- HYG High yield credit
- LQD Investment grade credit
- TLT U.S. Treasuries
- GLD Gold
- UUP U.S. dollar
- XLF Financials
- XLK Technology
- XLE Energy

Data source

Yahoo Finance, accessed through yfinance.

Measures

Shock identification

Daily log returns are standardised using trailing 60-day volatility, lagged by one trading day.

A shock event is identified when the largest absolute standardised move across the market universe exceeds **2.0σ** .

Only the largest shock on each trading day is retained.

The base specification contains **1,109 daily shock events**.

Pre-shock market state

Market commonality is measured over the preceding **120 trading days**.

Returns are standardised within each window before principal component analysis.

The first principal component variance share, **PC1**, measures the proportion of cross-market variation explained by the dominant common factor.

Higher PC1 variance share indicates greater pre-shock commonality.

Propagation measure

Subsequent propagation is measured across all instruments other than the shock origin.

For each event, cumulative absolute returns over the following **five trading days** are standardised by pre-shock volatility and adjusted for the forward horizon.

The event-level propagation measure is the mean standardised response across the remaining markets.

Estimation

The main specification is:

Propagation = Shock magnitude + Pre-shock commonality + Shock magnitude × Pre-shock commonality

Inference uses heteroscedasticity and autocorrelation consistent standard errors with **10 lags**.

The interaction term measures whether the effect of shock magnitude changes with the market state already in place.

Robustness

The interaction is re-estimated across:

- Forward horizons of 1, 3, 5 and 10 trading days
- Shock thresholds of 1.5σ , 2.0σ , 2.5σ and 3.0σ
- Pre-shock state windows of 60, 120 and 252 trading days

The estimated interaction remains positive in **11 of 11** specifications and statistically significant at the 5% level in **9 of 11**.

Research workflow

Step	Description
Data	Daily adjusted prices across the 11-market universe
Returns	Daily logarithmic returns
Volatility scaling	60-day trailing volatility, lagged one trading day
Shock standardisation	Daily return divided by lagged trailing volatility
Shock selection	Largest absolute standardised move across markets each day
Primary event	Daily shock exceeding 2.0σ
Pre-shock state	First principal component variance share
State window	120 trading days before each shock
Propagation horizon	Five trading days after the shock
Propagation measure	Mean standardised cumulative response across all non-origin markets

Interpretation

Higher PC1 variance share indicates that cross-market returns are increasingly dominated by a common factor. A positive shock magnitude $\times$ commonality interaction therefore indicates that larger shocks are associated with stronger subsequent propagation when the market is already more structurally compressed.

Research implications

The evidence presented in this report shows that the consequences of a market shock depend on the structure already in place before it arrives.

Key observations

- Larger shocks are followed by greater cross-market propagation.
- Shock sensitivity is weak when pre-shock commonality is low.
- The effect strengthens materially as common-factor dominance rises.
- High-commonality states produce substantially larger shock coefficients than low-commonality states.
- The role of market structure becomes more pronounced as increasingly large shocks are isolated.
- The state-dependent interaction remains positive across all 11 robustness specifications.
- Nine of the 11 alternative specifications are statistically significant at the 5% level.

Together, these results suggest that shock magnitude should not be interpreted independently of market structure. A large move entering a relatively independent system does not carry the same implications as a similar move entering a market already dominated by a common factor. Pre-shock commonality provides information about how strongly an initial disturbance may propagate across the wider system.

References

Data

Yahoo Finance, accessed through yfinance.

Market universe: SPY, QQQ, IWM, HYG, LQD, TLT, GLD, UUP, XLF, XLK and XLE.

Data through 25 August 2026.

Methodology

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Pearson, K. (1901). "On lines and planes of closest fit to systems of points in space." *Philosophical Magazine*, 2(11), 559–572.

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Software

Python, pandas, NumPy, scikit-learn, statsmodels, matplotlib and yfinance.

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