

RESEARCH INSIGHT

Markets Share Volatility Differently Under Stress

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Executive summary



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Cross-market volatility coupling rises around major stress events, but not equally across relationships or horizons.

Key findings

- SPY-QQQ is already highly coupled in normal conditions.
- QQQ-EEM and SPY-EEM show the largest stress-driven increases.
- The effect is strongest over 20-30 trading days.

Key metrics

SPY-QQQ coupling	0.72
SPY-EEM coupling	0.59
QQQ-EEM stress increase	+0.22
SPY-EEM stress increase	+0.21
Strongest horizon	20-30 days

Why it matters

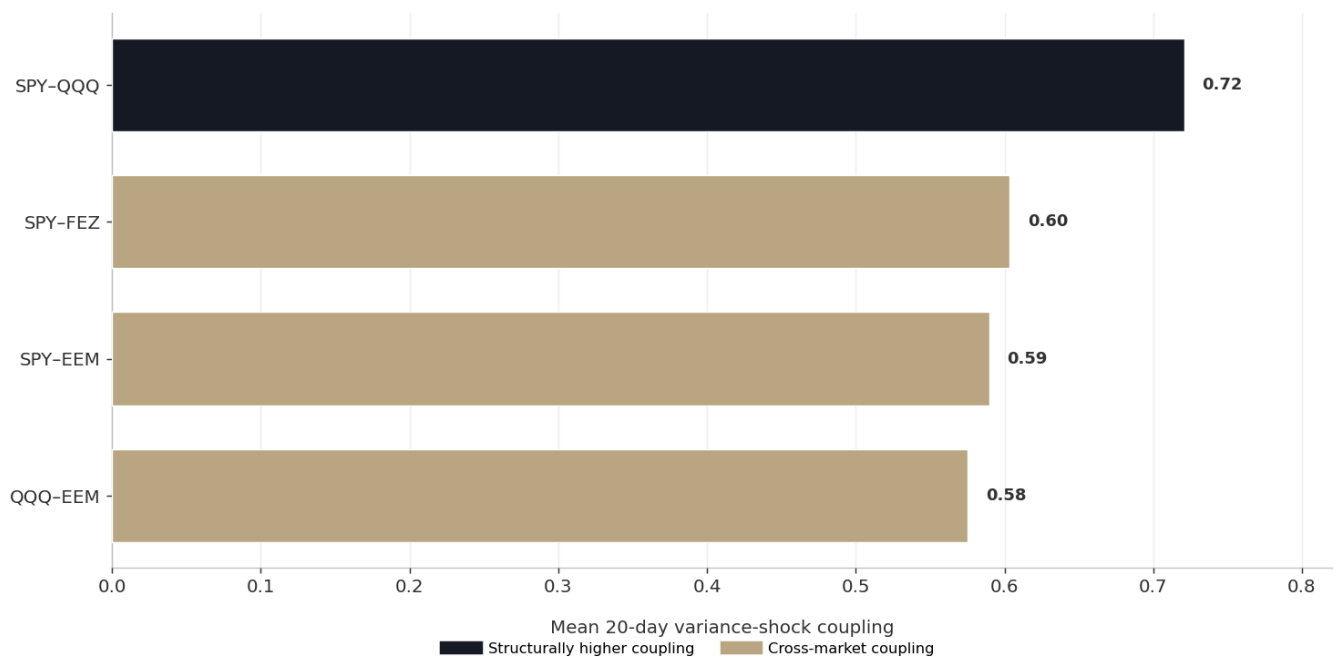
Some volatility coupling is structural. Other relationships tighten only when stress arrives. That means weaker cross-market relationships can converge quickly when markets come under pressure.

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Some volatility coupling is already structural

Volatility coupling is not constant across markets

SPY and QQQ share the strongest average variance shocks, while cross-market equity exposures remain materially less coupled



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

Figure 1. Mean 20-day variance-shock coupling across market pairs.

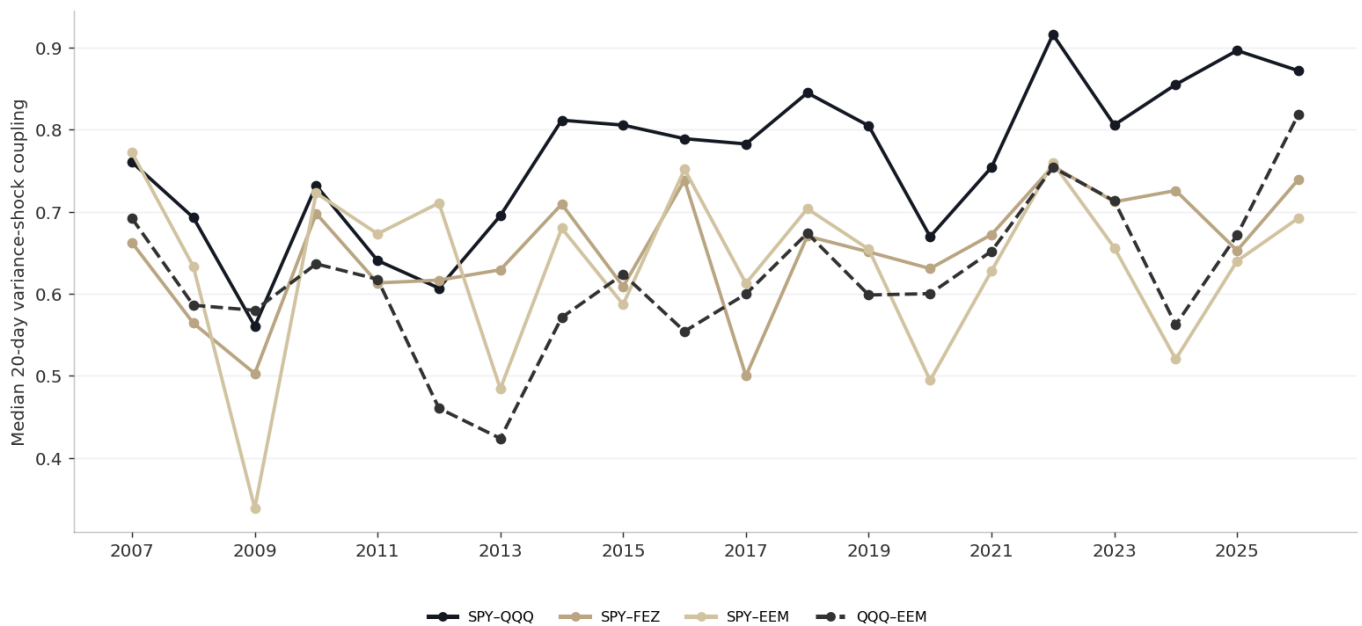
SPY-QQQ has the highest average variance-shock coupling at **0.72**, ahead of **SPY-FEZ (0.60)**, **SPY-EEM (0.59)** and **QQQ-EEM (0.58)**. Some relationships are therefore more tightly coupled even before stress arrives.

That matters because it shows that volatility coupling is not purely a crisis effect. Some of it is already structural. Stress may intensify these links, but it does not begin from the same baseline in every market pair.

Coupling changes through time

Structural and cross-market coupling evolve differently

SPY-QQQ remains comparatively elevated across most years, while international relationships move through larger regime shifts



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

Figure 2. Annual median 20-day variance-shock coupling across market pairs.

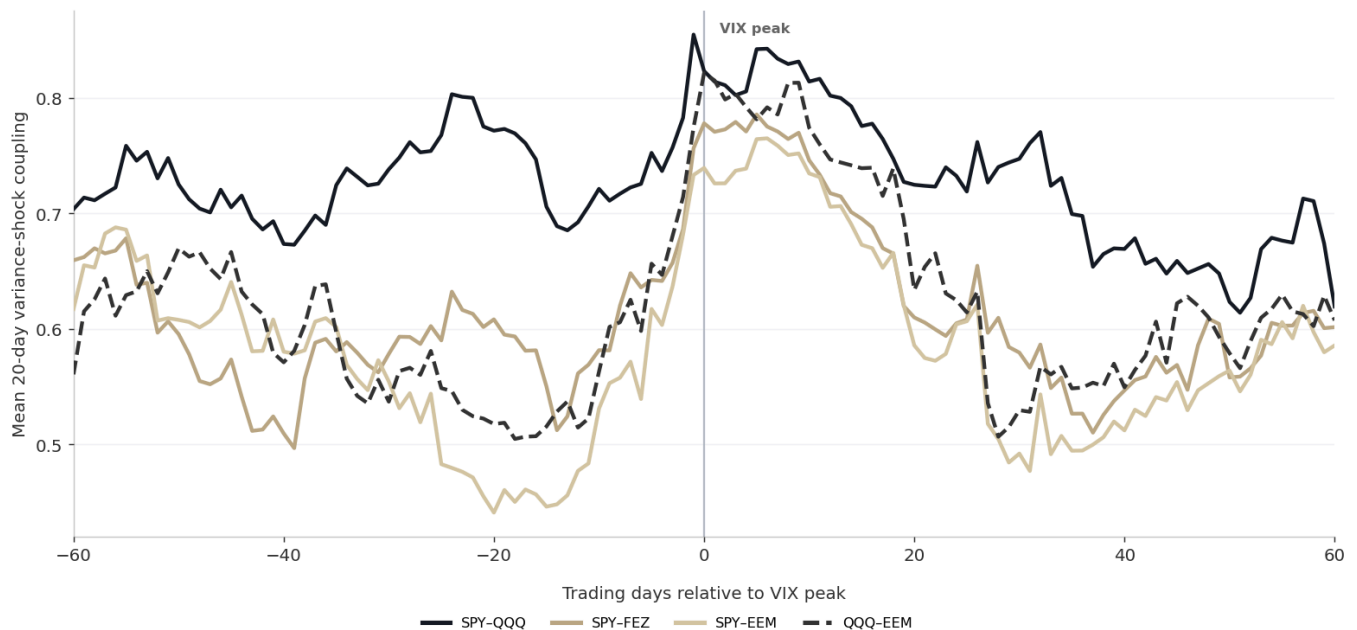
SPY-QQQ remains comparatively elevated across most of the sample, while the international pairs move through larger shifts. The gap therefore changes through time rather than remaining fixed.

Cross-market coupling can strengthen materially in some periods and weaken again in others. **The relationships are persistent, but their intensity is state-dependent.**

Stress pulls volatility shocks together

Volatility coupling rises around major stress peaks

Cross-market variance shocks converge sharply around major VIX events, then separate again as the stress episode passes



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

Figure 3. Mean 20-day variance-shock coupling around major VIX stress peaks.

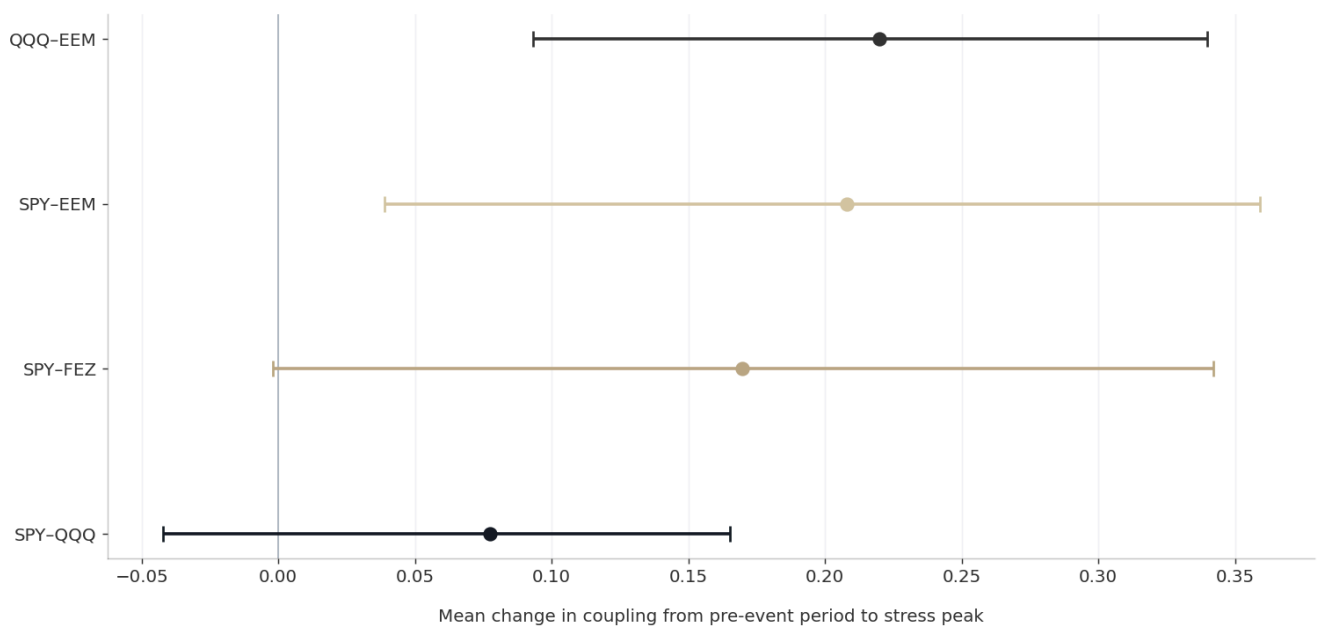
Cross-market volatility coupling rises sharply around major stress events. All four pairs move higher as the VIX approaches its peak, then separate again as the episode passes.

The response is not identical across relationships. **SPY-QQQ** remains the most tightly coupled throughout, but the cross-market pairs also converge materially around the stress peak. **Stress does not affect volatility in isolation. It increases the extent to which volatility shocks become shared.**

Stress adds the most where coupling starts lower

Stress adds more coupling to cross-market relationships

The average stress response is largest for US-emerging-market pairs, while already-coupled SPY-QQQ shows a smaller incremental change



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

Figure 4. Mean change in 20-day variance-shock coupling from the pre-event period to major stress peaks.

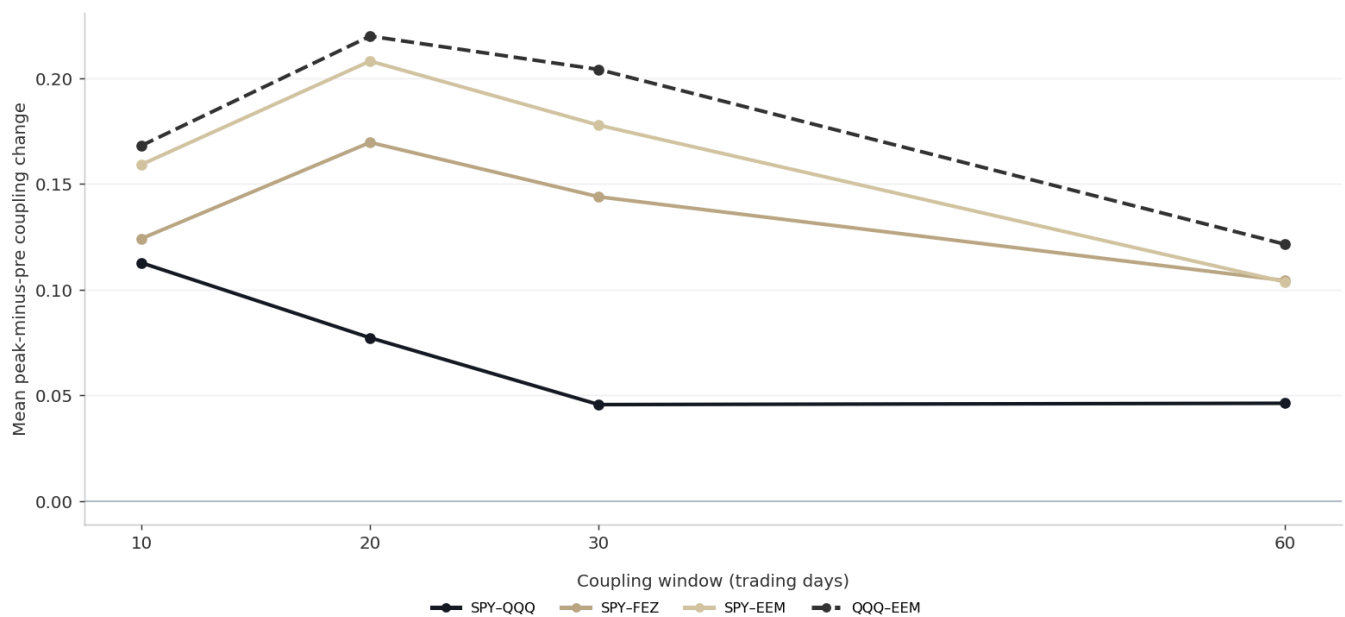
The largest average increases occur in the cross-market pairs. **QQQ-EEM rises by 0.22** and **SPY-EEM by 0.21**, compared with only **0.08 for SPY-QQQ**.

The confidence intervals are wider for some pairs, but the contrast is clear. **Stress has less incremental effect where coupling is already structurally high. The key distinction is between how volatile markets are and whether their volatility shocks are becoming shared.**

The stress effect fades with the horizon

Stress-induced coupling is strongest at shorter horizons

Cross-market coupling rises most over 20-30 trading days and weakens as the measurement horizon lengthens



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

Figure 5. Mean change in variance-shock coupling across 10-, 20-, 30- and 60-day windows.

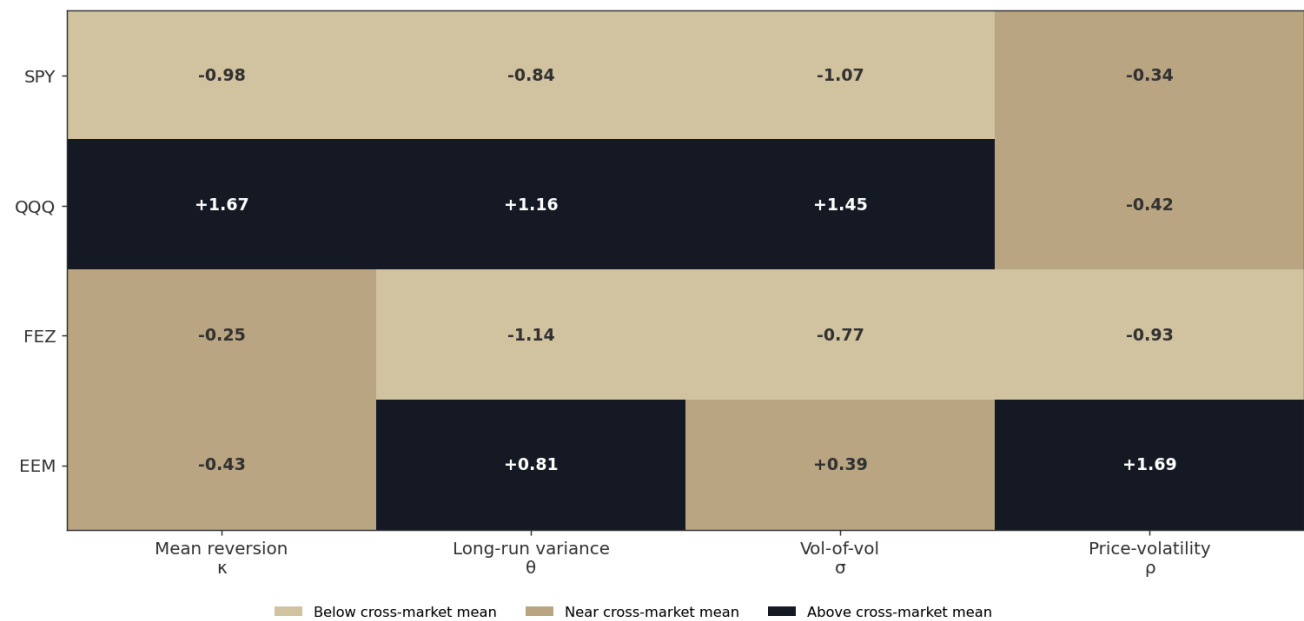
The stress response is strongest over **20-30 trading days** for the cross-market pairs. By 60 days, the increase is materially smaller.

SPY-QQQ behaves differently. Its incremental response falls quickly because coupling is already structurally high. **Stress-induced coupling is therefore strongest at shorter horizons and weakens as the measurement window lengthens.**

Similar volatility does not mean shared shocks

Standalone volatility dynamics do not explain shared coupling

SPY and FEZ share several similar univariate volatility characteristics, yet SPY-QQQ remains the more persistently coupled relationship



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

Figure 6. Standardised Heston-style volatility parameters across SPY, QQQ, FEZ and EEM.

The standalone volatility profiles do not map neatly onto the coupling results. **SPY and FEZ are relatively similar across several parameters**, yet SPY-QQQ remains the more persistently coupled relationship.

QQQ also differs materially in mean reversion, long-run variance and vol-of-vol, while EEM stands apart on price-volatility correlation. **Shared variance shocks therefore cannot be inferred from univariate volatility dynamics alone.**

Methodology

Data

Sample period

03 January 2007-24 September 2026

Universe

Five liquid equity-market exposures:

- SPY — S&P 500
- QQQ — Nasdaq 100
- FEZ — Euro Stoxx 50
- EWJ — Japan
- EEM — Emerging Markets

VIX is used as the external market-stress reference.

Data source

Yahoo Finance, accessed through yfinance.

Daily open, high, low and close prices are used to construct volatility measures. Incomplete current-day observations are excluded.

Volatility measure

Daily variance is estimated using the **Garman-Klass OHLC estimator**.

Close-to-close and Parkinson variance are retained as robustness checks.

Heston-style variance dynamics

For each market, the variance process is estimated in Heston-style form using:

- mean reversion κ
- long-run variance θ
- vol-of-vol σ
- price-volatility correlation ρ

Standardised variance innovations are then extracted from the fitted variance process.

Cross-market coupling

Pairwise variance-shock coupling is measured as the rolling correlation between standardised variance innovations.

Core pairs:

- SPY-QQQ
- SPY-FEZ
- SPY-EEM
- QQQ-EEM

The main specification uses a **20-trading-day window**, with 10-, 30- and 60-day windows used for robustness.

Stress events

Major stress events are identified from local VIX peaks above the 95th percentile.

Events are separated by at least **120 trading days** to reduce overlap.

Coupling is compared before, around and after each stress peak, with **event-level bootstrap intervals** used to assess uncertainty.

Research workflow

Step	Description
Data	Daily OHLC prices for SPY, QQQ, FEZ, EWJ and EEM
Stress reference	Daily VIX close
Volatility measure	Garman-Klass daily variance
Robustness measures	Close-to-close and Parkinson variance
Variance model	Heston-style mean-reverting variance process
Parameters	κ , θ , σ and ρ
Variance shocks	Standardised innovations from fitted variance dynamics
Coupling measure	Rolling correlation of standardised variance shocks
Core window	20 trading days
Robustness windows	10, 30 and 60 trading days
Market pairs	SPY-QQQ, SPY-FEZ, SPY-EEM and QQQ-EEM
Stress events	Local VIX peaks above the 95th percentile
Event separation	Minimum 120 trading days between stress peaks
Event comparison	Pre-event, peak and post-event coupling
Uncertainty	Event-level bootstrap intervals

Interpretation

Higher variance-shock coupling means that volatility innovations are moving more closely together across markets.

The measure captures **shared volatility shocks**, not simply high volatility. A pair can be volatile without being tightly coupled, and tightly coupled without having identical standalone volatility dynamics.

The event study compares coupling around separated VIX stress peaks. The results therefore describe how cross-market relationships change around major stress episodes.

The results should be read as structural and event-based associations, not as estimates of a causal transmission path.

Research implications

The evidence in this report shows that volatility coupling is both structural and stress-dependent.

Key observations

- SPY-QQQ has the highest average 20-day variance-shock coupling at **0.72**.
- Cross-market pairs begin from lower coupling levels of around **0.58-0.60**.
- Coupling rises sharply around major VIX stress peaks.
- The largest average increases occur in **QQQ-EEM (+0.22)** and **SPY-EEM (+0.21)**.
- The stress effect is strongest over **20-30 trading days** and weakens at longer horizons.
- Standalone Heston-style volatility parameters do not map directly onto shared variance-shock coupling.

Together, these results suggest that market stress does not affect every relationship in the same way. Some pairs already share volatility shocks in normal conditions, while others become substantially more coupled only when stress arrives.

That distinction matters for cross-market risk. A relationship that appears relatively weak in calmer conditions can tighten quickly around major stress events.

Volatility should therefore be read alongside the extent to which volatility shocks are becoming shared across markets.

References

Data

Yahoo Finance, accessed through yfinance.

SPY, QQQ, FEZ, EWJ, EEM and CBOE Volatility Index (VIX).

Data through **24 September 2026**.

Methodology

Heston, S. L. (1993). "A closed-form solution for options with stochastic volatility with applications to bond and currency options." *Review of Financial Studies*, 6(2), 327-343.

Garman, M. B. and Klass, M. J. (1980). "On the estimation of security price volatilities from historical data." *Journal of Business*, 53(1), 67-78.

Parkinson, M. (1980). "The extreme value method for estimating the variance of the rate of return." *Journal of Business*, 53(1), 61-65.

Li, J.-C., Guo, J., Ma, R. and Zhong, G. (2025). "Dynamic forecasting and mechanisms of volatility synchronization in complex financial systems." *PLOS ONE*, 20(10), e0334853.

Hansen, P. R. and Lunde, A. (2005). "A forecast comparison of volatility models: does anything beat a GARCH(1,1)?" *Journal of Applied Econometrics*, 20(7), 873-889.

Software

Python, pandas, NumPy, SciPy, matplotlib and yfinance.

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