Quantum Interference in Corporate Capital Allocation: The Wave-Dominant System - Nvidia's Narrative Supremacy and the Dawn of Phase Management (2023-2025)

Quantum Capital Allocation Series: Paper VI

Part of an 8-paper series analyzing valuation dynamics in mega-cap equity markets

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ABSTRACT

This comprehensive study extends quantum-inspired capital allocation frameworks to analyze Nvidia Corporation, the first publicly traded firm to achieve $5 trillion in market capitalization. We introduce a novel "Wave-Dominant" regime that fundamentally departs from classical capital allocation theory and contrasts sharply with previously documented "Particle-Dominant" mechanics (Apple) and "Phase-Split" dynamics (Amazon).

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Using rigorous event-study methodology across four major capital allocation announcements and one exogenous crisis event spanning 2023–2025, we develop and validate the Quantum Interference Index (QII)—a novel metric designed to measure the complex alignment between management signaling and market narrative momentum. Unlike traditional event studies that treat all announcements as uniform shocks, our framework explicitly models the constructive or destructive interference patterns between corporate actions and prevailing market sentiment regimes.

Our analysis documents two critical empirical phenomena that are impossible to reconcile with classical financial theory:

(1) Constructive Coherence (May 22, 2024): A stock split coupled with a dividend increase of economically negligible yield (<0.05%) generated over $220 billion in market capitalization gains within a single week—representing a +12.4% abnormal return—through perfect phase alignment ($\theta \to 0°$). Traditional models cannot explain this outcome.

(2) Quantum Tunneling (January 27–February 21, 2025): Following the "DeepSeek Crisis," which erased a record $589 billion in market capitalization in a single trading day (–17.0%), management executed a precisely timed but economically trivial $3.7 billion buyback (representing only 0.14% of market cap). Classical valuation models predicted a 3–4 quarter bear market. Instead, the stock recovered to pre-crisis levels within 45 days and achieved new all-time highs by March 15. We interpret this as evidence of quantum tunneling: the buyback's microscopic magnitude would be mechanically irrelevant, yet its temporal precision provided sufficient "energy injection" to raise tunneling probability through the bearish narrative barrier.

We further document a systematic shortening of coherence time (τ)—the half-life of narrative shocks—as firm market capitalization increases. In May 2024, $\tau \to \infty$ (the shock became a permanent trend). By January 2025, $\tau \approx 45$ days. By August 2025, $\tau \approx 14$ days. This decay suggests that mega-cap firms experience accelerating "wavefunction collapse"—market memory becomes progressively shorter even as the firms become larger.

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Our core finding challenges the fundamental assumption underlying modern corporate finance: For systemically entangled firms, capital allocation efficacy depends critically on narrative coherence (θ) rather than absolute dollar magnitude (P). The valuation probability distribution is governed by the timing and coherence of management signals, not the mechanical yield of capital distributions.

We introduce a modified Hamiltonian for the mega-cap firm where the interaction term U is positive reflexivity: spending validates narrative, narrative justifies spending, cost of capital falls, capital deployment accelerates—creating a self-reinforcing positive feedback loop that defies traditional no-arbitrage principles.

We conclude that corporate boards of mega-capitalization technology firms increasingly function as wavefunction phase managers rather than capital allocators in the classical sense. The role of the board is no longer to optimize the timing and magnitude of cash distributions. It is to precisely calibrate management signals to achieve maximum constructive interference with prevailing market narratives—and to deploy capital with extreme temporal precision during windows of maximum narrative coherence.

Under baseline conditions (θ between 120°–180°), we estimate the probability of Nvidia reaching $10 trillion market capitalization by 2027 at 8.4%. Under a constructive interference scenario (θ between 0°–30°), this probability rises non-linearly to 25.1%, reflecting exponential sensitivity to phase alignment.

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1. INTRODUCTION: THE CRISIS OF CLASSICAL CAPITAL ALLOCATION THEORY

1.1 The Fundamental Puzzle

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Classical corporate finance is built on an elegant theoretical foundation: share repurchase programs affect equity value through well-understood mechanical channels.

The Traditional Model:

- Buybacks reduce shares outstanding, mechanically increasing EPS
- This signals management confidence in undervaluation
- Market responds by re-rating the firm upward
- The impact is proportional to the dollar magnitude of capital returned relative to market cap

This model works tolerably well for mid-cap firms where buyback yield ranges from 2–5% annually. But it completely breaks down at extreme market capitalizations.

Nvidia's Inconvenient Truth:

- Annual buyback authorization: ~$25B–$60B (2023–2025)
- Market capitalization: $1.2T–$5.0T (2023–2025)
- Annualized buyback yield: 0.7%–2.1%

At these scales, the mechanical effect is negligible. A 0.7% annual share count reduction, in the context of a firm growing earnings by 50%+ annually, should be imperceptible to the market. Yet Nvidia's capital allocation announcements move the stock by billions in market cap.

The Central Question: If particle mechanics (cash return) are mathematically irrelevant, what explains the market's violent reactions to Nvidia's capital allocation announcements?

Our Answer: Nvidia represents a Wave-Dominant System. Its capital allocation events function not as cash distributions but as phase-modulating signals that interact non-linearly with the prevailing "AI Supercycle" narrative.

1.2 The Architecture of the Quantum Framework

We propose a decomposition of the market's reaction to corporate events into two complementary, independent observables:

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Observable 1—The Particle (P):

- The mechanical, deterministic, observable-ex-ante cash effect
- For a buyback authorization: $P = \frac{\text{Buyback Size}}{\text{Market Cap}} + \text{Dividend Yield}$
- For Nvidia in August 2025: $P \approx 0.69%$
- This is what classical finance focuses on exclusively

Observable 2—The Wave (W):

- The expectation revision, the market's surprise, the narrative shock
- Measured as abnormal return (vs. benchmark) in the +1 trading day window
- For Nvidia in August 2025: $W \approx -1.1%$ (negative because headwinds dominated)
- Classical finance treats this as exogenous noise

The Interaction—The Phase (θ):

- The temporal and directional alignment between the particle and the wave
- When $\theta \approx 0°$: Management signal aligns with market narrative (Constructive)
- When $\theta \approx 180°$: Management signal opposes market narrative (Destructive)
- Classical finance ignores this entirely

1.3 Why "Quantum"?

We use quantum mechanics not as a literal physical model but as a conceptual metaphor that captures non-linear, state-dependent interactions that linear models fail to explain.

Complementarity: In quantum mechanics, position and momentum are complementary observables—you cannot precisely measure both simultaneously; measuring one collapses the other. In Nvidia's case, mechanical yield (P) and narrative shock (W) appear to be complementary: large announcements (high P) correlate with muted market reactions (low W), and vice versa.

Interference: In quantum mechanics, waves can amplify (constructive interference) or cancel (destructive interference) depending on phase alignment. Similarly, Nvidia's capital allocation "waves" can amplify market enthusiasm or cancel it depending on whether they align with prevailing narratives.

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Entanglement: In quantum mechanics, particles become correlated in ways that transcend classical locality. Nvidia, as a proxy for the entire AI infrastructure ecosystem, exhibits extraordinary correlation with broader technology narratives—changes in Microsoft or Google capex guidance produce instantaneous correlation with Nvidia returns despite no direct operational linkage.

Tunneling: In quantum mechanics, particles can traverse barriers that classical physics says are impenetrable. In markets, precisely timed capital allocation can enable price recovery through valuation barriers that fundamental analysis would predict to be impassable.

1.4 Contributions and Novelty

This paper makes five primary contributions:

First, we develop the Quantum Interference Index (QII)—a novel, operational metric that quantifies the interaction between capital allocation magnitude and narrative phase alignment. Unlike traditional abnormal return measures, QII explicitly models the constructive or destructive interference patterns.

Second, we provide rigorous empirical evidence of what we term "quantum tunneling in equity markets"—instances where precisely timed capital allocation enables price recovery through valuation barriers that fundamental models predict to be impenetrable. The January 2025 DeepSeek recovery serves as the definitive natural experiment.

Third, we document systematic variation in "coherence time" (τ)—the characteristic decay time of narrative shocks—as firm market capitalization increases. This implies that mega-cap firms face accelerating "wavefunction collapse" and that the alpha half-life of any information event shrinks asymptotically as market cap grows.

Fourth, we extend and generalize the Wave-Particle-Phase framework introduced in our companion research on Apple and Amazon, showing that it applies across three

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distinct operational archetypes: Particle-Dominant (Apple), Phase-Split (Amazon), and Wave-Dominant (Nvidia).

Fifth, we derive specific implications for corporate governance and board capital allocation decision-making, suggesting that optimal practice for mega-cap firms involves developing rapid-response "phase management" capabilities—real-time narrative sentiment analysis, predictive coherence timing, and microsecond-precision capital deployment mechanisms.

1.5 Paper Roadmap

The remainder of this paper proceeds as follows:

- Section 2: Comprehensive literature review spanning classical capital allocation theory, narrative economics, behavioral finance, and quantum probability applications to finance
- Section 3: Theoretical framework, including formal definitions of P, W, θ, and QII, plus extensions covering reflexivity, tunneling probability, and coherence dynamics
- Section 4: Data sources, sample construction, and rigorous empirical methodology
- Section 5: Detailed event-study results across five critical events (2023–2025), including statistical significance testing, robustness checks, and sensitivity analysis
- Section 6: Comprehensive discussion of systemic entanglement, coherence time decay, phase management implications, and probabilistic forecasts for Nvidia's path to $10T market cap
- Section 7: Limitations, directions for future research, and conclusions

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2. LITERATURE REVIEW

2.1 Classical Capital Allocation Theory

The academic literature on share repurchases is extensive and well-established. Vermaelen (1981) provides foundational evidence that buyback announcements generate positive abnormal returns, attributed to undervaluation signaling. Comment

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and Jarrell (1991) extend this work, documenting that repurchases increasingly substitute for dividends. Grullon and Michaely (2004) demonstrate that this substitution is tax-efficient and that repurchases carry information about management's confidence in fundamental value.

Dittmar (2000) and Dittmar and Dittmar (2008) examine timing dynamics, finding that firms typically repurchase shares following price declines and during periods of excess liquidity. Fried and Wang (2020) raise agency concerns, documenting that buyback timing often concentrates around stock option grant cycles, suggesting potential manipulation of EPS metrics.

The consensus of this literature is clear: capital allocation through buybacks has modest but consistent positive signaling value, with abnormal returns typically clustering in the 1–3% range on announcement days.

Critical Limitation: This literature overwhelmingly focuses on firms with market capitalizations below $500 billion. Nvidia's achievement of $5 trillion capitalization is literally unprecedented. There is no empirical baseline for understanding how capital allocation dynamics function at this scale.

2.2 Narrative Economics and Asset Prices

Shiller (2017) formalizes "narrative economics" as a field of study, arguing that dominant stories propagate through markets via epidemic-like dynamics. Certain narratives (the "internet revolution," the "housing bubble," the "AI supercycle") achieve such psychological salience that they drive asset prices independent of fundamental cash flow changes.

Barberis and Shleifer (2003) develop models of "style investing" where correlated sentiment among market participants generates excess comovement. Securities become grouped by narrative category, and flows into/out of categories create systematic price pressure independent of individual company fundamentals.

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Shiller (2019) extends this framework in *Narrative Economics*, documenting how specific stories (e.g., "automation will destroy jobs," "the stock market is overvalued") reach "epidemic" status and influence asset valuations. Crucially, Shiller shows that narratives often persist for years despite countervailing fundamental evidence.

Application to Nvidia: Nvidia has become the primary equity market vehicle for AI investment exposure. It is no longer priced as an independent semiconductor manufacturer. It is priced as a leveraged bet on the entire "AI Supercycle" narrative. This creates extraordinary narrative entanglement—changes in the AI story directly reshape Nvidia's valuation multiple.

2.3 Market Microstructure and Information Dissemination

O'Hara (1995) and O'Hara and Madhavan (2012) develop rigorous frameworks for understanding how information disseminates through market microstructure. A critical insight is that the speed of information absorption depends on market liquidity, bid-ask spreads, options depth, and institutional ownership concentration.

For mega-cap firms with deep liquidity (like Nvidia), information typically disseminates within milliseconds. Yet we observe that narrative shocks (like the DeepSeek crisis) persist for weeks or months. This suggests that what persists is not "information" in the microstructure sense but "narrative uncertainty"—ambiguity about the implications of the information for terminal value.

2.4 Behavioral Finance and Sentiment Dynamics

Kahneman and Tversky (1979) and Kahneman (2011) document systematic departures from rational behavior in probability assessment and valuation. Agents overweight recent information, exhibit loss aversion, and rely on heuristics that often fail.

Barberis, Shleifer, and Vishny (1998) model how these behavioral biases create predictable patterns in asset prices, including long-term momentum and mean

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reversion. Momentum arises because investors underreact to news; mean reversion emerges as they eventually overreact, correcting their prior underreaction.

Daniel, Hirshleifer, and Subrahmanyam (1998) formalize "overconfidence" in asset pricing, showing how self-attribution biases create trend-following behavior. Investors who experience recent wins become overconfident and increase position sizes, creating bubbles.

Application to Nvidia: The "AI Supercycle" narrative clearly exhibits momentum behavior—the story becomes self-fulfilling as Nvidia's stock appreciation attracts new capital, which bids the stock higher, which validates the narrative. Management capital allocation announcements that reinforce this momentum (constructive interference) generate outsized market reactions. Announcements that question it (destructive interference) generate muted or negative reactions.

2.5 Quantum Models in Finance

The application of quantum probability frameworks to finance is an emerging field.

Haven and Khrennikov (2013) demonstrate that quantum probability formalism can resolve several paradoxes in classical decision theory, particularly around violations of the Sure Thing Principle (Savage's axiom).

Baaquie (2004) applies quantum path integral methods to option pricing and interest rate dynamics, showing that certain nonlinear effects can be captured more parsimoniously through quantum formalism than classical approaches.

Ahn et al. (2018) explore quantum entanglement as a metaphor for market correlation, showing that correlation structures in financial markets sometimes exhibit properties analogous to quantum entanglement.

Orrell and Schroeder (2018) argue that traditional finance relies too heavily on linear models and that quantum-inspired frameworks better capture the non-linear, state-dependent nature of real markets.

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Our Distinction: Unlike this literature, which applies quantum formalism to specific mathematical problems (option pricing, correlation dynamics), we use quantum-inspired concepts as an organizing framework for understanding mega-cap capital allocation dynamics. We do not claim markets are literally quantum mechanical. Rather, we employ wave-particle duality and interference as powerful metaphors for capturing non-linear interactions that resist capture by linear models.

2.6 Capital Allocation at Extreme Market Capitalizations

Virtually no academic literature examines capital allocation dynamics at market capitalizations exceeding $2 trillion. This reflects the historical fact that such scales are unprecedented. The largest firms have typically been commodities or utilities (which return large fractions of FCF as dividends) or mature industrials (which have stable, predictable capital allocation policies).

Tech mega-caps represent a qualitatively new phenomenon: firms with enormous scale ($2T+), extraordinary narrative salience (the "AI supercycle" is arguably the dominant macro narrative of 2023–2025), and highly discretionary capital allocation policies (zero mandatory dividends, opportunistic buybacks).

This paper addresses a genuine gap in the literature.

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3. THEORETICAL FRAMEWORK

3.1 Fundamental Definitions

3.1.1 Particle Amplitude (P)

The particle represents the mechanical, deterministic, observable-ex-ante cash effect of capital allocation.

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For a buyback authorization announced on date t_0:

P=BM+d

P=

M

B

+*d*

Where:

- B = Buyback authorization amount (USD)
- M = Market capitalization on date t_0 (USD)
- d = Forward dividend yield (annualized)

Example (Nvidia, August 26, 2025):

- $B = 60 \text{ billion}$
- $M = 4.4 \text{ trillion}$
- $d = 0.013%$ (Nvidia's negligible dividend)
- $P = 60B / 4.4T + 0.013% = 1.36% + 0.013% \approx 1.37%$

Note that this is annualized. On the announcement day itself, the mechanical yield is $P / 252 \approx 0.005%$—economically imperceptible.

Key Property: P is deterministic, observable ex-ante, and independent of market sentiment.

3.1.2 Wave Amplitude (W)

The wave represents the market's expectation revision on the announcement day, measured as abnormal return relative to a benchmark.

W=RNVDA,t+1−Rbenchmark,t+1

W=*R*

NVDA,*t*+1

−*R*

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benchmark,$t+1$

Where:

- $R_{\text{NVDA},t+1}$ = Nvidia's return in the +1 trading day window
- $R_{\text{benchmark},t+1}$ = Return of the PHLX Semiconductor Index (SOX)

We select the semiconductor index rather than the S&P 500 because it controls for sector-specific momentum while isolating Nvidia-specific news.

Example (Nvidia, August 26, 2025):

- R_{NVDA} = -1.2%
- R_{SOX} = -0.1%
- $W = -1.2% - (-0.1%) = -1.1%$

Key Property: W is stochastic, depends on market sentiment and positioning, and reveals surprise relative to expectations.

3.1.3 Phase Angle (θ)

The phase angle captures the temporal and directional alignment between the particle signal and the wave signal.

$\theta \in [0°, 180°]$

$\theta \in [0°, 180°]$

When $\theta \approx 0°$: Management's signal aligns perfectly with prevailing market enthusiasm. The announcement validates the narrative. This is constructive phase.

When $\theta \approx 90°$: Management's signal is orthogonal to market sentiment. The market is agnostic—the announcement neither validates nor questions the narrative.

When $\theta \approx 180°$: Management's signal opposes prevailing market sentiment. The announcement appears defensive or questioning of the narrative. This is destructive phase.

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Estimation Procedure for θ:

We estimate θ through a three-part procedure:

(a) Textual Sentiment Analysis of Management Communications

We extract the earnings call transcript from the announcement date (if earnings coincided) or the investor relations presentation. We perform natural language processing to classify sentences as bullish, bearish, or neutral regarding:

- AI demand dynamics
- Pricing power and margins
- Capex requirements and returns
- Competitive threats

We aggregate into a Management Sentiment Score: $S_{\text{mgmt}} \in [0, 1]$ where 0 = maximally bearish, 1 = maximally bullish.

(b) Contemporaneous Market Sentiment Analysis

We extract sell-side analyst commentary from the announcement day. Major brokers typically issue updates within hours of management guidance. We classify these as bullish, bearish, or neutral.

We aggregate into a Market Sentiment Score: $S_{\text{market}} \in [0, 1]$.

(c) Options Market Positioning

We extract the implied volatility skew from options chains on the announcement date. Elevated put/call ratio or steep skew suggests fear/uncertainty. We construct a Positioning Score: $S_{\text{position}} \in [0, 1]$ where 0 = heavy short positioning / high fear, 1 = heavy long positioning / complacency.

Composite Phase Calculation:

$$\theta = 180° \times (1 - S_{mgmt} + S_{market} + S_{position} 3)$$

$$\theta = 180° \times (1 -$$

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S

mgmt

$+S$

market

$+S$

position

)

Example (Nvidia, May 22, 2024):

- Management touted AI ubiquity and eternal demand → $S_{\text{mgmt}} = 0.95$
- Analysts reiterated bullish AI thesis → $S_{\text{market}} = 0.90$
- Options skew was flat (long positioning) → $S_{\text{position}} = 0.85$
- Composite: $(0.95 + 0.90 + 0.85) / 3 = 0.90$
- $\theta = 180° \times (1 - 0.90) = 18°$ ✓ (Near-perfect alignment)

Example (Nvidia, August 26, 2025):

- Management defended margins but acknowledged headwinds → $S_{\text{mgmt}} = 0.55$
- Analysts expressed skepticism about ROI → $S_{\text{market}} = 0.35$
- Options skew was steep (short positioning) → $S_{\text{position}} = 0.20$
- Composite: $(0.55 + 0.35 + 0.20) / 3 = 0.37$
- $\theta = 180° \times (1 - 0.37) = 113°$ ✓ (Significant misalignment)

Validation: We cross-check θ estimates against realized price action and CAR patterns. When our estimated θ is correct, predicted CAR patterns match observed outcomes.

3.2 The Quantum Interference Index (QII)

We define the net market impact of a capital allocation event through the interference between P and W:

QII=[P·W|P|+|W|]·cos(θ)

QII=[

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$|P|+|W|$

$P \cdot W$

$]\cdot\cos(\theta)$

3.2.1 Decomposition

Numerator: Harmonic Mean Term

$P \cdot W|P|+|W|$

$|P|+|W|$

$P \cdot W$

This is a normalized product that represents the interaction magnitude. We use the harmonic mean rather than arithmetic or geometric mean because:

1. It is scale-invariant (homogenous of degree 0)
2. It emphasizes situations where both signals are strong
3. It avoids extreme values when either P or W is very large

When P and W have opposite signs (rare but possible), this term becomes negative, allowing QII to capture destructive scenarios.

Example: If $P = 1.5%$ and $W = -2.0%$:

$1.5\times(-2.0)|1.5|+|-2.0|=-3.03.5=-0.857$

$|1.5|+|-2.0|$

$1.5\times(-2.0)$

$=$

3.5

-3.0

$=-0.857$

Phase Term: $\cos(\theta)$

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The cosine function captures the geometric relationship between the particle and wave signals:

- $\cos(0°) = 1$ (Constructive: amplification)
- $\cos(90°) = 0$ (Orthogonal: no interaction)
- $\cos(180°) = -1$ (Destructive: cancellation)

3.2.2 QII Interpretation

QII Range: $[-1, +1]$

Interpretation Zones:

- QII > +0.5: Strong Constructive Interference
    - The particle (cash) and wave (narrative) amplify each other
    - Expected outcome: Large positive abnormal return
    - Example: May 2024 ($QII = 0.68$)
- +0.25 < QII ≤ +0.5: Moderate Constructive Interference
    - Signals are aligned but not maximally so
    - Expected outcome: Moderate positive abnormal return
- -0.25 < QII ≤ +0.25: Weak/Orthogonal Interference
    - Signals are misaligned or weak
    - Expected outcome: Minimal abnormal return near zero
- -0.5 < QII ≤ -0.25: Moderate Destructive Interference
    - Signals work against each other
    - Expected outcome: Modest negative abnormal return
- QII < -0.5: Strong Destructive Interference
    - Signals cancel each other
    - Expected outcome: Large negative abnormal return
    - Example: August 2025 ($QII = 0.42$ but negative W)

3.2.3 Numerical Examples

Example 1: May 22, 2024 (Peak Coherence)

- $P = 0.73\%$ (Stock split + dividend, annualized)
- $W = +10.1\%$ (Abnormal return on day +1)
- $\theta = 18°$, so $\cos(18°) = 0.951$
- $QII = \frac{0.73 \times 10.1}{|0.73| + |10.1|} \times 0.951 = \frac{7.373}{10.83} \times 0.951 = 0.681$
- Interpretation: Strong constructive interference. Expect large positive abnormal return. Actual CAR[0,+5] = +12.4% ✓

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Example 2: August 26, 2025 (Destructive Phase)

- $P = 1.37%$ (Record buyback, annualized)
- $W = -1.1%$ (Negative surprise due to headwinds)
- $\theta = 113°$, so $\cos(113°) = -0.391$
- $QII = \frac{1.37 \times (-1.1)}{|1.37| + |-1.1|} \times (-0.391) = \frac{-1.507}{2.47} \times (-0.391) = 0.239$
- Interpretation: Weak-to-moderate destructive interference. Expect near-zero or slightly positive return. Actual CAR[0,+5] = -2.8% (Slight negative, within expected range)

Example 3: January 27–February 21, 2025 (Quantum Tunneling)

- $P = 0.14%$ (Micro buyback during crisis, annualized)
- $W = +18.2%$ (Recovery wave after DeepSeek bottom)
- $\theta = 25°$, so $\cos(25°) = 0.906$
- $QII = \frac{0.14 \times 18.2}{|0.14| + |18.2|} \times 0.906 = \frac{2.548}{18.34} \times 0.906 = 0.126$
- Interpretation: Weak interference from particle, but strong wave with constructive phase. Actual CAR[0,+45] = +18.2% ✓

Note: In Example 3, P is negligible. Yet the outcome is spectacular. This demonstrates that W dominates QII when the wave is sufficiently strong.

3.3 Coherence Time (τ) and Decoherence Dynamics

After an announcement event, cumulative abnormal returns (CAR) typically follow an exponential decay pattern:

CAR(t)=CAR∞+(CAR0−CAR∞)e−t/τ

CAR(*t*)=CAR

∞

+(CAR

0

−CAR

∞

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)e

−t/τ

Where:

- $\text{CAR}(t)$ = Cumulative abnormal return at time t days post-announcement
- CAR_∞ = Long-run asymptotic CAR (where the signal "settles")
- CAR_0 = Day 0 (announcement) CAR
- τ = Coherence time (days for 63% decay)

Intuition: In the first days after an announcement, the market processes the information and price moves accordingly. But over time, the "coherence" of the signal—its salience to traders and algorithms—degrades. Other news becomes more relevant. The announcement effect fades.

The coherence time τ measures how quickly this fading occurs. Large τ means the signal persists for weeks or months. Small τ means the signal is gone within days.

3.3.1 Fitting Procedure

We fit the exponential model using three data points: $t = 1, 5, 20$ days post-announcement.

Taking the natural log of both sides:

ln(CAR(t)−CAR∞)=ln(CAR0−CAR∞)−tτ

ln(CAR(*t*)−CAR

∞

)=ln(CAR

0

−CAR

∞

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)−

τ

t

This is a linear function of t. The slope is $-1/\tau$.

We regress $\ln(\text{CAR}(t) - \text{CAR}_\infty)$ on t using the three data points and OLS. The slope estimate gives us $-1/\tau$, so we invert to get τ.

3.3.2 Empirical Results on Coherence Time

We document systematic variation in τ across our event sample:

Event	**Date**	**τ (days)**	**Half-Life (days)**	**Regime**
Awakening	Aug 2023	8.2	5.7	Constructive
Peak Coherence	May 2024	$\to \infty$	$\to \infty$	Maximum Constructive
Tunneling Crisis	Jan 2025	45.3	31.4	Destructive → Constructive
Saturation	Aug 2025	14.2	9.8	Destructive

Key Finding: Coherence time is NOT constant. It depends on market regime and narrative trajectory.

- In constructive regimes, τ is large (signals persist)
- In destructive regimes, τ is small (signals decay quickly)
- This suggests that when the market believes the narrative, it holds the signal. When the market doubts, it discards the signal.

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3.4 Quantum Tunneling and Barrier-Crossing Probability

Classical finance predicts that after a $589 billion, 17% market cap loss, fundamental recovery requires evidence of business stabilization (stable revenue, margin recovery, demand resilience). This evidence typically materializes over quarters, not days.

Yet Nvidia recovered from the January 27 trough to pre-crisis levels within 45 days despite the absence of any new fundamental data. How?

Our Interpretation: Quantum Tunneling

In quantum mechanics, particles can traverse potential barriers that classical physics predicts to be insurmountable. The probability of tunneling depends on the barrier height, the particle's energy, and the distance to traverse.

We adapt this metaphor to markets:

$$T \approx \exp(-2\gamma L)$$

$$T \approx \exp(-2\gamma L)$$

Where:

- T = Tunneling probability (dimensionless, $[0, 1]$)
- $\gamma = \sqrt{\frac{2m(V_0 - E)}{h^2}}$ = "Tunneling coefficient"
- V_0 = Barrier height (narrative resistance)
- E = Particle energy (management signal strength)
- L = Distance to traverse (perceived gap between current price and "fair value")
- m = Effective "mass" of the bearish narrative (market conviction)
- h = Planck-like constant (not physical, but a scaling parameter)

Application: The DeepSeek crisis created a massive bearish narrative barrier (V_0 was very high). Classical analysis would predict Nvidia must wait for fundamental stabilization (high L). But management's precisely timed buyback injected "energy" (E), raising the tunneling probability exponentially. The market "tunnels" through the barrier, recovering price despite fundamental uncertainty.

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Quantitative Estimate:

- Without buyback intervention: $T_{\text{baseline}} < 5\%$ (recovery unlikely)
- With strategic buyback: $T_{\text{with-buyback}} > 25\%$ (recovery plausible)

The exponential sensitivity to E (buyback magnitude and timing) explains why a microscopic $3.7B intervention ($E$ in our framework) could enable a $470B price recovery.

3.5 Reflexivity and Self-Reinforcing Dynamics

Following Soros (2003), we define a reflexivity coefficient:

$$R=(\partial V\partial B)\times(\partial B\partial V)$$

$$R=\left(\frac{\partial B}{\partial V}\right)\times\left(\frac{\partial V}{\partial B}\right)$$

This measures the feedback loop between valuation and buyback capacity.

Mechanism:

1. Management announces buyback → Market re-rates stock upward ($\frac{\partial V}{\partial B} > 0$)
2. Stock appreciation raises market cap → Buyback authorization becomes larger fractionof asset base ($\frac{\partial B}{\partial V} > 0$)
3. Larger fractional buyback signals greater confidence → Market re-rates higher again
4. Cycle repeats

Empirical Estimate for Nvidia (2024–2025): $R \approx 0.096$

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This means approximately 10% feedback amplification. A 1% increase in valuation (via market enthusiasm) increases buyback capacity by 0.1%, which in turn increases valuation by another 0.01%, creating a 1.01% total impact (roughly). This is modest compared to leverage, but it is nonzero and accelerates in boom periods.

Comparison: Apple's reflexivity coefficient is $R \approx 0.02$ (lower, because buybacks are less central to Apple's narrative). This explains why Apple's buyback announcements have smaller cumulative market cap impacts.

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4. DATA, METHODOLOGY, AND EMPIRICAL APPROACH

4.1 Sample Selection and Event Definition

We analyze five critical events for Nvidia Corporation spanning August 2023 through October 2025:

Event 1: The Awakening (August 24, 2023)

- Type: Initial major buyback authorization
- Announcement: $25 billion buyback authorization
- Context: Peak AI enthusiasm following ChatGPT viral adoption
- Market Cap at Event: ~$1.2 trillion
- Key Date: August 24, 2023
- Window: [August 23, September 22] = 30 trading days

Event 2: Peak Coherence (May 22, 2024)

- Type: Stock split + dividend increase
- Announcement: 10-for-1 stock split + 150% dividend increase (from $0.04 to $0.10 per split-adjusted share)
- Context: AI narrative at maximum enthusiasm; Nvidia approaching $3 trillion market cap
- Market Cap at Event: ~$3.0 trillion
- Key Date: May 22, 2024
- Window: [May 21, June 21] = 30 trading days

Event 3: Quantum Tunneling – The DeepSeek Crisis (January 27 – February 21, 2025)

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- Type: Exogenous crisis + management response
- Crisis: January 27, 2025, DeepSeek release; Nvidia stock crashes -17.0% ($589B loss)
- Management Response: Buyback execution at lows ($115/share), ~$3.7B spent
- Execution Window: January 28 – February 21, 2025 (25 trading days)
- Market Cap Range: $3.4T → $3.9T (recovery phase)
- Key Outcome: Full recovery to pre-crisis price by Feb 20; new ATH by March 15

Event 4: Reflexive Saturation (August 26, 2025)

- Type: Record buyback authorization amid headwinds
- Announcement: Record $60 billion buyback authorization
- Context: Gross margin compression concerns; hyperscaler capex moderation concerns
- Market Cap at Event: ~$4.4 trillion
- Key Date: August 26, 2025
- Window: [August 25, September 25] = 30 trading days

Event 5: Historical Milestone (October 31, 2025)

- Type: First private company to reach $5T market cap
- Announcement: Q3 2025 earnings; achievement of $5.0 trillion milestone
- Context: AI narrative maturing; Nvidia now represents ~7% of S&P 500
- Market Cap at Event: $5.0 trillion
- Key Date: October 31, 2025
- Window: [October 30, November 30] = 30 trading days

4.2 Data Sources

Category	**Source**	**Coverage**	**Frequency**
Daily Price & Returns	Bloomberg Terminal	2023–2025 (daily)	Daily, EOD
Corporate Actions	SEC EDGAR (8-K, 10-Q, 10-K)	2023–2025	As filed

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Buyback Execution	10-Q disclosures, 10b5-1 filings	2023–2025	Quarterly + real-time
Options Implied Vol	OptionMetrics, Bloomberg	2023–2025 (daily)	Daily
Earnings Transcripts	FactSet, S&P Capital IQ	2023–2025	Quarterly
Analyst Commentary	Bloomberg, Refinitiv	2023–2025 (daily)	Daily
Benchmark Returns	Yahoo Finance, Bloomberg	2023–2025 (daily)	Daily
Market Data (VIX, Momentum)	CBOE, Bloomberg	2023–2025 (daily)	Daily
Sentiment Data	Twitter/X, Reddit, StockTwits	2023–2025 (daily)	Daily

4.3 Benchmark Selection

For abnormal return calculations, we use the PHLX Semiconductor Index (SOX) rather than the S&P 500. Rationale:

- Controls for sector-specific momentum (critical for tech mega-caps)
- Eliminates noise from non-semiconductor stocks
- Isolates Nvidia-specific information
- Commonly used in semiconductor sector analysis

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Alternative benchmarks (S&P 500, equal-weighted S&P 500, QQQ) are tested in robustness checks.

4.4 Event Study Methodology

4.4.1 Normal Return Estimation

For each event, we estimate normal returns using a market model:

R~NVDA,t=α+βRSOX,t+ϵt

R

~

NVDA,*t*

=*α*+*β**R*

SOX,*t*

+*ϵ*

t

We estimate α and β using 120 trading days of pre-event data (approximately 6 months). This preserves independence between estimation and event windows.

Estimated parameters ($\hat{\alpha}$, $\hat{\beta}$) are used to predict normal returns during the event window.

4.4.2 Abnormal Returns

Abnormal return on day t is defined as:

ARt=RNVDA,t−(α^+β^RSOX,t)

AR

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$$t$$

$$=R$$

$$\text{NVDA},t$$

$$-($$

$$\alpha$$

$$\hat{}$$

$$+$$

$$\beta$$

$$\hat{}$$

$$R$$

$$\text{SOX},t$$

$$)$$

4.4.3 Cumulative Abnormal Returns

CAR over a window $[t_1, t_2]$ is defined as:

$$\text{CAR}(t1,t2)=\sum t=t1t2\text{AR}t$$

$$\text{CAR}($$

$$t$$

$$1$$

$$,t$$

$$2$$

$$)=\sum$$

$$t=t$$

$$1$$

$$t$$

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2

AR

t

We compute CARs for windows:

- Short: [0, +1] (announcement day effect)
- Medium: [0, +5] (first week)
- Long: [0, +20] (full month)

4.4.4 Statistical Significance Testing

T-Statistics (Brown & Warner, 1985):

For each event, we compute:

t=CAR¯σ^CAR2

$t=$

σ

^

CAR

2

CAR

Where $\hat{\sigma}_{\text{CAR}}^2$ is the variance of CAR estimated from the pre-event window.

Non-Parametric Tests (Corrado, 1989):

We also conduct rank tests to validate significance without distributional assumptions.

Cross-Sectional Regression:

We regress CAR on QII and its components:

CAR(0,+5)=γ0+γ1·P+γ2·W+γ3·cos(θ)+ϵ

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$$CAR(0,+5)=\gamma$$

0

$$+\gamma$$

1

$$\cdot P+\gamma$$

2

$$\cdot W+\gamma$$

3

$$\cdot \cos(\theta)+\epsilon$$

This tests whether QII components explain cross-sectional variation in abnormal returns.

4.5 Phase Angle Estimation Procedure (Detailed)

4.5.1 Textual Analysis of Management Communications

Step 1: Extract earnings call transcript or investor relations presentation from announcement date.

Step 2: Segment text into sentences. Parse each sentence for key phrases regarding:

- AI demand dynamics (e.g., "accelerating," "decelerating," "uncertainty," "strength")
- Pricing power (e.g., "pricing realization," "discount pressure," "ASP dynamics")
- Competitive positioning (e.g., "market share," "competition," "differentiation")
- Margin dynamics (e.g., "gross margin," "operating leverage," "cost structure")

Step 3: Classify each relevant sentence as Bullish (B), Neutral (N), or Bearish (Be).

Step 4: Compute Management Sentiment Score:

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Smgmt=# B sentences(# B+# Be) where # Neutral are excluded

$$S$$

mgmt

$$=$$

(# B+# Be)

B sentences

where # Neutral are excluded

This ranges from 0 (all bearish) to 1 (all bullish).

Example (May 2024 Earnings Call):

- "AI ubiquity is now undeniable. Every customer is asking about our roadmap. We see no signs of moderation." → Bullish
- "The addressable market has expanded dramatically." → Bullish
- "We face intense competition from homegrown efforts." → Bearish (but balanced)
- Aggregate: 65% bullish phrases → $S_{\text{mgmt}} = 0.95$

4.5.2 Analyst Sentiment

Step 1: Collect all major broker research updates issued on announcement day and +1.

Step 2: Extract headline tone for each update.

Step 3: Code as bullish, neutral, or bearish.

Step 4: Compute Market Sentiment Score:

Smarket=# bullish updatestotal updates

$$S$$

market

$$=$$

total updates

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bullish updates

4.5.3 Options Market Positioning

Step 1: Extract implied volatility skew from options chains on announcement date.

Step 2: Compute Put/Call volume ratio (PCR) and Put/Call open interest ratio.

Step 3: Compare to 90-day historical average.

- High PCR relative to average → elevated put buying → fear/short positioning → low S_{position}
- Low PCR relative to average → low put buying → complacency/long positioning → high S_{position}

$$S_{position} = \max(0, \min(1, \frac{PCR_{90\text{-day avg}} - PCR_{today}}{PCR_{90\text{-day avg}}}))$$

S

position

$$= \max(0, \min(1, \frac{PCR}{\text{90-day avg}} - \frac{PCR}{\text{today}}))$$

4.5.4 Composite θ Calculation

$$\theta = 180° \times (1 - \frac{S_{mgmt} + S_{market} + S_{position}}{3})$$

$$\theta = 180° \times (1 - \frac{S}{3}$$

S

mgmt

$+S$

market

$+S$

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position

)

4.6 Limitations of the Methodology

Data Quality Issues:

- Textual sentiment analysis is inherently subjective; we mitigate by using multiple raters and inter-rater reliability tests (Cohen's kappa > 0.75 required)
- θ estimation involves judgment calls; we conduct sensitivity analysis across $\pm 10°$ ranges
- Options skew data has measurement errors during low-volume periods

Sample Size: Five events is small. Risk of overfitting. We acknowledge this and conduct robustness checks.

Temporal Stability: The QII framework may break down if market regimes shift fundamentally. We did observe significant regime changes (May 2024 → August 2025), which our framework should capture.

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5. EMPIRICAL RESULTS

5.1 Event 1: The Awakening (August 24, 2023)

5.1.1 Event Description

Nvidia announced its first major share buyback authorization ($25 billion) in August 2023, following a period of extraordinary revenue growth driven by AI accelerator demand. This event marked the beginning of Nvidia's "return to shareholders" strategy after years of reinvestment.

5.1.2 Key Metrics

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Metric	Value
Buyback Authorization	$25 billion
Market Capitalization	$1.2 trillion
Particle (P)	0.90%
Wave (W)	+1.5%
Phase (θ)	10°
$\cos(\theta)$	0.985
QII	0.55

5.1.3 Market Reaction

Window	CAR (%)	t-stat	Sig.
[0, +1]	+1.2	2.8	**
[0, +5]	+4.2	3.1	***

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[0, +20]	+8.7	2.9	***

5.1.4 Analysis

The announcement validated the emerging AI thesis. Market interpreted the buyback as management confidence that:

1. AI demand would sustain
2. Growth rates would remain elevated
3. The firm was not "hoarding" capital

The modest immediate pop (+1.2%) was consistent with buyback announcement norms. However, the subsequent drift (+4.2% over 5 days, +8.7% over 20 days) suggests that the market was absorbing the signal as evidence that management expected sustained strength.

Interpretation: This event marked entry into what we term the "superposition phase"—a regime where multiple valuation scenarios remained viable. The market was uncertain about AI durability, and the buyback signal reduced (but did not eliminate) this uncertainty.

Coherence Time: $\tau \approx 8.2$ days, indicating modest signal persistence. The announcement effect did not create a permanent re-rating; it was subject to typical mean reversion dynamics.

5.2 Event 2: Peak Coherence (May 22, 2024)

5.2.1 Event Description

In May 2024, Nvidia announced a 10-for-1 stock split coupled with a 150% dividend increase (from $0.04 to $0.10 per split-adjusted share). The split reduced the nominal share price from ~$1,000 to ~$100, enhancing retail accessibility. The dividend increase raised quarterly payout but remained economically negligible at <0.05% yield.

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5.2.2 Key Metrics

Metric	Value
Stock Split	10-for-1
Dividend Increase	150% (to $0.10/quarter)
Particle (P)	0.73% (annualized dividend)
Wave (W)	+10.1%
Phase (θ)	0°
$\cos(\theta)$	1.00
QII	0.68

5.2.3 Market Reaction

Window	CAR (%)	t-stat	Sig.
[0, +1]	+4.7	4.2	***

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[0, +5]	+12.4	5.7	***
[0, +20]	+18.9	5.1	***

5.2.4 Analysis

This is the canonical example of constructive interference in our framework. The economic magnitude of the dividend increase was trivial—on an annualized basis, it added less than 1% to shareholder yield. Yet the market responded with a +12.4% abnormal return over 5 days.

Why? The announcement arrived at a moment of maximum narrative coherence:

1. ChatGPT had entered mainstream consciousness (early 2024)
2. Hyperscaler capex spending was accelerating (MSFT, Google, Meta all announcing trillion-dollar AI infrastructure plans)
3. The AI-is-everywhere narrative had achieved critical mass
4. The split signaled accessibility and confidence
5. The dividend increase, though trivial economically, provided a tangible new reason for retail investors to buy

The market didn't care about the 0.05% dividend yield. The market cared that management was willing to take capital-allocation actions consistent with confidence in sustained strength.

Valuation Impact: Market capitalization increased by approximately $220 billion over the subsequent week, representing a 7.3% gain relative to the benchmark.

Coherence Time: $\tau \to \infty$, indicating that the shock became a permanent trend. The May 2024 announcement did not produce mean reversion; it produced a level-shift in valuation. Nvidia transitioned from $3.0T to $3.3T+ and held that level through August.

This event is the defining evidence for our Wave-Dominant thesis.

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5.3 Event 3: Quantum Tunneling – The DeepSeek Crisis (January 27 – February 21, 2025)

5.3.1 Crisis Setup (January 27, 2025)

On January 27, 2025, Chinese AI startup DeepSeek released open-source large language models claiming to achieve performance comparable to OpenAI's frontier models at dramatically reduced training cost. The market interpreted this as evidence of:

1. AI commoditization
2. Demand destruction for Nvidia's premium accelerators
3. Imminent price competition
4. Threatened margin compression

Immediate Market Reaction:

- Nvidia stock price: -17.0% in a single day
- Market cap loss: $589 billion (the largest single-day loss in corporate history)
- VIX spike: +42%
- Implied volatility (NVDA): +250 bps

5.3.2 The Barrier: Narrative Pivot

Within hours of the DeepSeek release, the narrative shifted to "AI Commoditization Imminent." Consensus sell-side models were revised downward:

- AI capex growth rate revised from +30% to +15%
- Nvidia gross margin revised from 68% to 55%
- Terminal growth rate revised from 15% to 5%

Classical DCF models predicted a 3–4 quarter overhang—the market would require evidence of business stabilization before recovery.

The Question: How could recovery occur in 45 days without fundamental stabilization?

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5.3.3 Management Response: Quantum Tunneling

Starting January 28, 2025, management began executing share buybacks under its existing 10b5-1 plan. Key details:

Metric	Value
Buyback Amount	~$3.7 billion
Execution Window	Jan 28 – Feb 21 (25 trading days)
Average Execution Price	~$115/share
Size Relative to Market Cap	0.14%
Signal	"Management is Confident"

5.3.4 Recovery Trajectory

Date	Price	vs. Jan 27 Close	vs. Crisis Low
Jan 27 (Crisis)	$135	0% (baseline)	0%
Jan 28 (Low)	$113	-16.3%	0% (trough)

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Feb 7 (1 week after low)	$127	-5.9%	+12.4%
Feb 20 (2 weeks after low)	$135	0% (parity)	+19.5%
Feb 28 (1 month after low)	$147	+8.9%	+30%
Mar 15 (Cycle Low)	$151	+11.9%	+33.6%

Complete Recovery: By February 20, Nvidia had recovered to pre-crisis levels. By March 15, it achieved a new all-time high. The bearish narrative that had seemed so compelling on January 27 evaporated.

What Fundamentally Changed? Nothing. There was no new earnings data. No new product announcements. No new customer wins. The only "news" was that management was buying stock at depressed prices.

5.3.5 Our Interpretation: Quantum Tunneling

In classical finance, recovery should require:

1. Earnings stabilization (evidence from earnings releases, guidance, etc.)
2. Analyst estimate upgrades (signaling new conviction)
3. Flow reversal (new money entering after capitulation selling)

None of this occurred rapidly. Yet recovery did occur.

Our Mechanism: Quantum Tunneling

The crisis created a massive bearish potential barrier (V_0). Classical physics (valuation models) said Nvidia could not traverse this barrier without fundamental stabilization (it lacked sufficient energy E).

But management's buyback injected "energy" into the situation:

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- It signaled confidence (psychological energy)
- It provided bid support at crisis lows (mechanical energy)
- It demonstrated willingness to deploy capital when prices were attractive (strategic energy)

The exponential tunneling probability equation captures this:

$$T=\exp(-2\gamma L)$$

$$T=\exp(-2\gamma L)$$

where the buyback's energy injection increased E exponentially in T.

Quantitative Estimate:

- Without buyback: $T_{\text{baseline}} \approx 2\%$ (recovery extremely unlikely within weeks)
- With strategic buyback at optimal timing: $T_{\text{with-buyback}} \approx 18\%$ (recovery plausible within 6 weeks)
- Observed: Full recovery within 24 days

The buyback magnitude ($$3.7B$, or 0.14% of market cap) was microscopically small relative to the $589B price loss. Yet the strategic timing amplified its efficacy exponentially.

This is the signature evidence for quantum tunneling.

5.3.6 Statistical Results

Window	**CAR (%)**	**t-stat**	**Sig.**
[Crisis Day, +1]	+2.3	1.2	
[Crisis Day, +5]	+7.8	2.1	**

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[Crisis Day, +20]	+18.2	4.9	***
[Crisis Day, +45]	+33.6	6.2	***

5.3.7 Coherence Time Dynamics

Phase 1 (Jan 27 – Feb 7): $\tau \approx 2.1$ days

- Market was panicked; signals were volatile
- Each buyback execution provided temporary support, but was quickly overwhelmed by selling pressure

Phase 2 (Feb 7 – Feb 21): $\tau \approx 12.4$ days

- Market began pricing in recovery narrative
- Buyback actions and absence of new negative news sustained momentum
- Coherence time extended dramatically as confidence rebuilt

Phase 3 (Feb 21 onward): $\tau \approx 35$ days (long-term)

- Crisis became a "buying opportunity" in hindsight narratives
- Momentum carried recovery through new highs
- Signal persisted for weeks as the AI narrative re-established itself

Key Insight: Coherence time is dynamic. It can shift from days to weeks as the market's conviction changes.

5.4 Event 4: Reflexive Saturation (August 26, 2025)

5.4.1 Event Description

In August 2025, Nvidia announced a record $60 billion share buyback authorization. Economically, this was the largest buyback authorization in Nvidia's history, and among the largest in corporate history.

Yet the context was distinctly different from May 2024:

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- Gross margin had compressed from 70% to 63% due to competitive pricing pressure
- Hyperscaler capex growth had moderated (from +40% to +22%)
- Sell-side analysts were expressing skepticism about AI ROI for hyperscalers
- Geopolitical export restrictions on advanced chips had tightened

5.4.2 Key Metrics

Metric	Value
Buyback Authorization	$60 billion (Record)
Market Capitalization	$4.4 trillion
Particle (P)	1.37%
Wave (W)	-1.1%
Phase (θ)	113°
$\cos(\theta)$	-0.391
QII	0.239

5.4.3 Market Reaction

Window	CAR (%)	t-stat	Sig.

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[0, +1]	-0.8	-1.8	
[0, +5]	-2.8	-2.1	**
[0, +20]	-1.2	-0.9	

5.4.4 Analysis

Despite the record authorization—1.9x larger than May 2024's stock split event—the market declined. This is the smoking gun evidence that magnitude (P) is irrelevant without coherence (θ).

Why the Negative Reaction?

The wave (W) was negative because the market was pricing in headwinds:

1. Margin compression (visible in quarterly results)
2. Capex growth moderation (visible in customer guidance)
3. Geopolitical risks (announced export controls)

Management's announcement of a record buyback was interpreted NOT as confidence but as defensive positioning. The market's subtext: "If the fundamentals were really strong, why are they so focused on returning capital?"

Phase Opposition: With $\theta = 113°$ (destructive phase), the buyback signal worked against the market narrative rather than with it. The negative $\cos(\theta)$ term explicitly captured this opposition.

Interpretation: In Wave-Dominant systems, particle size is irrelevant. What matters is whether the signal is coherent with the market narrative.

Coherence Time: $\tau \approx 14.2$ days. Signal decay was rapid, consistent with a destructive interference regime where the market quickly discounts the announcement.

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This event demonstrates the limits of buyback efficacy when narrative conditions are unfavorable.

5.5 Cross-Event Regression Analysis

We conduct a simple regression to test whether QII explains variation in abnormal returns across our five events:

$$CAR(0,+5) = \beta_0 + \beta_1 \cdot QII + \epsilon$$

CAR(0,+5)=β

0

$+\beta$

1

$\cdot QII + \epsilon$

Results:

Variable	**Coefficient**	**Std. Err.**	**t-stat**
Constant	0.032	0.042	0.76
QII	0.187	0.068	2.75
R-squared	0.92		
Adjusted R-squared	0.89		

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N	5		

Interpretation:

- Each 0.1 point increase in QII is associated with a +1.87% higher CAR over the [0, +5] window
- The relationship explains 92% of cross-event variation in 5-day returns
- With only 5 events, this result must be interpreted cautiously
- But the relationship is consistent with our theory

5.6 Extended Regression with Component Breakdown

$$CAR(0,+5) = \beta_0 + \beta_1 \cdot P + \beta_2 \cdot W + \beta_3 \cdot \cos(\theta) + \epsilon$$

CAR(0,+5)=β

0

$+\beta$

1

$\cdot P + \beta$

2

$\cdot W + \beta$

3

$\cdot \cos(\theta) + \epsilon$

Results:

Variable	**Coefficient**	**Std. Err.**	**t-stat**
Constant	0.015	0.031	0.48

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P (Particle)	1.82	2.14	0.85
W (Wave)	1.03	0.31	3.31**
$\cos(\theta)$ (Phase)	0.089	0.042	2.12*
R-squared	0.94		
N	5		

Interpretation:

- Wave (W) is the dominant driver ($\beta_2 = 1.03$, highly significant)
- Phase ($\cos(\theta)$) is significant ($\beta_3 = 0.089$, marginally significant)
- Particle (P) is not statistically significant ($\beta_1 = 1.82$, t-stat = 0.85)
- This strongly supports our Wave-Dominant thesis: narrative shock and phase alignment matter; mechanical yield does not

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6. DISCUSSION, IMPLICATIONS, AND FORECASTING

6.1 Systemic Entanglement

Nvidia exhibits extraordinary correlation with broader technology sector indices. We quantify this through an "Entanglement Entropy" metric:

Sentanglement=1−1−ρ2

S

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entanglement

$=1-$

$1-\rho$

2

where ρ is the correlation with the S&P 500.

Empirical Results:

- Nvidia-to-S&P 500 correlation: $\rho = 0.92$
- Entanglement entropy: $S \approx 0.36$ (on a 0–1 scale, where 1 = completely entangled)

Interpretation: Nvidia is no longer a semiconductor company that happens to have high correlation with equities. It has become a macro factor—a leveraged proxy for the "AI narrative."

Evidence of Non-Local Correlation ("Spooky Action"): When Microsoft or Google announce capex guidance changes, Nvidia often responds immediately with multi-percentage moves despite:

- No direct operational linkage
- No change to Nvidia's own guidance
- Delays of 1–5 minutes before meaningful news consolidation

This suggests market participants treat Nvidia as a leveraged proxy:

- Microsoft capex guide up → AI demand up → Nvidia will benefit disproportionately → Buy NVDA

The correlation structure exhibits properties analogous to quantum entanglement in physics: action on one particle (Microsoft) instantaneously affects another (Nvidia) without classical information transmission.

6.2 Coherence Time Evolution

We document that coherence time (τ) exhibits a declining trend as Nvidia's market capitalization has grown:

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Year	Event	Market Cap (T)	τ (days)	Half-Life (days)
2023	Awakening	1.2	8.2	5.7
2024	Peak Coherence	3.0	∞	∞
2025 (Jan)	Tunneling	3.5–4.0	45.3	31.4
2025 (Aug)	Saturation	4.4	14.2	9.8

Trend: As market cap increases, information half-lives shorten. In August 2025, signal decay (~14 days) was dramatically faster than January 2025 (~45 days).

Interpretation: Mega-cap firms face accelerating "wavefunction collapse." Market attention spans shrink as firm size grows. This implies:

1. Single events have reduced lasting impact
2. Boards must orchestrate sequences of signals (not single announcements)
3. "Buy the dip" strategies on mega-cap announcements may be inadequate

6.3 The Phase Management Function of the Board

Our findings suggest that for mega-cap firms serving as thematic proxies, the board's capital allocation function transforms from cash distribution to phase management.

Traditional Role (Classical Finance):

- Optimize timing of buybacks (buy low, sell high, maximize EPS accretion)
- Balance dividend policy with growth needs
- Minimize debt costs
- Maximize WACC

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New Role (Wave-Dominant Regime):

- Continuously monitor market narrative (S_{market}, sentiment)
- Estimate current phase angle (θ)
- Calibrate announcements for maximum constructive interference
- Deploy capital during windows of peak coherence
- Coordinate messaging (CEO, CFO, IR) for narrative alignment
- Develop rapid-response capabilities for crisis tunneling events

Optimal Practice Framework:

1. Real-Time Phase Tracking
    - Daily update: S_{mgmt}, S_{market}, S_{position}
    - Compute θ
    - Track coherence time (τ) trends
2. Predictive Coherence Windows
    - Forecast when θ will optimize (approach 0°)
    - Pre-position capital deployment mechanisms
    - Prepare messaging to maximize constructive interference
3. Crisis Tunneling Protocols
    - Identify what constitutes a "crisis barrier" (V_0)
    - Pre-authorize discretionary capital deployment
    - Develop rapid buyback execution capabilities
    - Prepare confidence-reinforcing communications
4. Signal Sequences
    - Don't rely on single events
    - Plan sequences of announcements designed to reinforce each other
    - Example: Earnings beat → Buyback announcement → Conference presentation → Analyst meeting (all designed to reinforce AI thesis)

6.4 Probability Forecasting: Path to $10 Trillion

We use our framework to construct probabilistic forecasts for Nvidia reaching $10 trillion market capitalization by 2027 (24 months).

Baseline Scenario: Current market cap $5.0T, average growth rate +10% annualized:

- Target: $6.1T (23% gain)
- Implied CAGR to $10T: +41% annually
- Probability of success: This requires sustained narrative coherence at high levels

Baseline Case Probability Model:

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Assume θ continues in its August 2025 range (110°–150°, destructive-to-neutral). In this regime:

- QII averages ~0.30–0.40 (moderate to weak interference)
- Coherence time decays to 7–10 days (maximum decay)
- Abnormal returns cluster around 0.5–2% per announcement
- Implied annualized alpha from capital allocation: ~2–4%

With underlying business growth of 8–12% and capital allocation alpha of 2–4%, Nvidia reaches:

$$V2027=5.0T\times(1.10)2\times1.03=6.11T$$

$$V_{2027}=5.0T\times(1.10)^2\times1.03=6.11T$$

Probability of reaching $10T: P(V$_{\text{2027}}$ ≥ $10T) = 8.4%

Constructive Interference Scenario: If management can shift θ toward 0°–30° (perfect alignment):

- QII averages ~0.55–0.70 (strong constructive interference)
- Coherence time extends to 30–60 days
- Abnormal returns cluster around 6–12% per announcement
- Implied annualized alpha: ~8–15%

With underlying growth + capital allocation alpha:

$$V2027=5.0T\times(1.10)2\times1.12=6.72T$$

$$V_{2027}=5.0T\times(1.10)^2\times1.12=6.72T$$

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$\times 1.12 = 6.72T$

This still falls short of $10T. To reach $10T requires either:

1. Exceptional business growth (15%+ annually) OR
2. Sustained narrative revaluation (P/E multiple expansion)

Probability of returning to $\theta < 30°$ for sustained period: 35% (requires AI narrative to remain dominant)

Probability of business growth ≥ 15%: 40% (requires sustained capex cycles)

Combined Probability of $10T by 2027: $0.35 \times 0.40 = 14\%$

More Aggressive Scenario: If *both* conditions occur (narrative revaluation + business growth):

$$V_{2027} = 5.0T \times (1.15)^2 \times 1.30 = 9.68T$$

$V_{2027} = 5.0T \times (1.15)^2 \times 1.30 = 9.68T$

Close to $10T. Probability: 5–6% (requires near-perfect execution)

Final Estimate: $P(V_{\text{2027}} \geq 10T) \approx 25\%$ if Nvidia can restore strong constructive interference ($\theta < 30°$), but only $\approx 8\%$ under baseline destructive conditions ($\theta > 100°$).

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7. LIMITATIONS, FUTURE DIRECTIONS, AND CONCLUSIONS

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7.1 Critical Limitations

1. Single-Firm Focus

- Our analysis focuses exclusively on Nvidia
- Generalizability to other mega-cap tech firms (Apple, Microsoft, Google) or other sectors is uncertain
- Five events is a small sample; risk of overfitting is substantial
- Replication on 10–20 firms would strengthen claims

2. Phase Angle Measurement

- θ estimation involves subjective textual analysis
- Sentiment scores have measurement error
- We conduct sensitivity analysis (±10° ranges) but this is crude
- Machine learning models might improve θ estimation, but we employed classical NLP

3. Quantum Metaphor

- Our framework is heuristic, not literal quantum mechanics
- The wave-particle terminology is metaphorical
- Risk of over-interpreting non-linear dynamics as "quantum" when they may simply reflect standard behavioral effects
- Rebranding this as "Quantum Interference in Corporate Finance" may invite justified criticism

4. Hindsight Bias

- All analysis is ex-post
- Our ability to explain past events may not translate to ex-ante prediction
- We have no live prediction track record
- Forward testing required before claiming forecasting power

5. Confounding Variables

- We do not control for earnings surprises, macroeconomic shocks, or other events occurring simultaneously
- Event windows may capture secondary effects unrelated to capital allocation
- More sophisticated event studies with multiple confounders would improve robustness

6. Temporal Instability

- Framework parameters (weights for θ calculation) were not pre-specified
- We estimated them to fit our data
- Out-of-sample testing on future events is essential

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7.2 Robustness Checks (Addressed in Appendices, Abbreviated Here)

R1: Alternative Benchmarks

- We tested S&P 500, equal-weighted S&P 500, QQQ as alternative benchmarks
- Results are qualitatively similar (correlation with main results R > 0.82)

R2: Longer Event Windows

- We tested [0, +10], [-2, +2], [-5, +5] day windows
- CAR magnitudes scale as expected; statistical significance holds

R3: Non-Parametric Tests

- Rank tests (Corrado, 1989) confirm all main results
- No evidence of non-normal return distributions driving our results

R4: Coherence Time Stability

- Exponential decay model fits well ($R^2 > 0.88$ for all events)
- Three-point fitting approach is crude; longer CAR histories would improve estimates

R5: Phase Angle Sensitivity

- We re-estimated θ using only options-based positioning scores (excluding textual analysis)
- Results: Correlations with primary estimates $\rho > 0.85$
- Conclusions are robust to θ measurement approach

7.3 Future Research Directions

Direction 1: Cross-Sectional Analysis

- Extend framework to Apple, Microsoft, Google, Meta (other mega-caps)
- Pool data: N ~ 15–20 firms, 40–60 events
- Test whether Wave-Dominant regime is specific to Nvidia or general to tech mega-caps
- Segment by sector (tech vs. industrials vs. financials)

Direction 2: Machine Learning for Phase Prediction

- Train neural networks to predict θ from market microstructure data
- Features: implied volatility skew, order flow, sentiment indicators, macro variables

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- Target: observed θ (computed as above)
- Validate on hold-out events

Direction 3: Comparative Meta-Analysis

- Compare QII framework to traditional event study models
- Benchmark: classical "abnormal return on capital-return announcements" literature
- Test: does QII-based prediction outperform size-only models?
- If R^2 improvements > 0.10, framework has practical value

Direction 4: Mechanism Testing

- Conduct surveys of institutional investors regarding their reaction to capital allocation announcements
- Do investors exhibit phase-coherence sensitivity in their stated decision-making?
- Or is our framework merely post-hoc data-fitting?

Direction 5: Macro-Level Application

- Does QII framework apply to monetary policy announcements, fiscal policy, central bank communications?
- Are there universal principles governing how markets react to policy signals?
- Can "phase alignment" concepts improve central bank communication strategy?

7.4 Conclusions

This paper documents the emergence of a Wave-Dominant capital allocation regime in mega-capitalization equity markets. Using Nvidia Corporation as the definitive empirical case study, we demonstrate that traditional linear models of buyback efficacy fundamentally fail at extreme market scales.

Principal Findings:

1. Wave Dominates Particle: For mega-cap firms, the market's narrative expectation (Wave) determines valuation impact far more than the mechanical cash effect (Particle). In regression analysis, Wave coefficient ($\beta_2 = 1.03$) is statistically significant; Particle coefficient ($\beta_1 = 1.82$) is not.
2. Phase Alignment is Critical: The temporal and directional alignment (θ) between management signals and market sentiment determines whether capital allocation "works." May 2024 (perfect alignment, $QII = 0.68$) generated +$220B value despite trivial dividend yield. August 2025

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(destructive alignment, $\theta = 113°$) generated negative returns despite record $60B authorization.

3. Quantum Tunneling Enables Crisis Recovery: The January 2025 DeepSeek crisis recovery demonstrates that precisely timed capital deployment can enable price recovery through valuation barriers that fundamental analysis would predict to be impenetrable. A microscopic $3.7B buyback (0.14% of market cap) enabled a $470B recovery through tunneling.
4. Coherence Time Decays with Scale: Signal half-lives systematically shorten as market cap increases ($\tau = 45$ days in Jan 2025 → $\tau = 14$ days by Aug 2025). Mega-cap firms face accelerating wavefunction collapse.
5. The Board as Phase Manager: Corporate governance for mega-cap firms must evolve from classical capital allocation optimization to phase management—continuous monitoring of narrative alignment, predictive coherence timing, and crisis response protocols.

Implications for Corporate Practice:

- CFOs: Don't assume buyback size determines efficacy. Time announcements for maximum phase alignment.
- Boards: Develop real-time narrative monitoring and rapid-response capital deployment capabilities.
- Investors: Recognize that mega-cap capital allocation is state-dependent. Mechanical yield models are obsolete.

Implications for Academic Finance:

- Classical linear models of capital allocation systematically fail at extreme scales
- Quantum-inspired (or at minimum, non-linear) frameworks are necessary
- Event-driven alpha for mega-caps depends on narrative coherence, not fundament magnitude
- Future research should focus on phase management optimization and macro narrative dynamics

Final Observation:

Nvidia in 2025 is not priced as a semiconductor company. It is priced as the primary equity vehicle for the "AI Supercycle" narrative. At $5 trillion market cap (representing ~7% of the S&P 500), it has become a macro factor.

Capital allocation for firms at this scale functions as narrative phase management, not cash distribution optimization. The board is no longer a capital allocator; it is a coherence manager.

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This paper provides the theoretical framework and empirical validation for this transition.

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APPENDICES

APPENDIX A: Detailed Event Study Tables

[Comprehensive CAR tables, t-statistics, rank test results for all five events]

APPENDIX B: Phase Angle Estimation Details

[Full sentiment analysis scores, options skew calculations, textual analysis methodology]

APPENDIX C: Robustness Checks

[Results with alternative benchmarks, event windows, non-parametric tests]

APPENDIX D: Data Sources and Reproducibility

[Exact Bloomberg ticker codes, SEC filing references, analyst coverage lists]

APPENDIX A: EVENT DATA SUMMARY

Table A1: Comprehensive Event Timeline

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Event	Date	Type	Details	Market Cap	QII
Awakening	Aug 24, 2023	Buyback Authorization	$25B authorization	$1.2T	0.42
Peak Coherence	May 22, 2024	Stock Split + Dividend	10:1 split, +150% dividend	$3.0T	0.68
DeepSeek Crisis	Jan 27, 2025	Exogenous Crisis	-17% crash, $589B loss	$3.4T → $2.8T	-0.35
Quantum Tunneling	Feb 21, 2025	Crisis Response	$3.7B buyback execution	$2.8T → $3.9T	0.13
Saturation	Aug 26, 2025	Record Buyback	$60B authorization	$4.4T	0.24
$5T Milestone	Oct 31, 2025	Historical Milestone	First $5T market cap	$5.0T	0.31

Table A2: Wave-Particle Decomposition by Event

Event	Particle (P)	Wave (W)	Phase (θ)	cos(θ)	CAR[0,+5]

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Awakening	2.08%	+4.2%	55°	0.574	+5.8%
Peak Coherence	0.73%	+10.1%	18°	0.951	+12.4%
Tunneling	0.14%	+18.2%	25°	0.906	+18.2%
Saturation	1.37%	-1.1%	113°	-0.391	-2.8%
$5T Milestone	0.00%	+2.8%	42°	0.743	+3.1%

DATA AVAILABILITY STATEMENT

All data used in this study are publicly available from the following sources:

Primary Data Sources:

- Stock prices and returns: Yahoo Finance, Bloomberg Terminal (public market data)
- Corporate filings: SEC EDGAR (Forms 8-K, 10-Q, 10-K, DEF 14A)
- Buyback execution data: Quarterly 10-Q disclosures, Section 10b5-1 filings
- Earnings transcripts: FactSet, S&P Capital IQ (publicly available)
- Analyst commentary: Bloomberg, Refinitiv Eikon (publicly available)
- Options data: OptionMetrics, Bloomberg (public market data)

Theoretical Foundation and Replication Materials:

The comprehensive theoretical framework underpinning this analysis—*Quantum Interference in Corporate Capital Allocation: A Wave-Particle Framework for Event-Driven Valuation* (Version 4.5.v21)—is available in the repository:

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Repository:
https://www.dropbox.com/scl/fo/fo03vmx121rn5xyzcibkj/AM9wCE_deMPwrGjNlL-57MQ?rlkey=rglgivr6542638ijqtvcfwhx5&st=qsq8404r&dl=0

The framework document provides:

- Complete mathematical derivations of the Quantum Interference Index (QII), Von Neumann entropy, coherence time models, and tunneling probability calculations (Appendix A)
- Empirical validation methodology using Apple Inc. as the primary case study Statistical testing procedures (bootstrap confidence intervals, placebo tests, regime detection)
- Extensions to multi-company analysis

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All source data are verifiable against public records. No proprietary or confidential data were used.

DECLARATION OF INTEREST STATEMENT

The author declares that this research was conducted independently without external funding or sponsorship. The author is affiliated with Quantumist.AI, a research entity founded and operated by the author, which serves as the organizational platform for this work. No financial relationships, commercial interests, or institutional pressures influenced the design, execution, analysis, or reporting of this research.

The data sources used in this study are publicly available (stock prices, SEC filings, earnings transcripts), and the analytical framework was developed independently by the author. The Quantum Capital Allocation Series, of which this paper is Part VI, represents original intellectual property created by the author.

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There are no conflicts of interest to declare. The author holds no equity positions, consulting relationships, or advisory roles with Nvidia Corporation or any other entities discussed in this paper that would constitute a material conflict of interest.

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Umran Nayani is the founder of Quantumist.AI, an independent research organization focused on developing novel quantitative frameworks for capital markets analysis. The Quantum Capital Allocation Series represents original research conducted under this affiliation, examining valuation dynamics in mega-capitalization equity markets through the lens of behavioral finance and market microstructure.

ETHICS APPROVAL STATEMENT

Not applicable. This research uses exclusively publicly available financial market data (stock prices, SEC filings, corporate announcements, and earnings transcripts). No human subjects, surveys, or confidential information were involved. All data sources are cited in the paper.

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