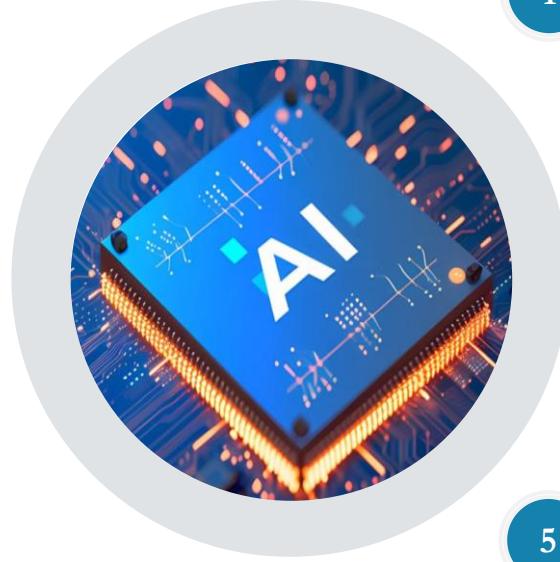


The Economics of AI Boom in U.S. Markets

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“Mohammad Ahmadi is a recent Tufts University graduate with a dual bachelor’s degree in economics and sociology. Over the past few years, he has worked in investment banking, consulting, and private equity, where he has been involved in M&A, deal sourcing, and capital raising. Mohammad enjoys learning about how businesses grow, how markets move, and how financial decisions create long-term value.”



1 Intro & AI Gains

2 AI Market Map

3 Market Valuations

4 AI Risks & Residue

5 Main Takeaways

Executive Summary

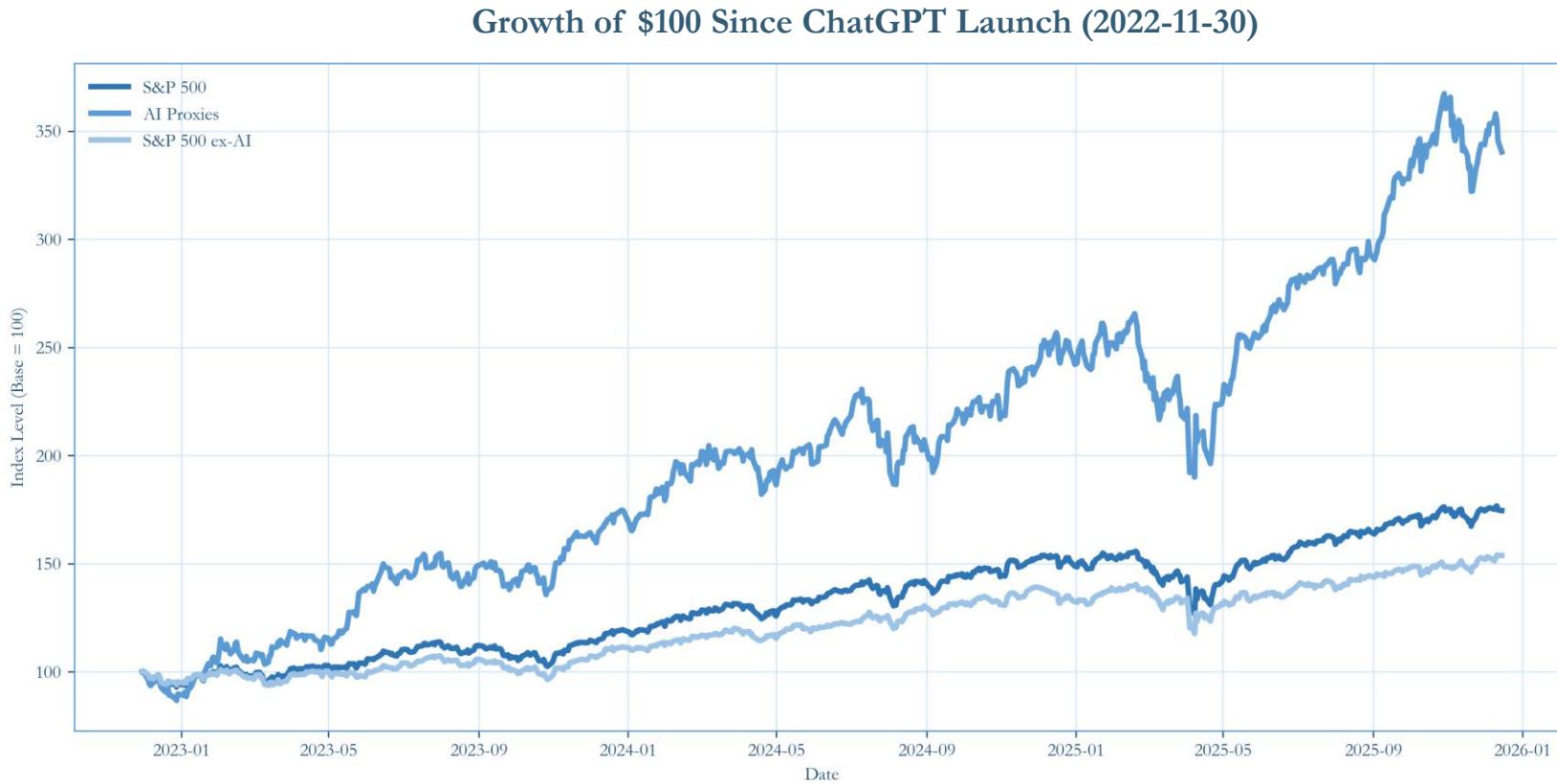
Since the launch of ChatGPT in late 2022, AI-exposed equities have driven a disproportionate share of U.S. market gains, leading to elevated concentration, correlation, and valuation expansion. A narrow group of semiconductor enablers, hyperscale platforms, and large technology firms now account for much of index performance, with price appreciation outpacing realized earnings growth.

This report shows that economic value in the AI ecosystem accrues unevenly, concentrating upstream in compute and infrastructure, while downstream applications face margin pressure, commoditization, and competitive risk. Market behavior reflects this structure, with AI equities trading increasingly as a crowded thematic factor rather than as differentiated businesses.

While AI-linked stocks have not yet amplified market drawdowns, they exhibit bubble-like dynamics, including tight correlations, elevated volatility, and dependence on sustained capital inflows. At the same time, AI expansion is generating material externalities, such as rising energy demand, memory and chip shortages, and growing safety and compliance costs, that remain largely unpriced.

Overall, U.S. equity markets appear to be pricing AI for near-perfect outcomes, leaving valuations vulnerable to disappointment if growth, margins, or macro conditions fall short of expectations.

Gains Since ChatGPT Launch



Sources: Yahoo Finance; Wikipedia (S&P 500 Constituents)

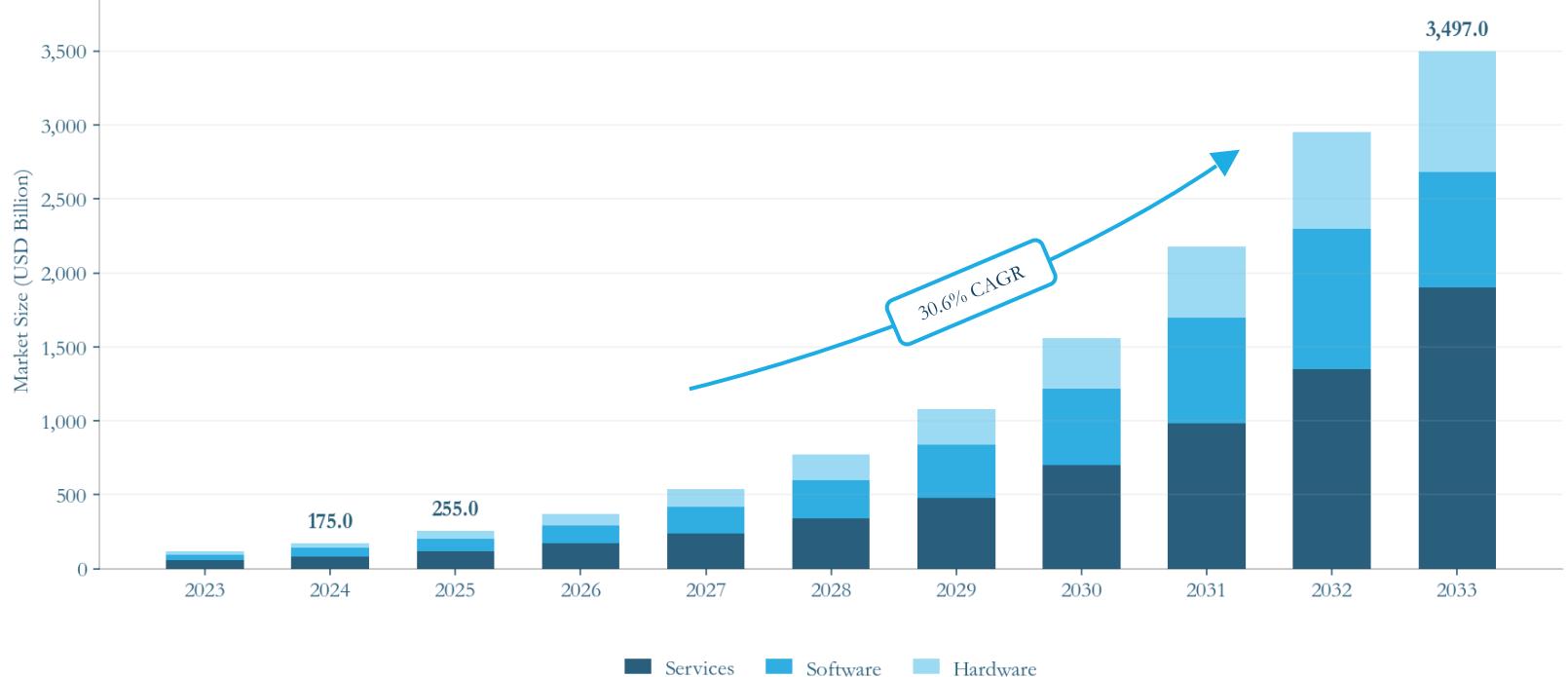
AI Proxy Basket:
Palantir Technologies, Tesla, Intel, Adobe, Snowflake, Qualcomm, Salesforce, Oracle, ServiceNow, Taiwan Semiconductor Manufacturing Company (not part of S&P 500), Amazon, Alphabet (Google), Meta Platforms, Microsoft, Micron Technology, ASML Holding (not part of S&P 500), Advanced Micro Devices, NVIDIA, and Broadcom

AI Global Market Value

While precise measurement of the AI market is inherently difficult, third-party estimates from Grand View Research and Statista place global AI revenues between \$244 and \$255 billion in 2025, growing at approximately 30% annually through 2030.

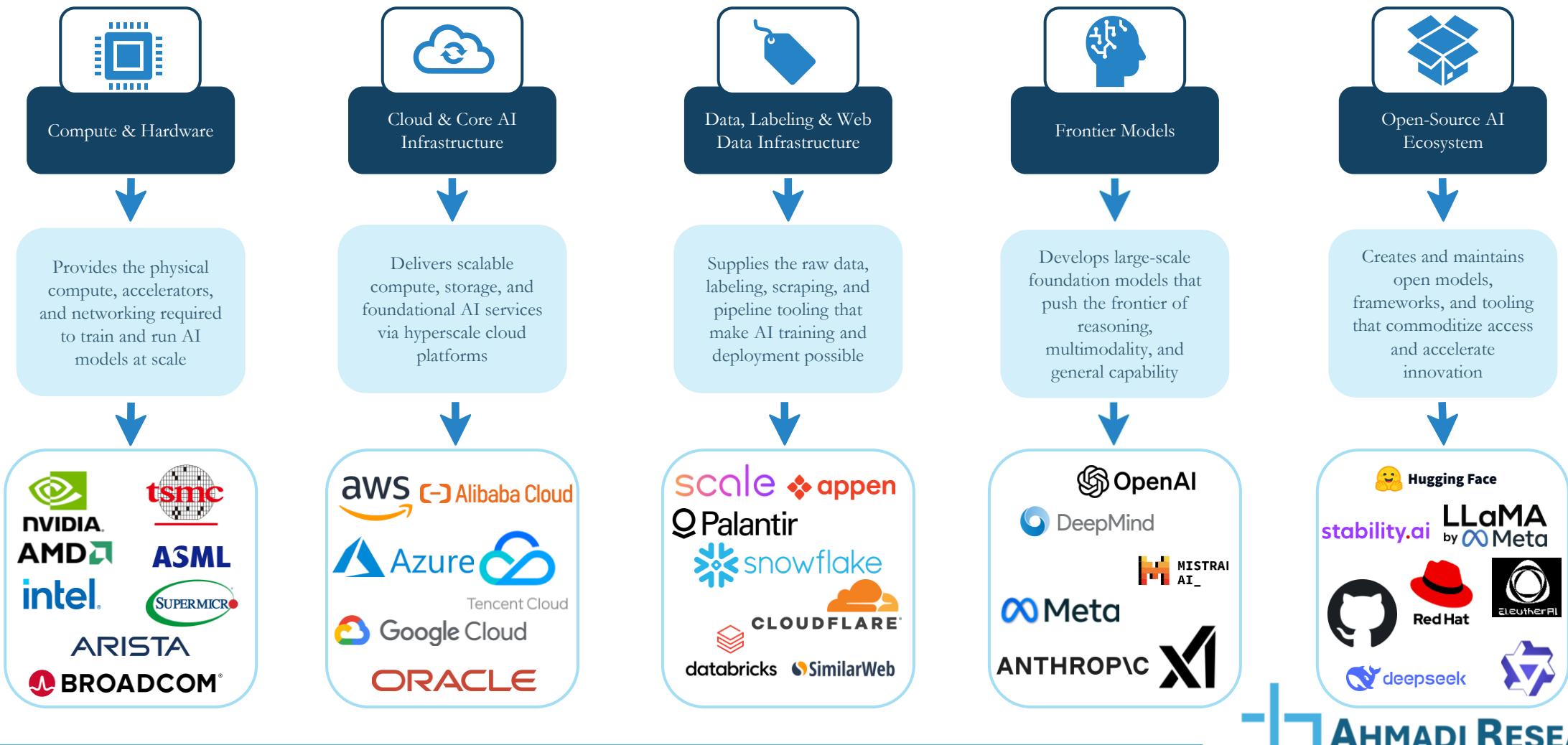
These figures represent revenue capture, not total economic value created. The gap between reported market size and firm-level outcomes is already evident: OpenAI's private valuation exceeds \$500 billion, while Nvidia alone generated over \$130 billion in AI-related revenue in 2024.

This divergence suggests current market sizing methodologies materially underestimate AI's true economic footprint, particularly as AI capabilities are increasingly embedded within software, cloud infrastructure, and enterprise services rather than sold as standalone products.



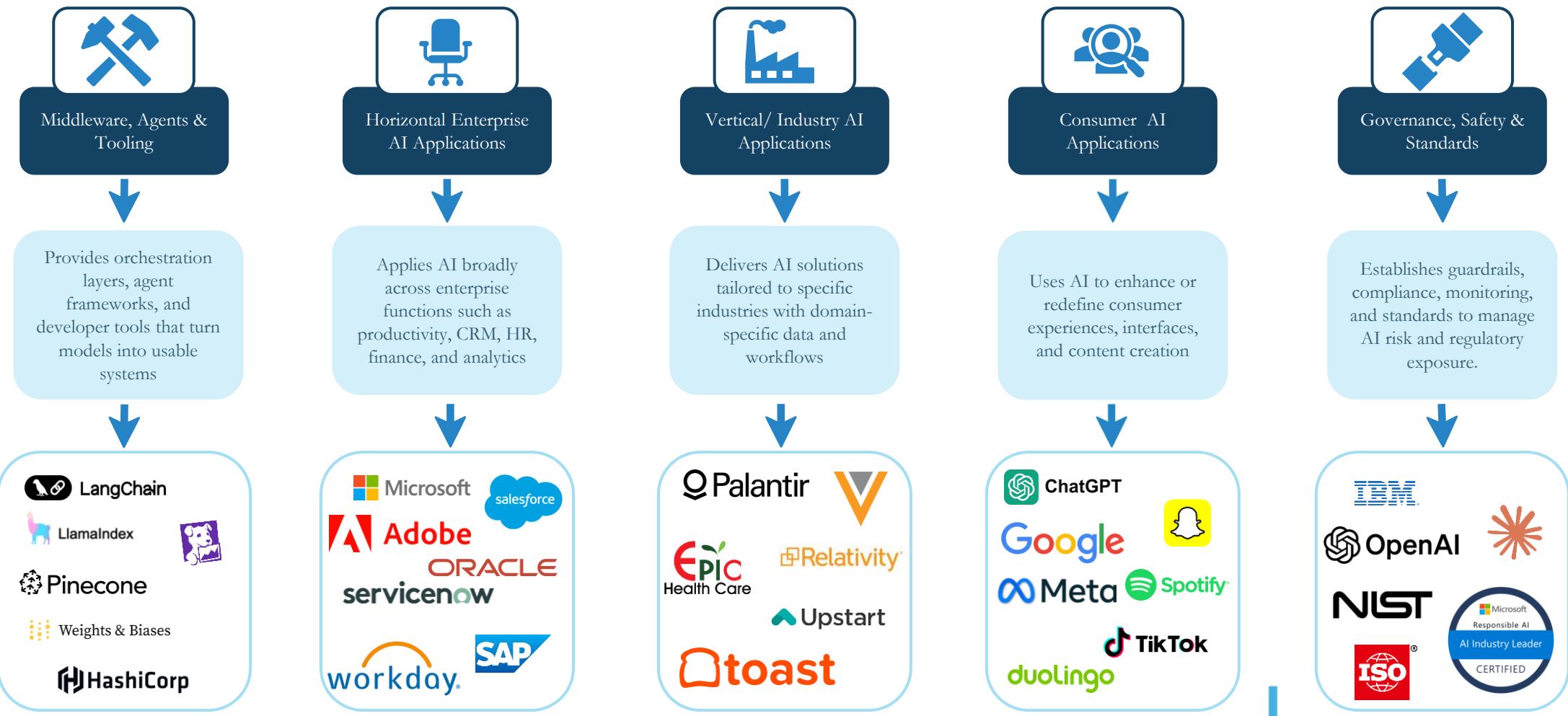
Sources: Grand View Research; Statista

AI Market Map: Defining AI-Driven Equity Segments (1/2)



Sources: Yahoo Finance; Pitchbook

AI Market Map: Defining AI-Driven Equity Segments (2/2)



Sources: Yahoo Finance; Pitchbook

AI Market Map: Where Value Accrues in the AI Stack

AI does not distribute economic value evenly. Value concentrates upstream where bottlenecks, capital intensity, and technical constraints limit competition: Upstream layers monetize the entire AI ecosystem's growth, not just their own products.

- Compute and hardware are limited by physics, fabrication, and capital
- Frontier models require rare talent, massive datasets, and sustained investment
- Cloud infrastructure benefits from scale economies and customer lock-in



Upstream segments capture outsized value because they control constraints

- Fewer winners
- Higher pricing power
- Elevated margins and valuation multiples
- Slower commoditization relative to downstream layers



Economic outcome

- Nvidia monetizes AI demand regardless of which applications succeed
- Hyper-scalers extract rent through bundled compute and AI services
- Frontier model providers capture value as capability gatekeepers



Examples

AI Market Map: Revenue Growth vs Margin Compression Downstream

Downstream AI segments scale revenue rapidly but face long-term margin pressure due to competition and falling costs: Downstream AI captures growth, but upstream AI captures profit.

- Horizontal enterprise AI tools are easy to replicate
- Consumer AI applications compete on UX and distribution
- Open-source models reduce differentiation over time



Downstream segments grow fast but lack durable bottlenecks

- Rapid declines in inference and training costs
- Open-source models narrowing performance gaps
- Low switching costs for customers
- Increasing buyer leverage as AI becomes standardized



Structural forces compressing margins

- Large revenue pools
- Intense competition
- Lower long-term pricing power
- Higher risk of overvaluation during hype cycles



Economic outcome

- Vertical AI applications with domain expertise
- Regulated or mission-critical use cases
- Platforms with embedded distribution or proprietary data



Where margins hold up better

Thus, AI Risk Are the Highest in Firms Where Most Values are Accrued. . .

Pure-Play AI Firms

These are companies whose core business is AI software, platforms, or AI-enabled services. Many are high-growth and remain unprofitable, with valuations driven more by expected adoption than current earnings. Pitchbook reports that nearly two-thirds of U.S. venture deal value in early 2025 was allocated to AI and machine-learning startups. However, The MIT Project NANDA State of AI in Business 2025 report finds that 95% of organizations are getting zero measurable return from GenAI investments, despite an estimated \$30–40 billion in enterprise spending.

Semiconductor (AI Enablers)

This category includes chipmakers and hardware firms that supply the computational backbone of AI. Nvidia is the clearest example, with its GPUs now essential for training and inference. Since the release of ChatGPT, Nvidia's market capitalization increased more than tenfold, briefly approaching \$4 trillion by mid-2025. While this reflects surging demand for AI chips, valuations have expanded faster than earnings, with price multiples rising sharply as investors extrapolate long-term AI demand. The rise of new competitors, particularly AMD and Huawei, are threatening the margins.

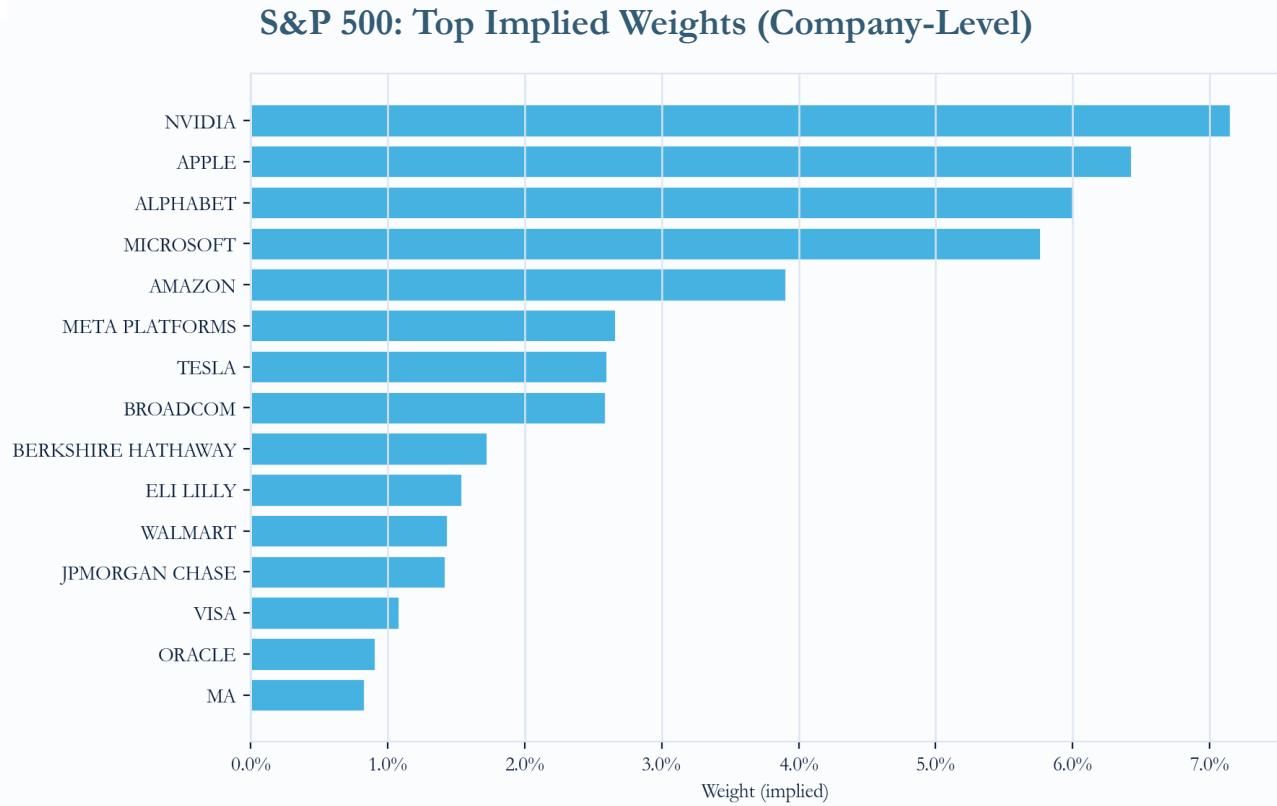
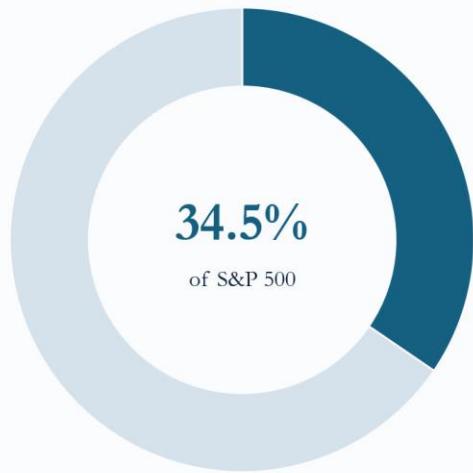
Big Tech with AI Exposure

The largest U.S. technology firms, led by Microsoft and Alphabet and supported by Meta, Amazon, Apple, and Tesla, are integrating AI at scale across products and cloud platforms. According to data from Yahoo Finance, they accounted for over one-third of the S&P 500's market capitalization and roughly 75% of the index's total returns since late 2022, reflecting a high concentration of AI-driven value in a small group of incumbents.

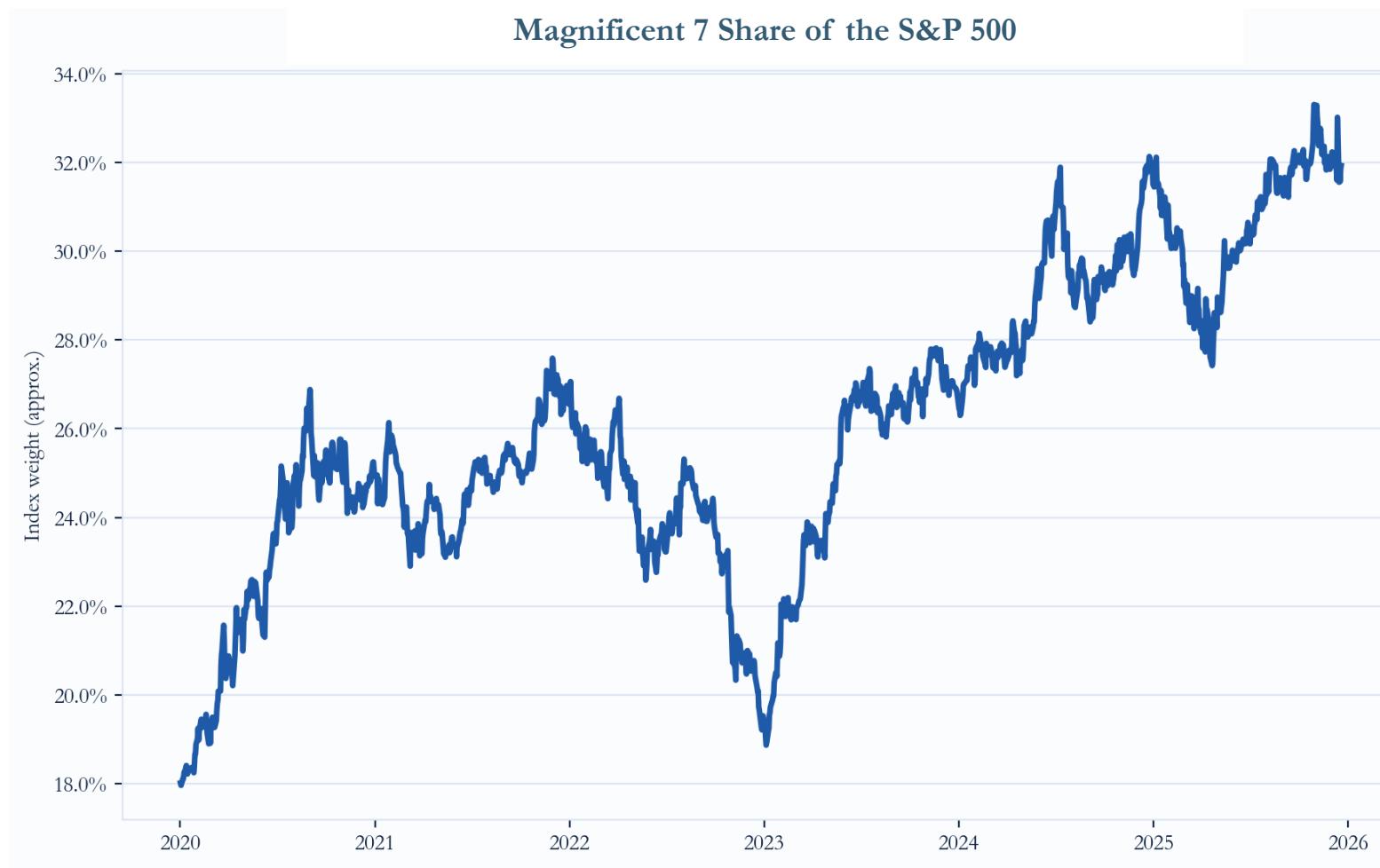


Sources: Pitchbook; The MIT Project NANDA State of AI in Business 2025 Report; Reuters.com; Yahoo Finance

Market Valuations: “The Magnificent Seven” vs. S&P 500 (1/2)



Market Valuations: “The Magnificent Seven” vs. S&P 500 (2/2)



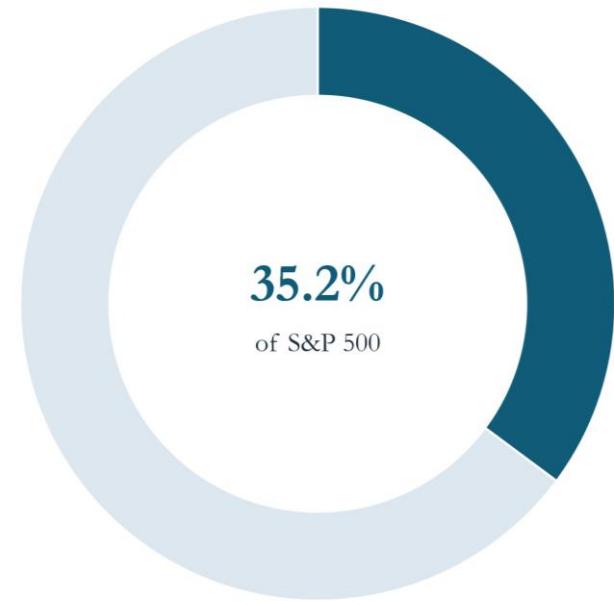
Sources: Yahoo Finance; Implied weight applied retroactively based on current weights

The Magnificent Seven's share of the S&P 500 rose from roughly 18 percent in 2020 to over 32 percent by late 2025. The sharp post-2023 increase indicates that AI exposure has become a primary driver of index composition, increasing concentration risk and dependence on a narrow group of firms.

Market Valuations: AI Basket vs. S&P 500 (1/2)

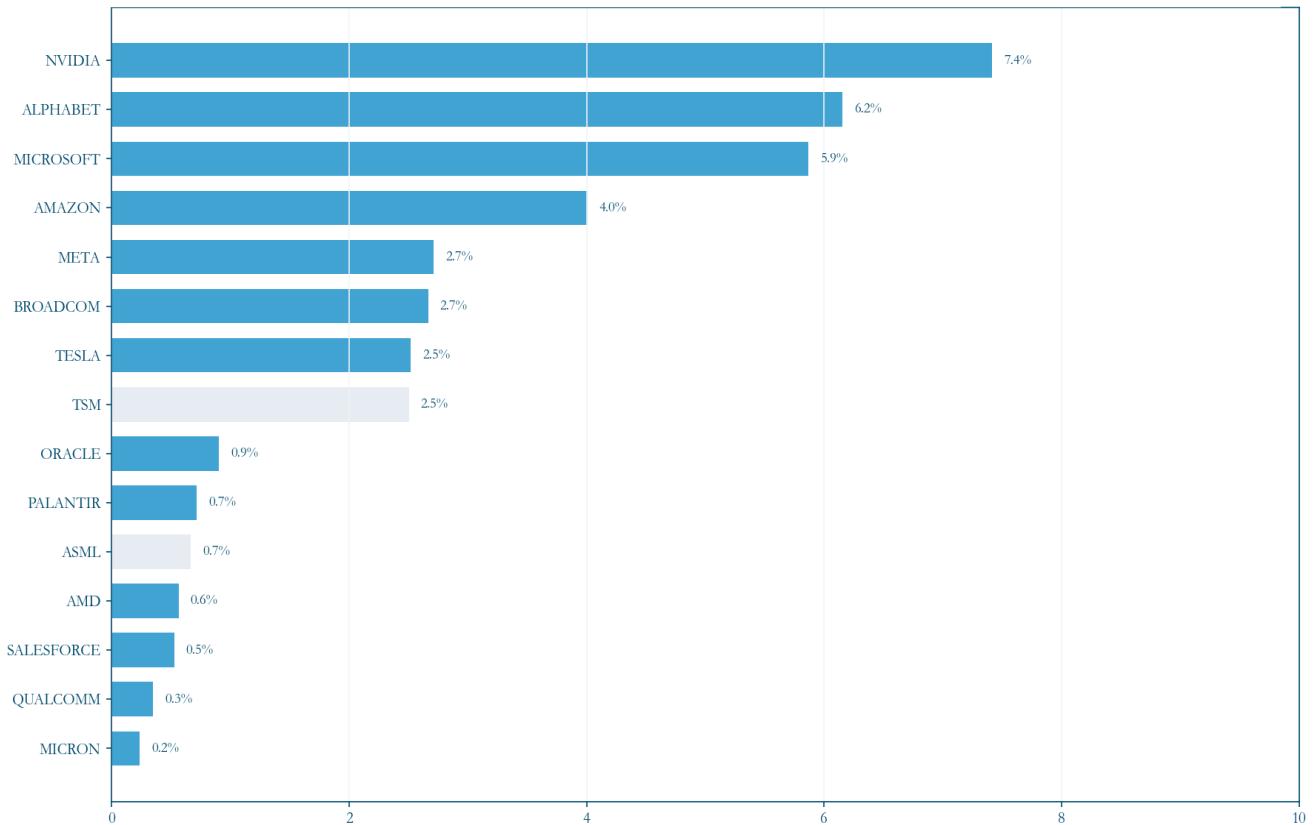
AI Basket Concentration

Share of S&P 500 index weight (members only)



Method : sum of current S&P 500 constituent weight. Excludes non-members:
TSMC, ASML

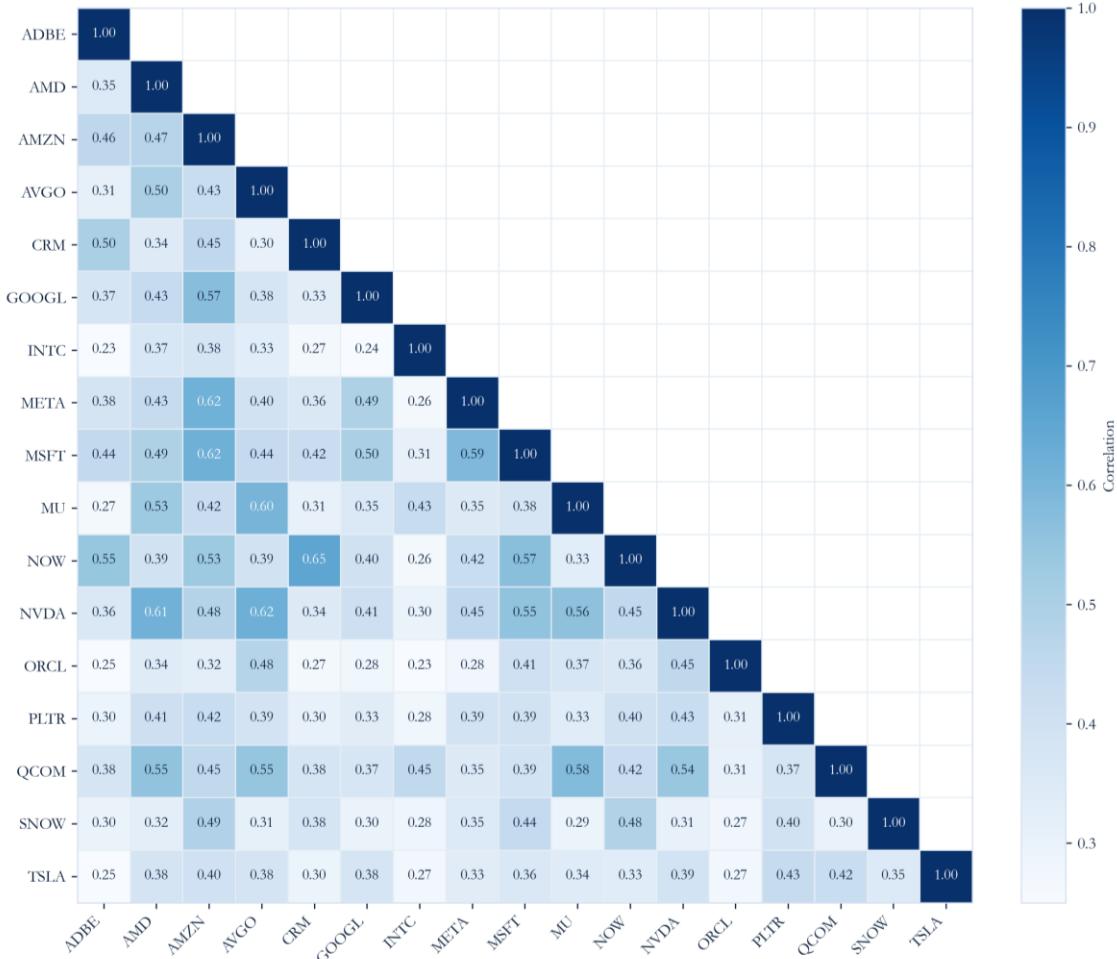
AI Basket: Implied Weights vs. S&P 500 (Company-Level)



Foreign (not in S&P500): TSMC and ASML, shown as market-cap relative weight vs. total S&P 500

Sources: Yahoo Finance

Market Valuations: AI Basket Correlation Heatmap Since the Launch of ChatGPT (2/2)



Post-ChatGPT Correlation Structure:

Since the launch of ChatGPT in November 2022, the AI proxy basket has exhibited meaningfully elevated correlations, indicating that many “AI equities” have traded as a shared factor rather than as distinct, idiosyncratic bets. This reflects the market’s tendency to price AI exposure as a thematic trade during this period.

Core Compute and Platform Clustering:

The strongest correlations are concentrated among large-cap platforms and semiconductor leaders, including NVIDIA, Microsoft, Alphabet, Amazon, and Broadcom. These firms sit at the center of the AI value chain, spanning model development, cloud infrastructure, and compute, which drives synchronized return behavior.

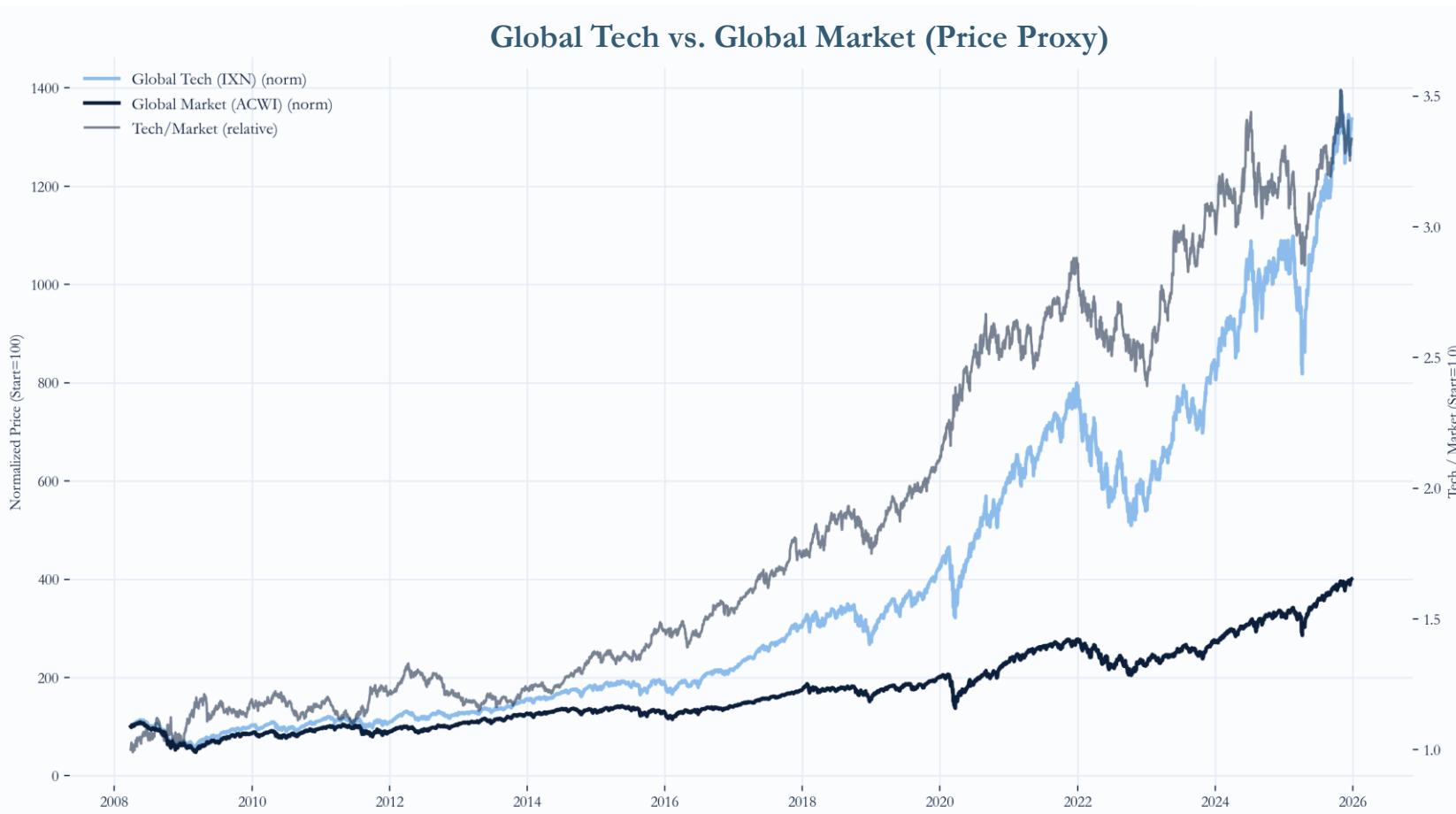
Partial Diversification at the Periphery:

Select names such as Palantir, Tesla, and Snowflake show comparatively lower correlations with the core cluster, suggesting more differentiated revenue drivers or narrative exposure. While these stocks still participate in the AI theme, their return dynamics are less tightly coupled to the dominant compute-platform complex.

Sources: Yahoo Finance

Methodology note: Foreign-listed AI leaders (Taiwan Semiconductor Manufacturing Company and ASML Holding) are excluded from the correlation analysis to avoid ADR and currency-related distortions in daily return correlations.

Market Valuations: Global Technology's Rising Share of Market Performance



Sources: Yahoo Finance

Global Tech (IXN): A global technology equity index proxy capturing large- and mid-cap technology companies across developed markets, heavily weighted toward U.S. and other advanced-economy tech leaders.

Global Market (ACWI): A broad global equity benchmark representing large- and mid-cap stocks across both developed and emerging markets, spanning all major sectors.

Tech/Market relative is the ratio of the global technology index (IXN) to the broad global equity index (ACWI), rebased to a common starting point. It shows how technology has performed relative to the overall market over time.

Global technology has materially outperformed the broader global equity market over the past decade, as reflected in the persistent rise in the Tech/Market ratio despite periodic risk-off drawdowns. The post-2020 step-up suggests a widening structural gap in performance rather than a simple cyclical rebound, leaving tech at elevated relative levels.

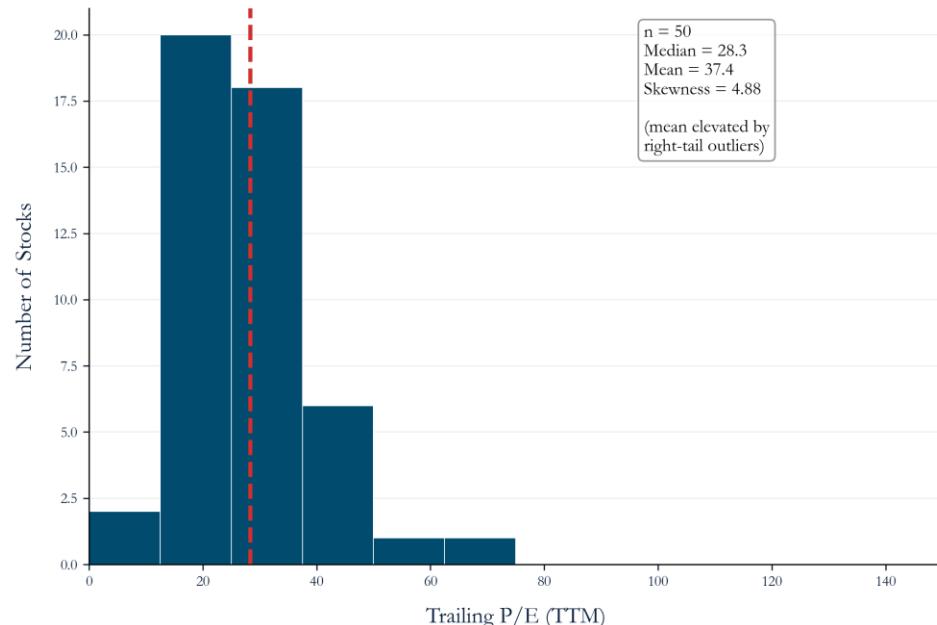
Because long-run forward PEG series for global indexes are proprietary, the comparison uses a transparent price-based proxy: IXN and ACWI are aligned to the same start date, normalized, and paired with a Tech/Market ratio to isolate relative performance.

Market Valuations: Earnings Growth vs. Price Growth

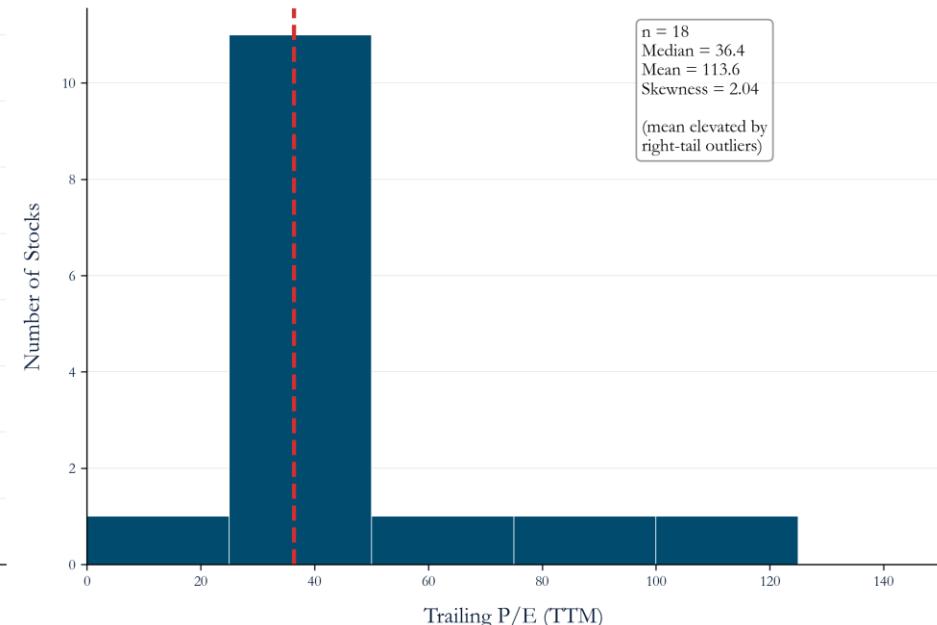
The AI Proxy Basket trades at a substantial valuation premium to the S&P 500, with a median P/E of 36.4 versus 28.3 for the broader market. This 28% premium confirms elevated valuations for AI-themed stocks. More notably, the AI basket shows extreme right-skew, with a mean P/E of 113.6 far exceeding its median, indicating that several AI stocks trade at exceptionally high multiples well above 100x earnings. In contrast, the S&P 500 exhibits more moderate skewness and a tighter distribution.

Trailing P/E Distribution Comparison (2025)

Panel A: S&P 500

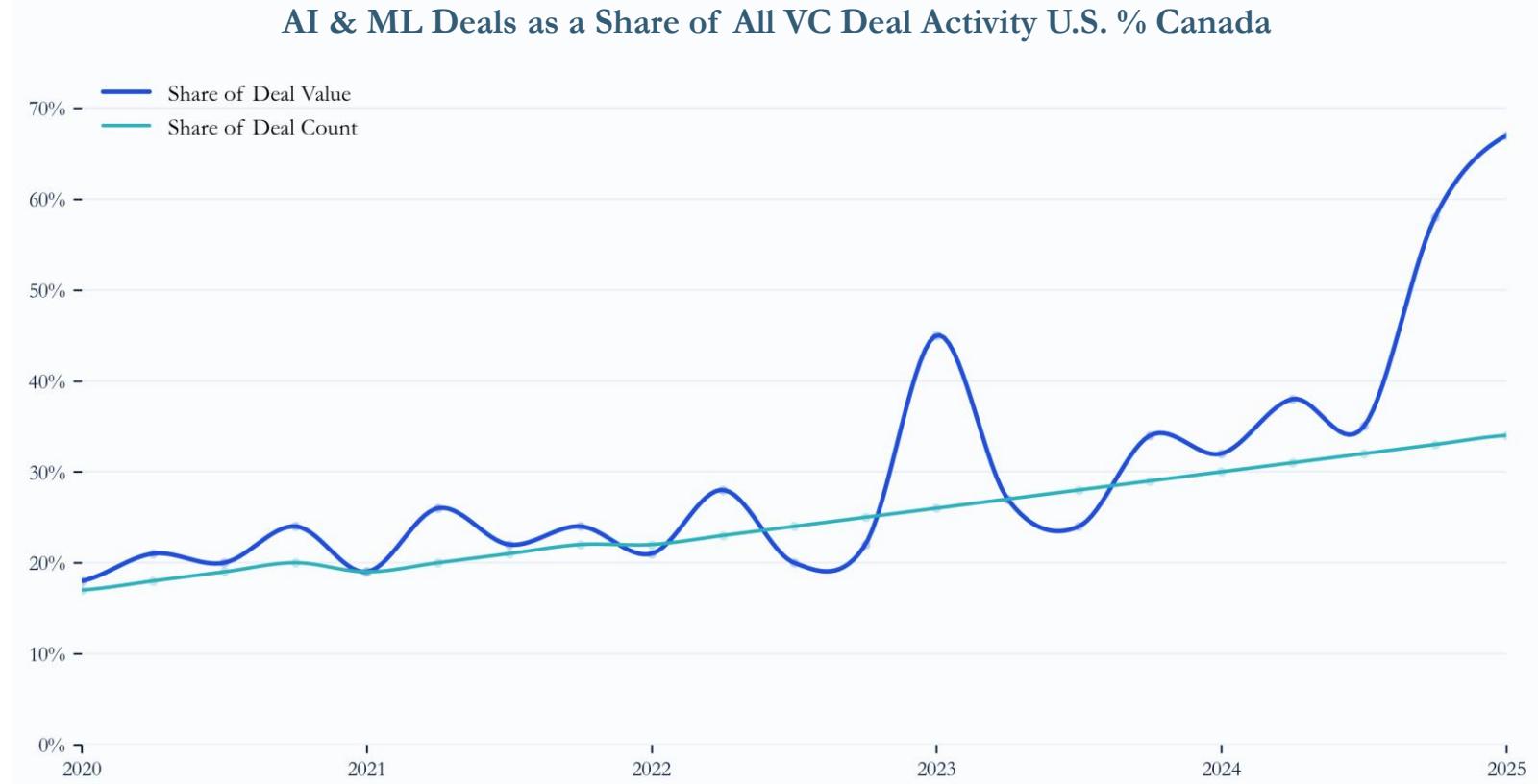


Panel B: AI Proxy Basket



Market Valuations: Capital Inflows and Market Concentration in VCs

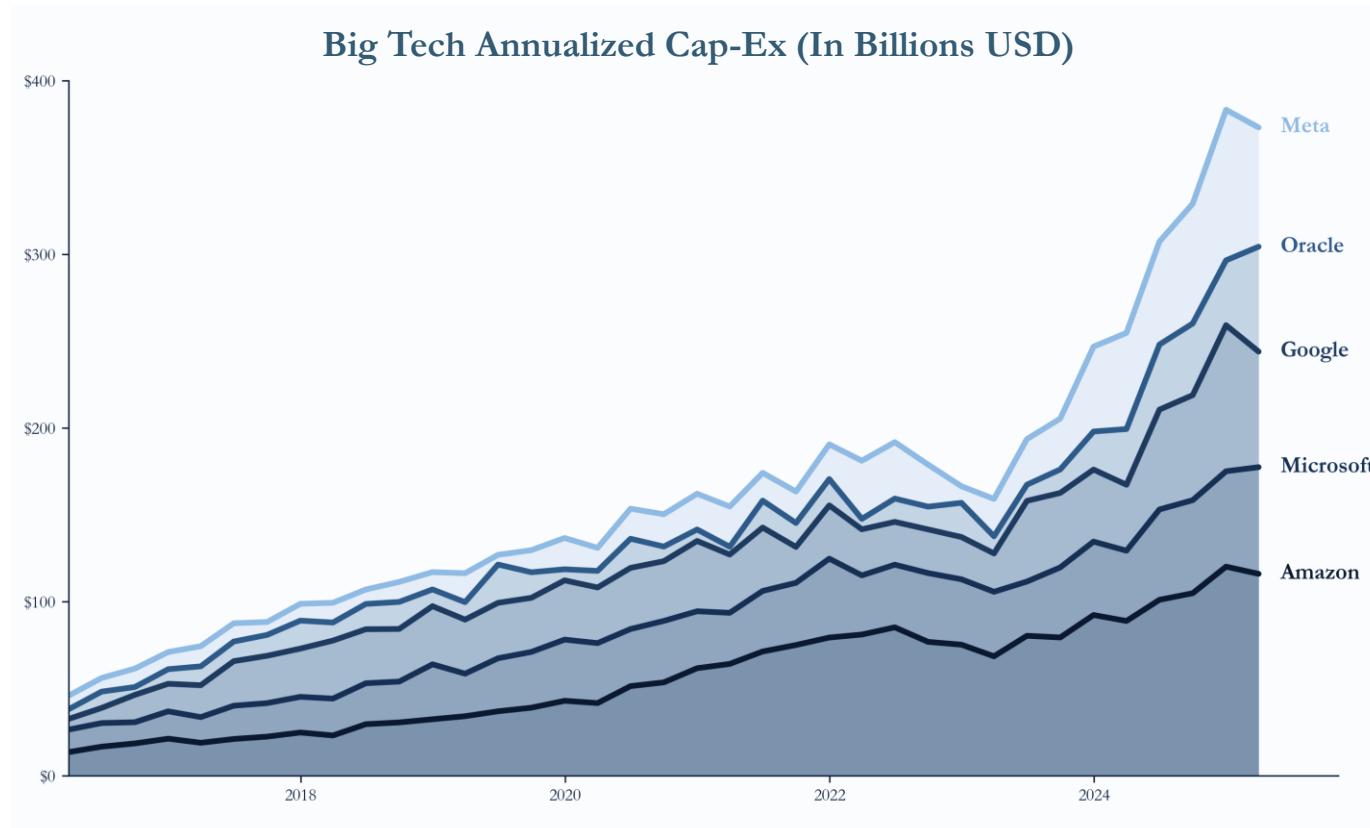
In the first quarter of 2025, AI and machine learning startups absorbed 57.9% of all global venture capital dollars, up sharply from roughly around the high-20% range in earlier years, and an even larger share of deal value in the U.S. and Canada where AI's percentage of total VC funding jumped above 65% by Q1 2025 while the share of deal count only rose modestly to the low-30% range. This dynamic shows that a disproportionate amount of total venture capital is being allocated to a relatively small number of AI mega-rounds, rather than broadly across a larger base of companies. Such concentration elevates risk: when more than half of all venture dollars flow into a single sector, portfolio diversification weakens, valuations inflate rapidly, and downside exposure increases if commercial adoption or returns fail to materialize at the scale investors are pricing in. Historical patterns from prior tech investment cycles suggest that high concentration driven by fear of missing out can precede sharp market corrections.



Sources: Pitchbook; Chart recreated using Pitchbook data with approximate values

Market Valuations: Capital Inflows and Market Concentration in Big Tech Capital Expenditure

Since 2022, AI infrastructure has absorbed the bulk of incremental Big Tech capex, crowding out spending on non-AI initiatives such as consumer hardware, experimental platforms, and legacy software expansion. Companies like Meta and Google have explicitly slowed or canceled non-core projects while simultaneously ramping data-center and AI compute investment. This signals that AI is now the primary sink for capital rather than one priority among many.

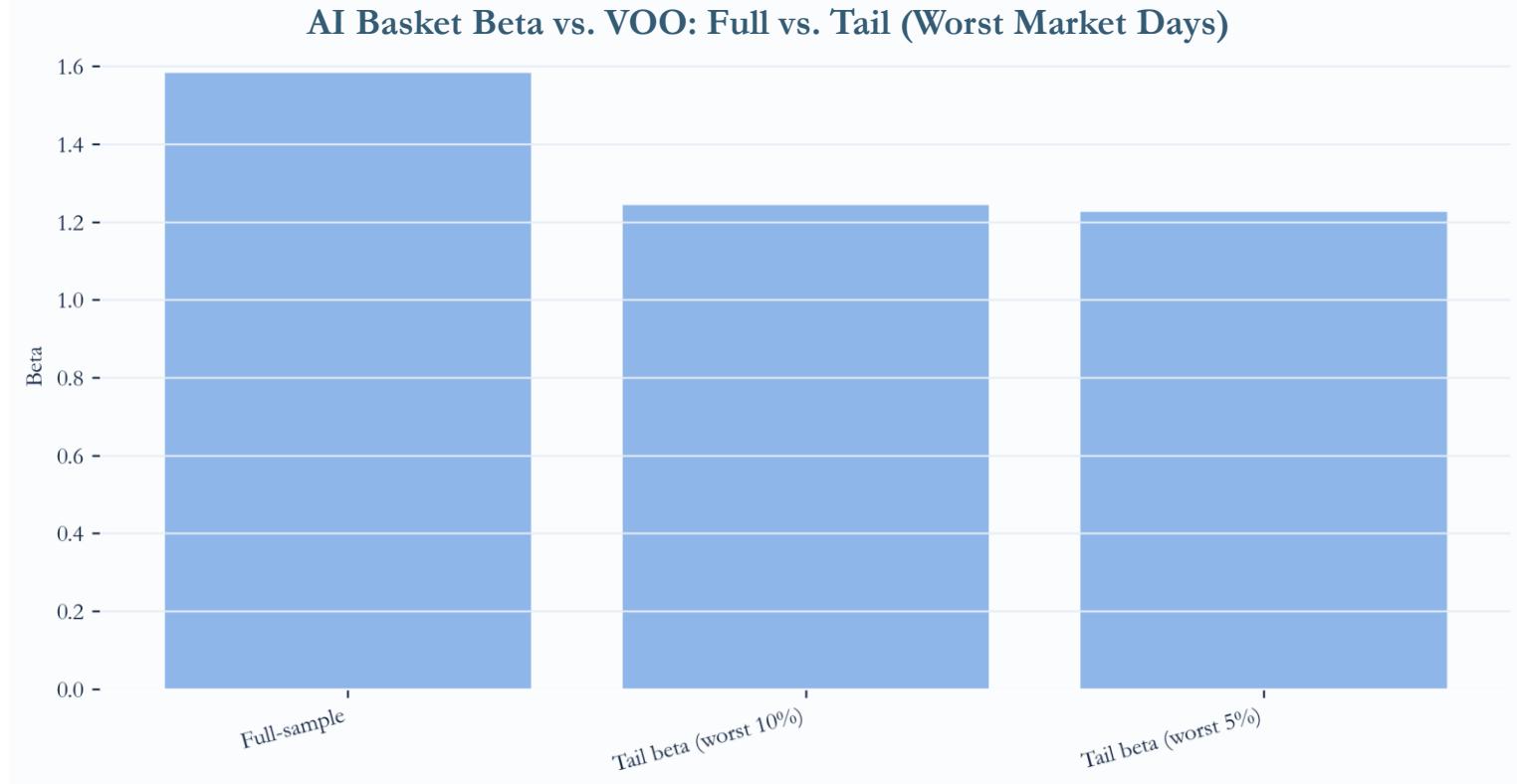


Sources: understandingai.org; Chart recreated using Understanding AI data with approximate values

Volatility and Risk Appetite: AI Basket Beta vs. VOO

Over the full sample, the AI basket exhibits a market beta of approximately 1.6. However, when conditioning on the worst 10% of market days, beta declines to roughly 1.24, and remains near 1.22 when restricted to the worst 5% of market days. In other words, AI's market sensitivity falls by roughly 20–25% during the most severe market selloffs relative to normal conditions.

With AI Baskets making up over one-third of the S&P 500, they amplify losses within the index.

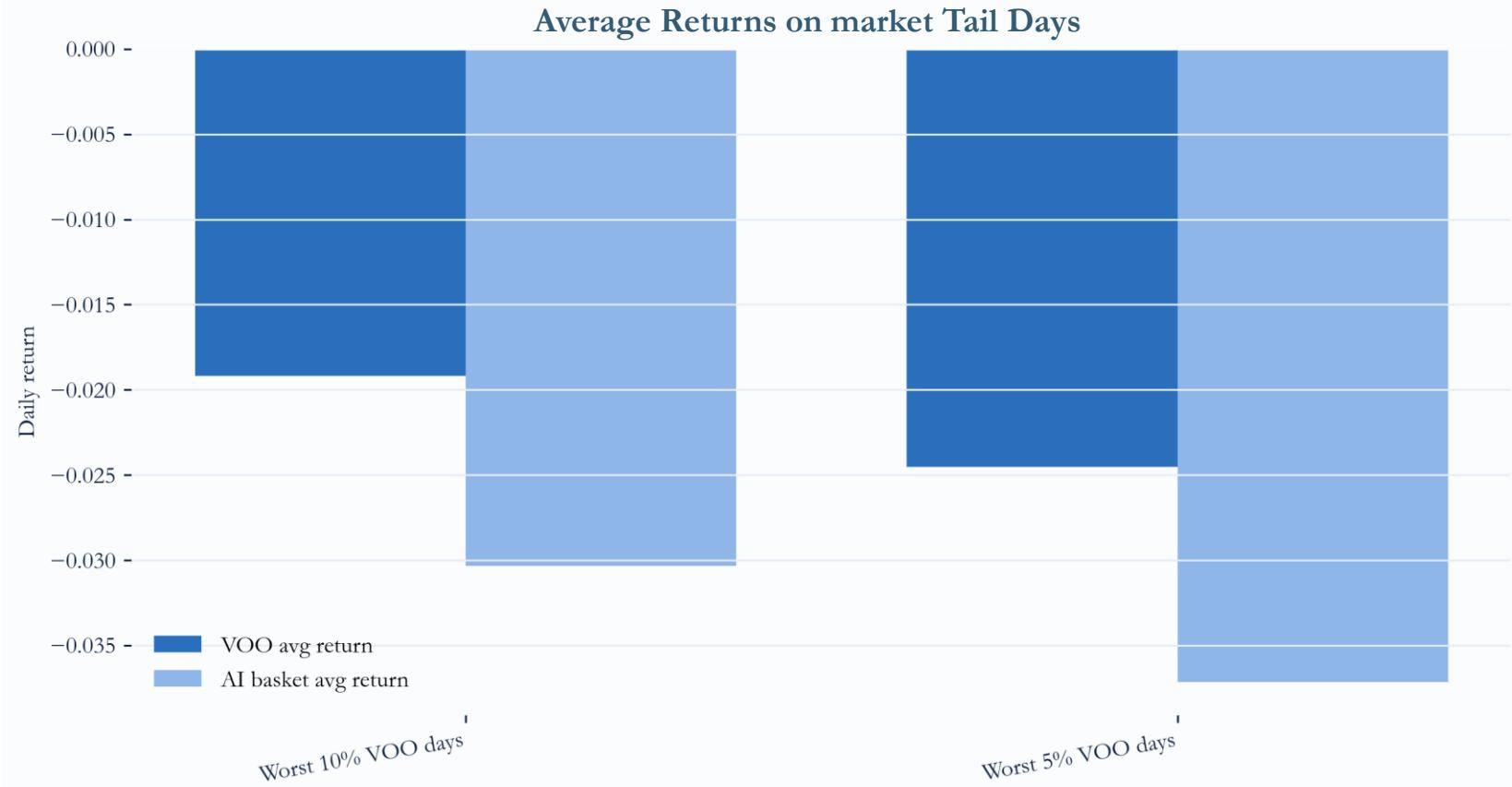


Methodology and Data: Using daily total returns from Yahoo Finance (January 2018 – late 2025), an equal-weight basket of 19 AI-exposed equities was compared against the Vanguard S&P 500 ETF (VOO). Market beta was estimated across the full sample, while tail betas isolated sensitivity during market stress by focusing specifically on the worst 10% and 5% of VOO return days.

Volatility and Risk Appetite: Average Returns on Market Tail Days

On the worst 10 percent of market days, VOO posts an average daily loss of approximately -1.9 percent, while the AI basket declines by roughly -3.0 percent, representing underperformance of about 1.6×. On the worst 5 percent of market days, average losses deepen to approximately -2.5 percent for VOO and -3.7 percent for the AI basket, implying a similar relative underperformance ratio. Across both stress regimes, AI consistently experiences materially larger losses than the market on the same days.

Although AI does not exhibit crash-convex behavior in terms of beta, it remains a leveraged expression of market stress in realized returns. When markets decline sharply, AI equities underperform meaningfully, reflecting amplified exposure rather than nonlinear breakdown. This pattern reinforces the view that AI risk manifests through loss severity and drawdown depth.

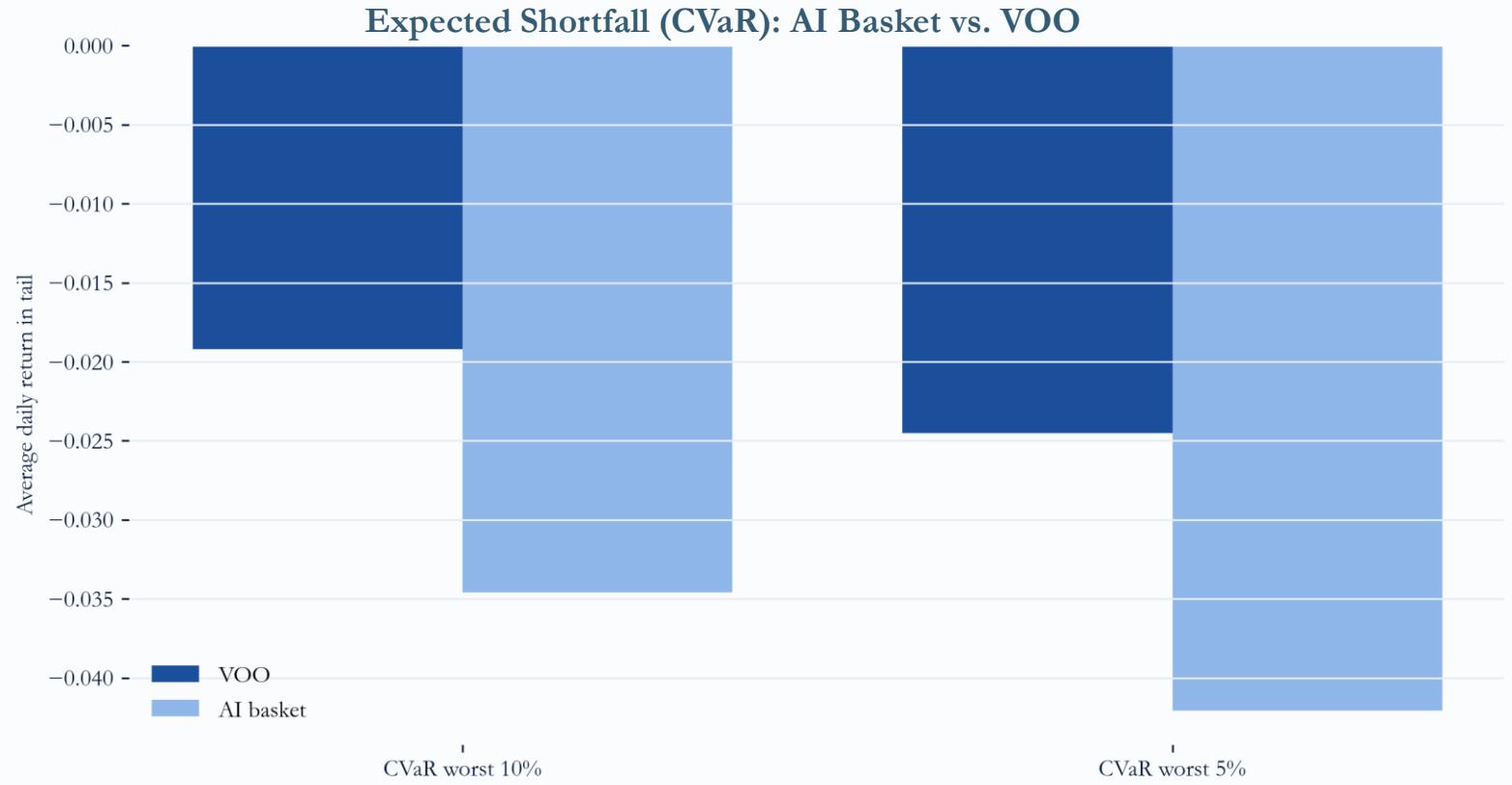


Methodology and Data: Using Yahoo Finance daily returns from January 2018 through late 2025, average returns for an equal-weight AI basket and the VOO were compared across two stress regimes (the worst 10% and 5% of market days). This conditional analysis isolates how AI-exposed equities perform specifically during tail-risk events rather than under normal conditions.

Volatility and Risk Appetite: Expected Shortfall (CVaR)

At the 10 percent tail level, VOO exhibits an average daily loss of approximately -1.9 percent, while the AI basket posts a materially larger average loss of roughly -3.4 percent. At the 5 percent tail level, expected shortfall deepens to approximately -2.5 percent for VOO and -4.2 percent for the AI basket. Across both tail thresholds, AI tail losses are roughly $1.7\times$ to $1.8\times$ larger than those of the broader market.

AI equities exhibit substantially higher tail loss severity once stress materializes.

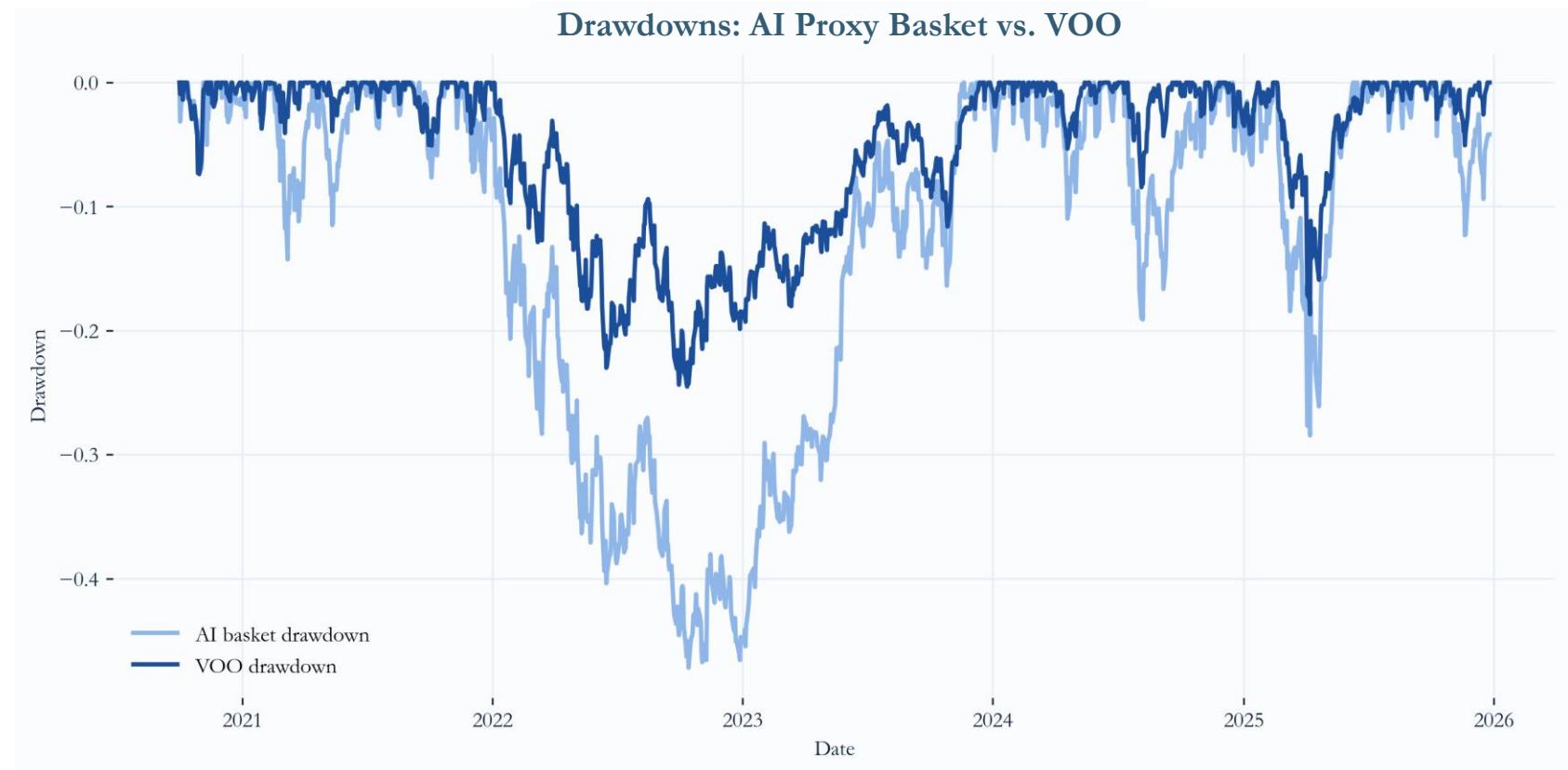


Methodology and Data: Using Yahoo Finance daily returns (Jan 2018 – late 2025), Expected Shortfall (CVaR) was computed by averaging losses within the worst 10% and 5% of each asset's own return distribution. This approach isolates the specific severity of losses for both the AI basket and VOO during their respective tail events, rather than measuring their co-movement.

Volatility and Risk Appetite: Drawdowns

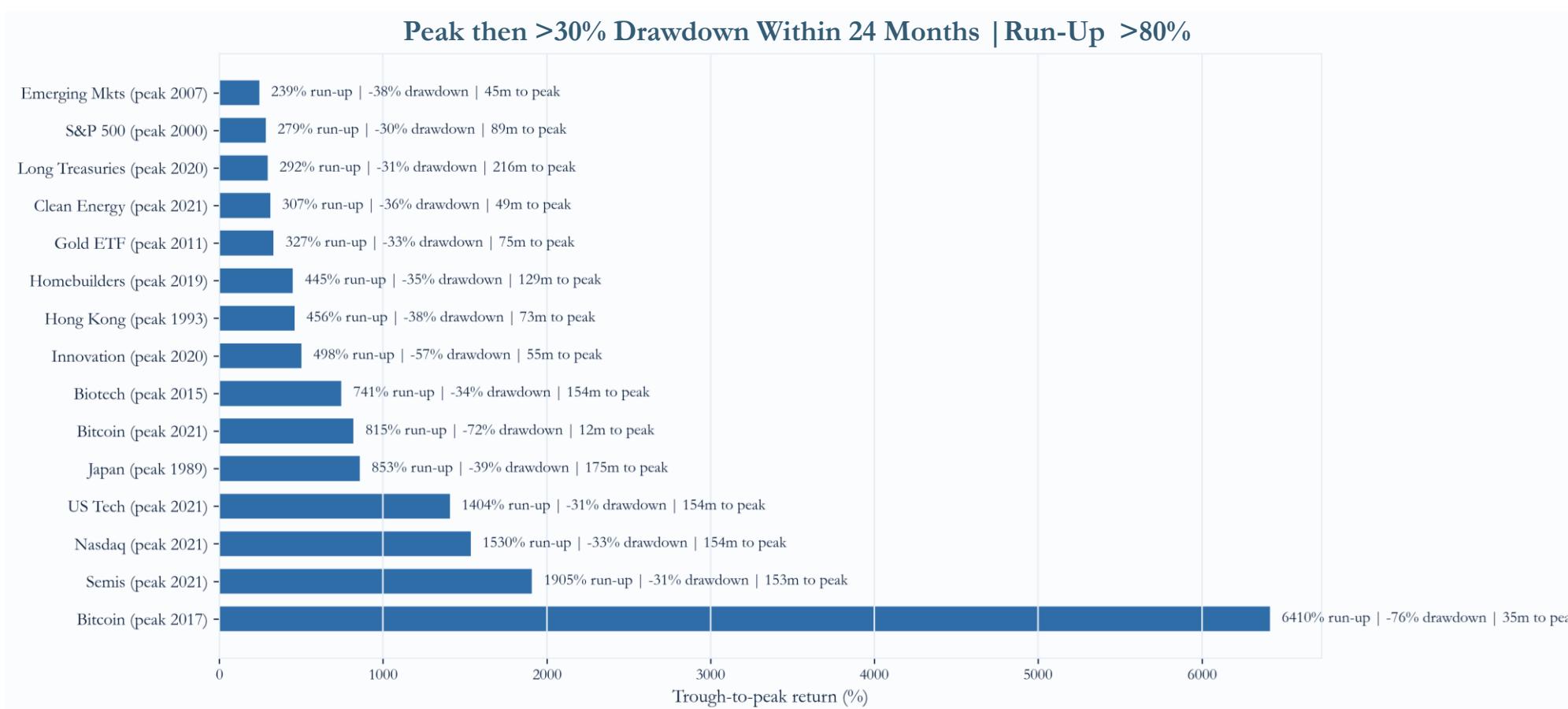
The AI basket experiences materially deeper and more persistent drawdowns than the market across the sample. During the 2022–early 2023 period, the AI basket reaches a peak drawdown of approximately –45 percent, compared with a maximum drawdown of roughly –25 percent for VOO over the same interval. Even outside major market stress episodes, AI drawdowns consistently exceed those of the market by 10 to 20 percentage points, and recovery to prior peaks occurs more slowly.

Because AI Basket comprises a big portion of S&P 500 index, it drags down and amplifies losses.



Methodology and Data: Using Yahoo Finance daily returns (Jan 2018 – late 2025), cumulative wealth indices and drawdowns were constructed for both the AI basket and VOO. By measuring percentage declines from rolling peaks, this analysis captures peak-to-trough loss severity and recovery dynamics to evaluate path-dependent risk.

Volatility and Risk Appetite: Largest Bubble Episodes (Scoreboard)

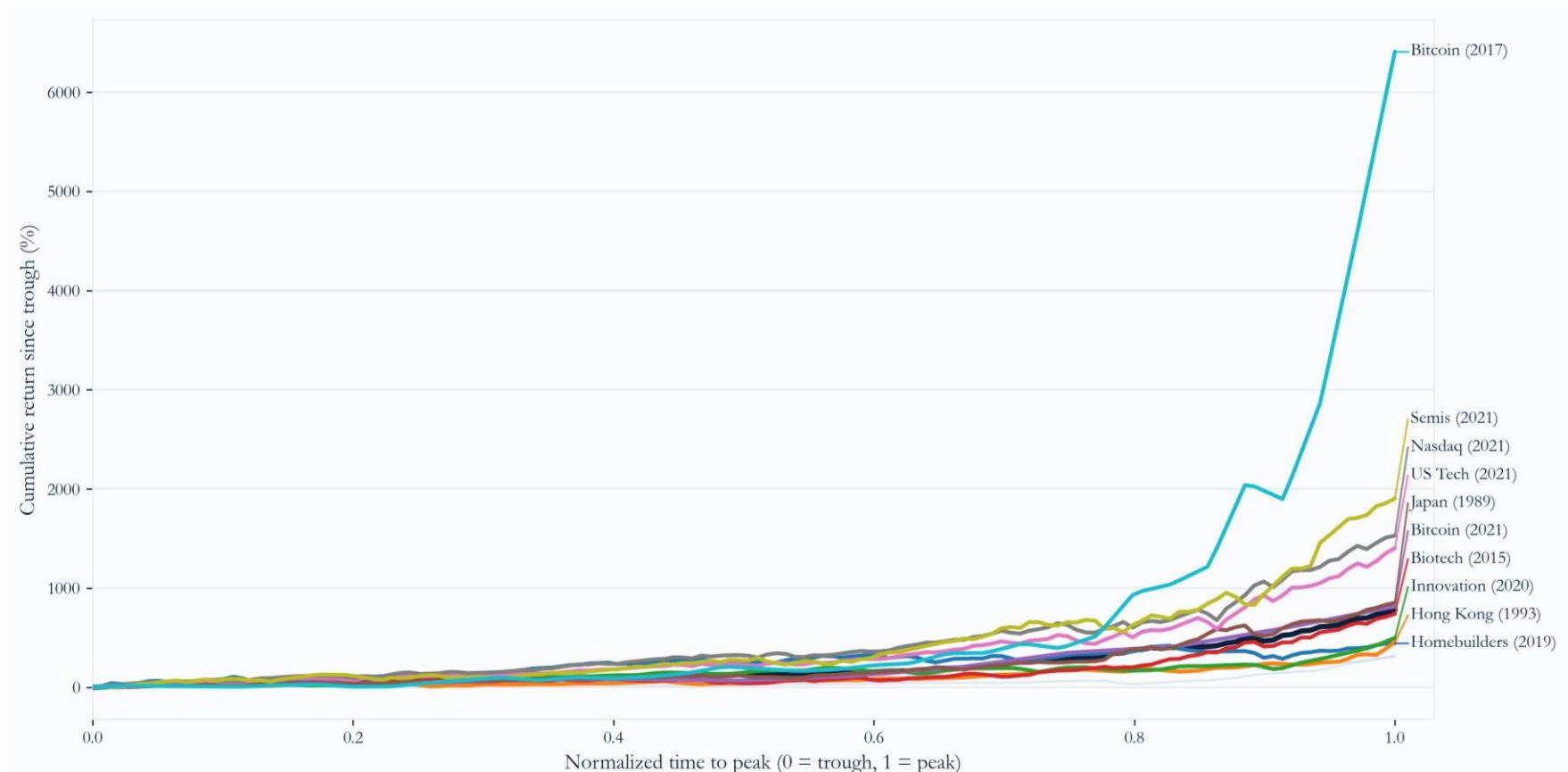


Sources: Yahoo Finance (monthly prices for indices, ETFs, and BTC-USD); Federal Reserve Economic Data (FRED) for select macro series. Bubble episodes identified algorithmically using trough-to-peak returns and $\geq 30\%$ post-peak drawdowns within 24 months.

Across assets and decades, equity bubbles typically peak between roughly 250% and 2,000% trough-to-peak returns, followed by drawdowns of 30–40% or more. Crypto stands far outside this range, with Bitcoin reaching over 6,000% in 2017, highlighting how speculative intensity and subsequent crash risk increase sharply once prices escape historical equity envelopes.

Volatility and Risk Appetite: Bubble Shape Overlay

Despite differences in assets and eras, bubbles share a common shape, with most gains concentrated in the final 10–20% of the cycle as prices accelerate sharply into the peak. AI-linked equities are now tracing this late-stage convexity seen in prior innovation bubbles, where upside becomes increasingly back-loaded and downside risk rises nonlinearly.



Sources: Yahoo Finance (monthly prices for indices, ETFs, and BTC-USD); FRED where applicable. Episodes rebased to trough and time-normalized to compare bubble shapes across assets.

AI Residue: Emerging Spaces (Energy, Memory, Non-AI Crowding-Out, and Safety)

Even as AI adoption remains speculative, its economic and social externalities are already material.

1. Energy

According to MIT Technology Review, AI is driving a structural surge in energy demand that is already reshaping the power grid. US data centers consumed ~200 TWh of electricity in 2024, with AI-specific servers using 53–76 TWh, and data centers now account for 4.4% of total US electricity use. By 2028, AI alone is projected to consume 165–326 TWh per year, equivalent to the annual electricity use of ~22% of US households, with data-center power on average 48% more carbon-intensive than the US grid due to 24/7 operation and reliance on natural gas.

Based on Reuters reporting, the AI boom has triggered a global memory-chip crunch as manufacturers redirect capacity toward AI servers and high-bandwidth memory (HBM). Industry inventories have collapsed from 13–17 weeks in late 2024 to just 2–4 weeks by late 2025, while memory prices in several segments have more than doubled since early 2025. The shortage now spans both advanced HBM for AI accelerators and commodity DRAM used in phones and PCs, with suppliers warning tight conditions could persist through 2027–2028, pushing higher costs across the broader tech supply chain.

3. Non-AI (Crowding-Out)

As memory, chips, and power are increasingly absorbed by AI infrastructure, capacity available for non-AI products continues to shrink. Reuters reporting indicates this reallocation is translating into reduced output, delayed production cycles, and higher end-consumer prices for PCs, smartphones, and other electronics. These pressures are compounded by rising electricity costs, as AI-driven data center demand tightens power markets and raises energy expenses that are ultimately passed through to non-AI manufacturers and consumers.

AI has introduced new systemic risks that previously did not exist, including model misuse, bias, and large-scale deployment failures, requiring costly mitigation and oversight. In 2025, companies reported \$4.4 billion in aggregate financial losses linked to AI risk and safety failures. At the same time, global spending on AI capabilities exceeds \$100 billion, compared with only ~\$10 million in public AI safety research funding, forcing reactive regulation and downstream costs onto consumers and taxpayers. AI Industry leaders have simultaneously invested in firms offering AI safety, governance, and risk-management solutions, monetizing the mitigation of problems they have created.

2. Memory

4. Safety

Main Takeaways: How Would the End of AI Race Look Like

Compute Commoditization Breaks Nvidia's Bottleneck

The AI race meaningfully slows once advanced compute is no longer gated by Nvidia's GPUs. If Chinese or alternative suppliers achieve performance parity in accelerators, interconnects, or packaging, the current upstream bottleneck dissolves.

Economic Returns Fail to Match Capital Intensity

Sustained underperformance of AI monetization relative to capex marks the end of the race narrative. As enterprise adoption plateaus and ROI remains elusive, capital markets reprice AI exposure from growth optionality to efficiency discipline, compressing multiples across pure-play and platform firms.

1

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Model Parity Eliminates Frontier Advantage

The race ends when frontier model performance converges and incremental gains no longer justify exponential capital outlays. Open-source and low-cost models narrowing the gap with closed systems weaken pricing power, and reduce switching costs.

Externalities Trigger Structural Constraints

Energy strain, memory bottlenecks, safety liabilities, and regulatory intervention impose real limits on unconstrained scaling. As AI's negative externalities become explicit costs rather than abstract risks, growth shifts from speed-driven expansion to regulated, incremental deployment.

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