

October 2025

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Surviving the AI Capex Boom

Executive Summary

The AI revolution has reached a key inflection point, with the largest U.S. tech firms embarking on a massive AI infrastructure buildout. While the market has rewarded this spending so far, we find that historical capital expenditure booms have typically resulted in overinvestment, excess competition, and poor stock returns – both at the macro and individual firm level. With the AI arms race transforming Big Tech from asset-light to asset-heavy, a model we find associated with inferior returns, our value-based playbook suggests rotating toward a broader set of AI beneficiaries with lower capital requirements and valuations.

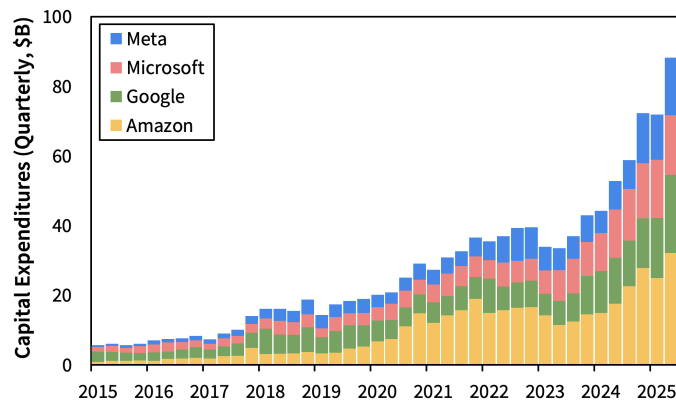
Introduction

AI Infrastructure Boom 🧑‍🔧

Over the past year, the AI boom has reached a key inflection point. Fueled by the promise of exponential “scaling laws,” capital expenditures have skyrocketed. The largest U.S. tech firms are on track to spend nearly \$400 billion this year alone. Over the next five years, [McKinsey](#) estimates that cumulative AI investment will reach a staggering \$5.2 trillion.

Exhibit 1

AI Investment Boom



Source: S&P, Sparkline. From Q1 2015 to Q2 2025.

So far, investors have looked upon these capital investments favorably. The so-called Magnificent 7, who are driving much of the buildout, have continued to outperform; Oracle's stock surged 36% after announcing a deal to build OpenAI's data centers; and CoreWeave, an upstart AI cloud provider, has seen its stock triple since its March listing. The valuations of AI stocks reflect considerable optimism.

However, it remains far from clear if these investments will ultimately deliver adequate financial returns. [Bain](#) estimates that, to justify their cost, these data centers will need to generate \$2 trillion in annual revenue by 2030. Yet, three years after ChatGPT's launch, AI revenues remain modest. At

an estimated [\\$20 billion](#), they would have to grow 100-fold to justify the expected buildout. Enterprises have [struggled](#) to implement AI, and even ChatGPT, by far the most popular AI consumer application, has yet to fully monetize its users.

The parallels to past technology buildouts are hard to ignore. In the late 1990s, telecoms, such as Global Crossing and AT&T, spent over \$500 billion laying fiber optic cable in anticipation of rapid Internet adoption. However, their projections proved overoptimistic, leaving the industry to suffer for years amid a glut of capacity and collapsing prices.

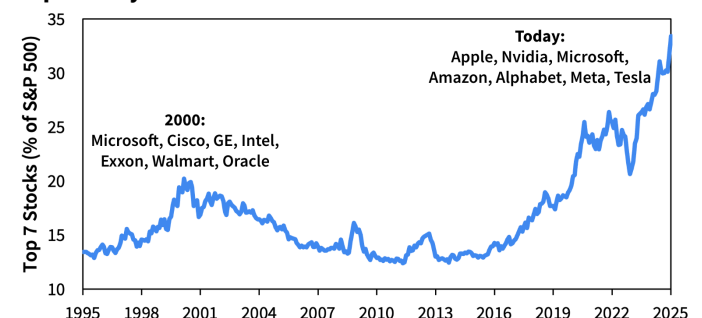
AI-Driven Stock Market Fragility ⚠️

Big Tech's huge AI gambit has put investors in a precarious position. The stock market is increasingly driven by a single theme: AI. According to [JPMorgan](#), AI stocks have accounted for 75% of S&P 500 returns, 80% of earnings growth, and 90% of capital spending growth since ChatGPT's release.

The Magnificent 7, which represent both the largest AI stocks and those most exposed to a potential AI overbuild, now comprise over 30% of the S&P 500, a level of concentration exceeding even that of the dot-com bubble.

Exhibit 2

Top-Heavy Stock Market



Source: S&P, Sparkline. Exhibit shows the total S&P 500 weight in the top 7 stocks at each point in time. As of 12/31/2024.

In fact, Big Tech's AI spending is now so large that it appears to be propping up the broader economy, accounting for an estimated [half of U.S. GDP growth](#) so far this year. Despite tariff and immigration headwinds, the economy has stayed resilient on the back of AI spending. Investors' fortunes are now inextricably tied to the success of Big Tech's AI gambit.

To be clear, we are staunch proponents of AI. Since 2020, AI has played a [central role](#) in our investment process, and we have published several [research pieces](#) illustrating practical AI applications in finance. Although we do not expect "digital god" overnight, we are quite optimistic about AI progress.

However, while we remain bullish on AI as a technology, we are less confident in its current prospects for investors. Past infrastructure booms teach us that the path to sustainable revenue is often punctuated by a period of overinvestment and poor returns. The S&P 500's concentration in the most profligate AI spenders leaves investors particularly exposed.

In this paper, we study past investment booms, assess the risks to the all-important Magnificent 7, and lay out a value-based playbook for navigating today's challenging market.

Capital Cycles

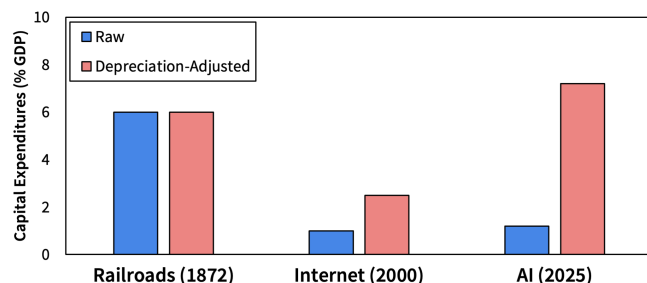
Echoes of Past Booms 🚂

As noted, this is not the first time that a narrow group of private firms have made massive capital outlays to build the infrastructure underpinning a transformative technology.

Over a century before the Internet, railroads revolutionized the American economy. Following the Civil War, the boom began in earnest, with over 33,000 miles of tracks laid from 1868 to 1873. The next exhibit compares the scale of the current AI boom to the railway and Internet buildouts.

Exhibit 3

Tech-Led Investment Booms



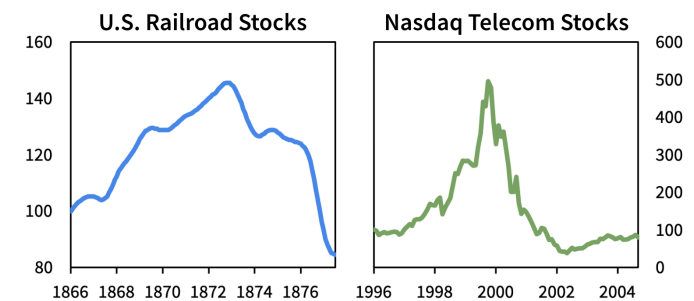
Source: [ExponentialView](#), [Paul Kedrosky](#), Sparkline. Useful life assumed to be 30-, 7- and 5-years, respectively. Depreciation-adjusted scales spending to 30-year useful life.

Relative to GDP, current AI spending already exceeds the peak achieved in the Internet boom. While it remains below the peak attained in the railroad buildout, the useful life of AI chips is much shorter than that of railroads. If we adjust for faster depreciation, today's AI buildout tops the chart.

While the railroads and Internet proved transformative, how did shareholders in the firms building these technologies fare? The next exhibit shows the stock prices of railroad and telecom stocks during their respective booms.

Exhibit 4

Railroad and Internet Bubbles



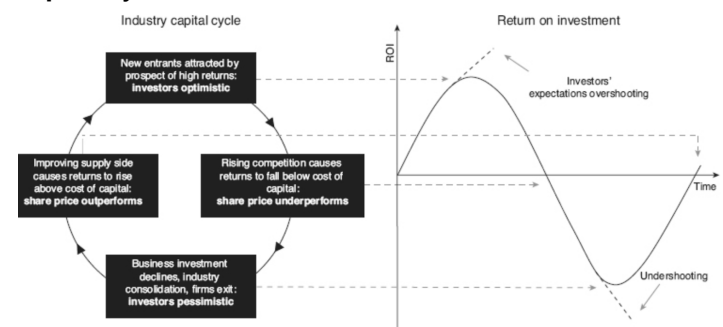
Source: [NBER](#) via [FRED](#), [Nasdaq](#), Sparkline.

These buildouts provide textbook examples of the so-called "capital cycle" (see [Chancellor](#) (2015)). Initially, excitement around a new technology spurs firms to make massive capital investments. Investors reward these bold outlays with soaring stock prices, encouraging further investment.

However, demand is ultimately unable to keep up with the influx of new supply coming online, causing prices to crater and saddling firms with years of excess capacity. Corporate values collapse, with those that took on debt to finance the buildout facing the risk of bankruptcy.

Exhibit 5

Capital Cycle Schematic



Source: [Chancellor](#) (2015).

While most investor effort is spent on the challenging task of forecasting demand, capital cycle theory reminds us to not overlook the supply side. Massive investment booms require equally massive levels of demand. Unless this demand fully materializes, the resulting capacity overhang leads to fierce competition, low pricing power, and weak industry profits.

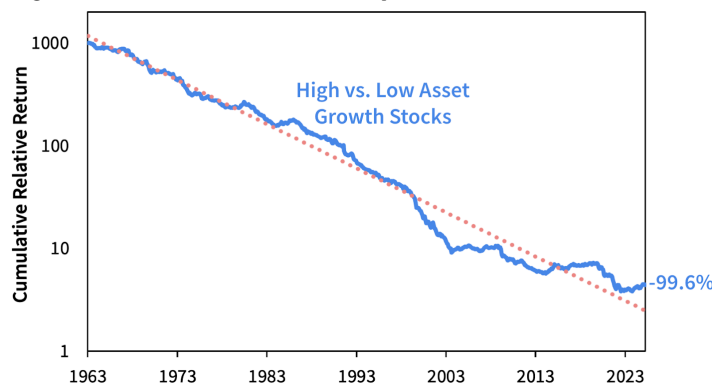
Firm-Level Evidence

While the railroad and Internet booms offer memorable case studies, they are still just two data points. In order to improve our statistical power, we next turn to a panel of thousands of stocks over the past several decades.

Let's start with the next exhibit, which shows the historical stock returns of firms with high trailing asset growth relative to those with low asset growth, rebalanced annually.

Exhibit 6

High Asset Growth Firms Underperform



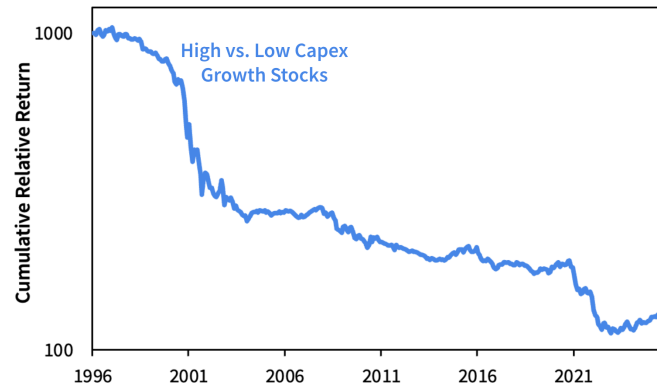
Source: [Ken French](#), Sparkline. Relative return of top vs. bottom quintile stocks based on trailing 1-year asset growth. Equally-weighted and rebalanced annually. Universe consists of NYSE-, AMEX- and Nasdaq-listed stocks. No transaction or financing costs. From 6/30/1963 to 8/31/2025. See important backtest disclosure below.

Since 1963, companies that aggressively grew their balance sheets underperformed their more conservative peers by a considerable -8.4% per year. This so-called “[asset-growth anomaly](#)” is actually widely studied in the academic finance literature. The illustrious Fama and French even included it as a distinct factor in their [five-factor model](#), alongside the market, size, value, and profitability factors.

Of course, companies expand their balance sheets for a variety of reasons. We are most interested in cases where they do so to invest in physical infrastructure. As the next exhibit shows, firms rapidly increasing capital expenditures have also underperformed their more conservative peers.

Exhibit 7

Rising Capex Firms Underperform



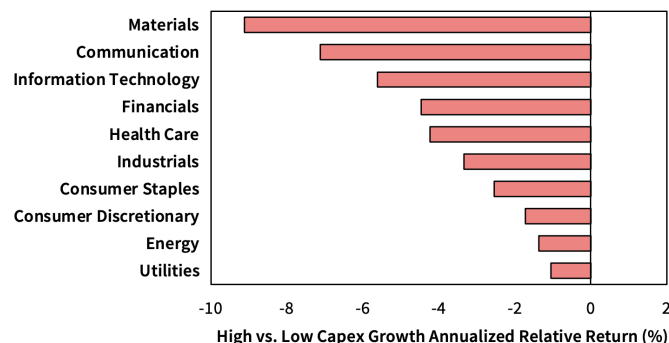
Source: S&P, Sparkline. Relative return of top vs. bottom quintile stocks based on trailing 1-year capital expenditure growth. Equally-weighted and rebalanced monthly. Universe consists of top U.S. stocks summing to 99% of total market cap. No transaction or financing costs. From 12/31/1995 to 9/30/2025. See important backtest disclosure below.

This underperformance accelerated in the dot-com bust, as the excesses of the boom were washed out. However, even in periods outside of the dot-com bubble, we see a strong and consistent pattern of underperformance.

The capital cycle operates not only across industries (e.g., telecoms in the 1990s, shale producers in the 2010s) but also within them. The next exhibit shows how firms ramping up capital expenditures perform relative to their sector peers.

Exhibit 8

Rising Capex Firms Underperform in All Sectors



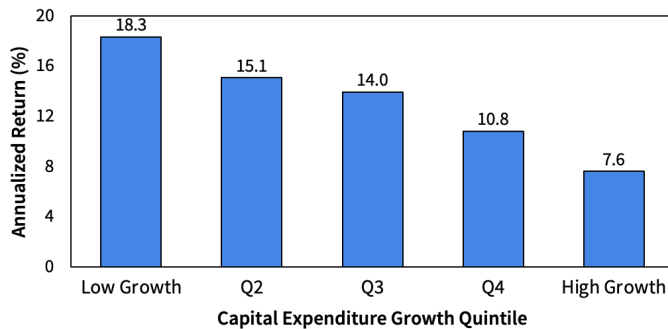
Source: S&P, Sparkline. Relative return of top vs. bottom quintile stocks based on trailing 1-year capital expenditure growth within each GICS sector. Equally-weighted and rebalanced monthly. Universe consists of top U.S. stocks summing to 99% of total market cap. No transaction or financing costs. From 12/31/1995 to 9/30/2025. See important backtest disclosure below.

In all ten sectors, the firms embarking on the largest capital expenditure campaigns tend to underperform their more conservative sector peers. Notably, we see a stronger effect

in materials than communications, despite the latter sector containing the epicenter of dot-com malinvestment.

Moreover, the effect is not driven only by the extremes. While the most extreme spenders do have the worst subsequent stock returns, the relationship appears relatively monotonic.

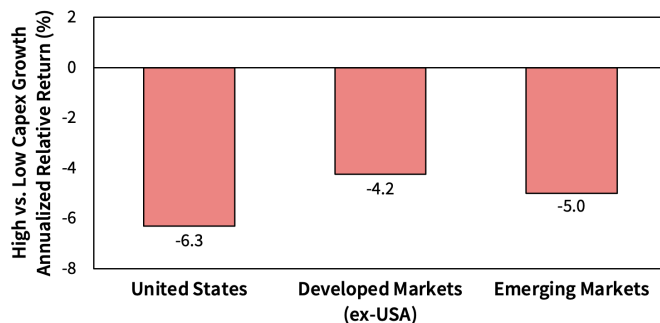
Exhibit 9 Rising Capex Firms Underperform Across Quintiles



Source: S&P, Sparkline. Average return of each quintile group based on trailing 1-year capital expenditure growth. Data pooled across dates and stocks. Universe consists of top U.S. stocks summing to 99% of total market cap. No transaction or financing costs. From 12/31/1995 to 9/30/2025. See important backtest disclosure below.

Finally, we find [evidence](#) of this phenomenon outside of the U.S. The next exhibit documents the underperformance of rising capital expenditure firms in the major equity regions.

Exhibit 10 Rising Capex Firms Underperform in All Regions



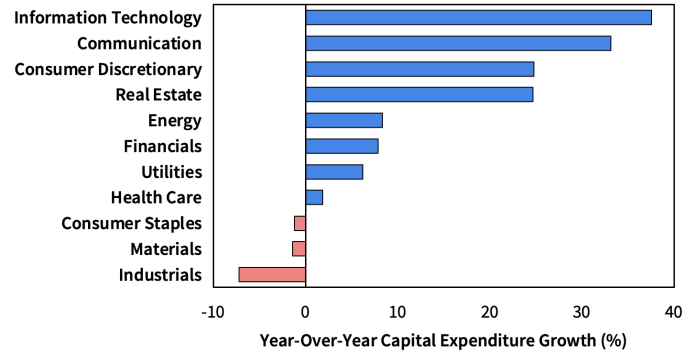
Source: S&P, MSCI, Sparkline. Relative return of top vs. bottom quintile stocks based on trailing 1-year capital expenditure growth in each geographic region based on MSCI definitions. Equally-weighted and rebalanced monthly. Universe consists of top U.S. stocks summing to 99% of total market cap. No transaction or financing costs. From 12/31/1995 to 9/30/2025. See important backtest disclosure below.

Big spenders have underperformed in all three regions, despite each region having its own unique capital cycle. For example, Japan experienced a massive investment boom in the late 1980s, followed by a multi-decade deleveraging. More recently, other Asian emerging market countries (e.g., Singapore, China) have had their own investment booms.

AI's Profligate Spenders 🛍️

What does this picture look like today? In order to build intuition, let's first check which sectors experienced the greatest capital expenditure growth over the past year.

Exhibit 11 Capex Growth by Sector



Source: S&P, Sparkline. Universe consists of top U.S. stocks summing to 99% of total market cap. As of 9/30/2025.

We clearly see the impact of the Magnificent 7's spending spree, with capital expenditure growth of 25 to 40% in the technology, communication, and consumer discretionary sectors. We also see its downstream impact, with capex also ramping up in real estate, energy, and utilities – sectors supplying crucial power and land for data center operations.

Next, let's zoom in on the individual company level. The next exhibit lists the 12 firms with the fastest capital expenditure growth from within the largest 100 U.S. stocks.

Exhibit 12 Top Capex Growth Stocks



Source: S&P, Sparkline. Universe consists of top 100 U.S. stocks. As of 9/30/2025.

Most of these stocks are AI-related. Oracle, which has been signing huge AI cloud deals, tops the chart, having ramped up capex by 249% over the past year. We find Magnificent 7 stalwarts Nvidia, Meta, and Amazon, as well as networking and semiconductor companies Arista, Amphenol, Lam, and Micron. Palantir, a heavy user of AI, rounds out the top 12.

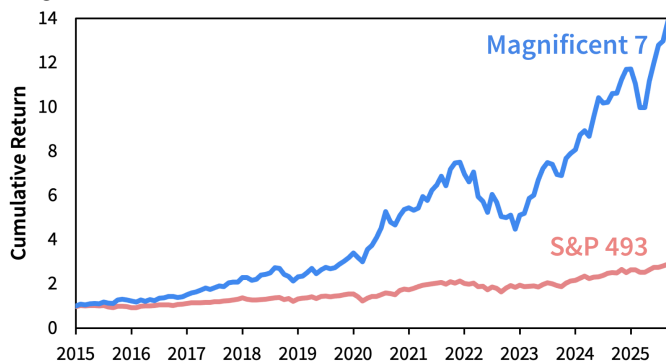
With the AI boom in full swing, investors should heed the lessons of history. Aggressive capital spending has generally led to poor stock returns, both at the sector and individual firm level. Even if we manage to avoid a full-fledged bubble, the capital misallocation that often results from such profligate spending may dampen prospective returns.

Magnificent Risks

The Asset-Heavy Transition

Over the past decade, the Magnificent 7 have significantly outperformed the rest of the S&P 500. Since 2015, they have delivered compound annual returns of 27.5%, creating over \$23 trillion in wealth for their shareholders.

Exhibit 13
Magnificent Dominance



Source: S&P, Sparkline. Magnificent 7 is Apple, Microsoft, Amazon, Meta, Google, Nvidia, and Tesla. S&P 493 is the S&P 500 excluding the Magnificent 7. Both are rescaled to 100% and cap-weighted. Past performance is no guarantee of future results. One cannot invest directly in an index. From 12/31/2014 to 9/30/2025.

The Magnificent 7's exceptional success has been fueled by their asset-light business models. By leveraging intangible assets, such as intellectual property, brand equity, human capital, and network effects, these firms have generated outsized returns without requiring a lot of capital.

As the top panel of the next exhibit shows, the Magnificent 7 have enjoyed enviable returns on invested capital of 22.5%, compared to just 6.2% for the S&P 493 over the past decade.

Their higher capital efficiency is explained by their heavier use of intangible assets. As the bottom panel shows, their intangible intensity has been 3-7 times that of the S&P 493.

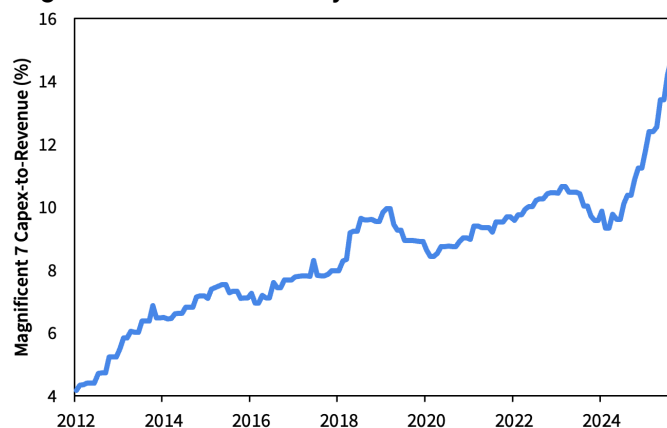
Exhibit 14
Asset-Light Money Machines

2015-2025, %	Magnificent 7	S&P 493
Return on Invested Capital	22.5	6.2
Return on Equity	29.7	13.2
Free Cash Flow Margin	16.4	8.8
R&D / Revenue	11.5	1.9
S&M / Revenue	6.3	2.0
Patents / Assets *	8.2	1.2
AI Employee Share	0.5	0.1

Source: S&P, USPTO, LinkedIn, Sparkline. R&D is research and development and S&M is sales and marketing. All figures are expressed as percentages, except for patents / assets, which are scaled by billions. AI employees are defined based on a proprietary classification of firms' employee's LinkedIn profiles. From 12/31/2014 to 9/30/2025.

However, the Magnificent 7 are now turning away from the asset-light model that fueled their past success. Since 2012, capital expenditures have surged from 4 to 15% of revenue. Unfortunately for investors, the AI arms race is transforming these firms from asset-light to asset-heavy.

Exhibit 15
Magnificent 7's Asset-Heavy Transition

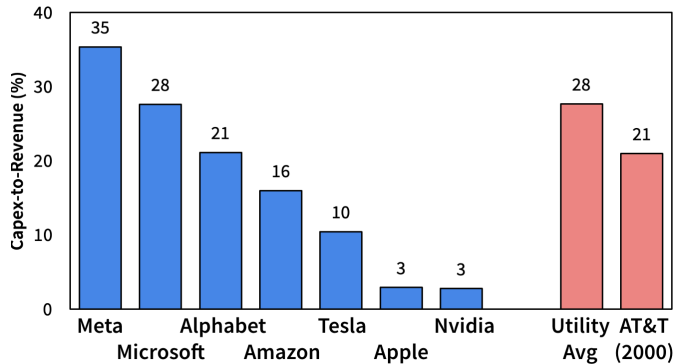


Source: S&P, Sparkline. Trailing 12-month figures. As of 9/30/2025.

The Magnificent 7's capital intensity is quickly approaching that of utilities, the most asset-heavy sector. As the next exhibit shows, Meta, Microsoft, and Alphabet are each set to spend between 21 and 35% of their revenue on capex, more than both the average global utility today and AT&T at the height of the telecom bubble.

Exhibit 16

Magnificent 7: The New Utility?



Source: S&P, Sparkline. Consensus NTM estimates as of 9/30/2025, except AT&T, which is TTM as of 12/31/1999. Utility average includes all global utility stocks based on GICS.

Asset-Heavy Woes 🏗️

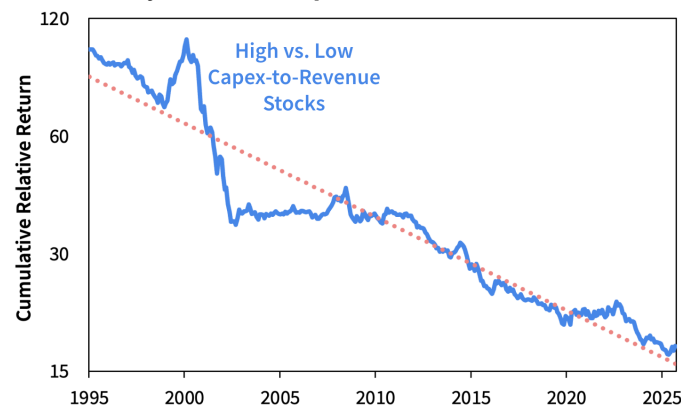
The Magnificent 7's asset-heavy transition is concerning, as asset-heavy firms have [struggled](#) to deliver high returns on invested capital. These firms require significant investment simply to offset the constant depreciation of their assets, either due to wear-and-tear or technical obsolescence.

Moreover, physical assets tend to be easier for competitors to replicate. Lower barriers to entry result in capital cycle dynamics, where high returns attract competitors, leading to excess capacity, price wars, and poor returns on capital.

We confirm this in the next exhibit, which shows the stock returns of asset-heavy firms compared to asset-light ones.

Exhibit 17

Asset-Heavy Firms Underperform



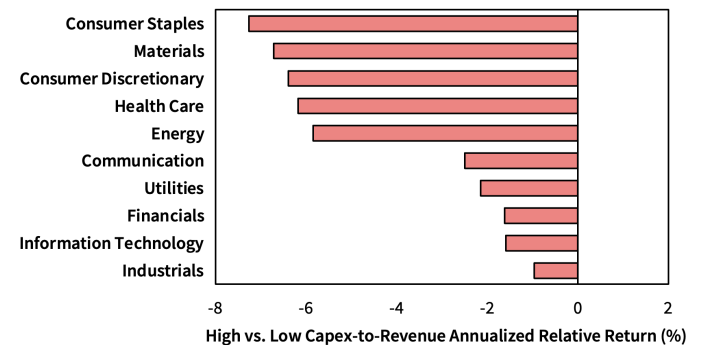
Source: S&P, Sparkline. Relative return of top vs. bottom quintile stocks based on trailing 1-year capex to revenue. Equally-weighted and rebalanced monthly. Universe consists of top U.S. stocks summing to 99% of total market cap. No transaction or financing costs. From 12/31/1994 to 9/30/2025. See important backtest disclosure below.

Previously, we found that firms rapidly growing their capital bases have tended to underperform. We now learn that all capital-intensive firms – not only those investing in growth but also those simply spending on maintenance – have tended to underperform their asset-light peers.

Notably, this empirical pattern exists not only across but also within industries. The next exhibit shows the performance of asset-heavy vs. asset-light stocks within each sector.

Exhibit 18

Asset-Heavy Firms Underperform in All Sectors



Source: S&P, Sparkline. Relative return of top vs. bottom quintile stocks based on trailing 1-year capex to revenue within each GICS sector. Equally-weighted and rebalanced monthly. Universe consists of top U.S. stocks summing to 99% of total market cap. From 12/31/1994 to 9/30/2025. See important backtest disclosure below.

In all ten sectors, capital-intensive firms underperformed their more intangible sector peers. This effect exists not only in asset-heavy sectors like utilities, communication, and energy, but also in asset-light sectors, such as healthcare, consumer staples, and consumer discretionary.

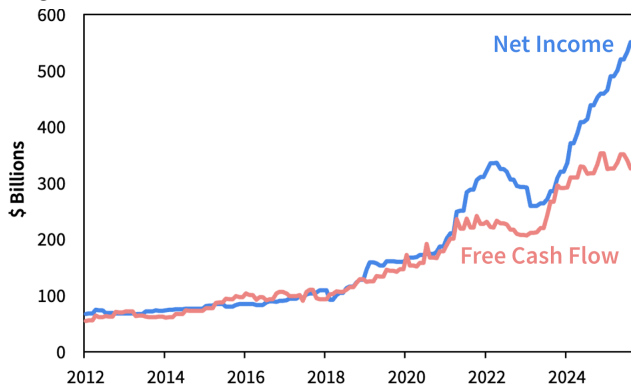
As a final robustness check, we find that asset-heavy firms also underperform outside the U.S., implying that their struggles cannot simply be explained by the exceptionally high [intangible-intensity](#) of the U.S. economy.

Deteriorating Fundamentals 📉

The Magnificent 7's abdication of their superior asset-light business models is reflected in deteriorating fundamentals.

Entering the cycle, the asset-light Magnificent 7 generated more free cash flow than they knew what to do with – hence their lavish use of buybacks. However, they are now set to embark on an estimated \$400 billion per year AI buildout. As the next exhibit shows, rising AI capital expenditures are already starting to erode their free cash flow position.

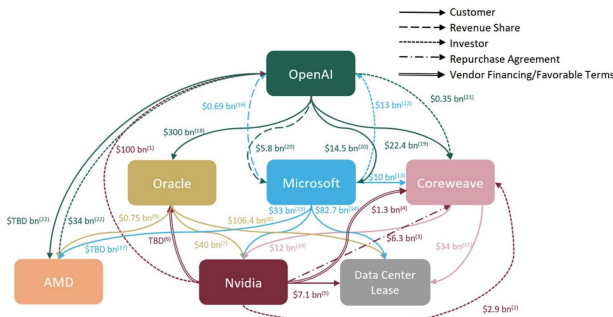
Exhibit 19 Magnificent 7 Free Cash Flow



Source: S&P, Sparkline. Trailing 12-month figures. As of 9/30/2025.

Moreover, in an echo of the dot-com bubble, we are seeing the return of [circular financing deals](#), with AI firms investing in their customers and suppliers. For example, Nvidia recently invested \$100 billion in OpenAI, providing capital that OpenAI could use to buy Nvidia chips. One week later, OpenAI made a deal with AMD to buy their chips in exchange for a large equity stake.

Exhibit 20 Web of Circular AI Deals



Source: Morgan Stanley, Sparkline.

Although the Magnificent 7 still have sterling balance sheets, they are increasingly entangled with less financially-sound firms like OpenAI, CoreWeave, and Oracle. In addition, with free cash flows dwindling, they are starting to turn to debt financing. For instance, Meta recently obtained \$27 billion in [off-balance-sheet debt](#) to build its Hyperion data center – the largest private-credit offering ever.

While the Magnificent 7 are extremely profitable, their net income will be dragged down over the next few years once depreciation charges from their surging capital expenditures kick in. Making some very rough assumptions, we estimate their annual depreciation expense could climb from \$150 to \$400 billion over the next five years.

Furthermore, many [analysts](#) believe that the hyperscalers' 5-6 year useful life assumption for AI data centers is overoptimistic, with 2-3 years more appropriate given Nvidia's accelerating GPU replacement cycle. If correct, any adjustment would result in an even quicker hit to earnings.

AI Prisoner's Dilemma 🤖

"If we end up misspending a couple of hundred billion dollars, I think that that is going to be very unfortunate, obviously. But what I'd say is I actually think the risk is higher on the other side."

📷 Mark Zuckerberg, Meta CEO

"I'm willing to go bankrupt rather than lose this race."

🌐 Larry Page, Google co-founder

The Magnificent 7 have a well-deserved reputation as high-quality, ensconced in an oligopoly across key tech markets.

However, AI appears poised to disrupt this cozy oligopoly, at least in the minds of Big Tech CEOs. As Bill Gates himself has argued, AI collapses their respective markets – search, social media, shopping – into one, and whoever wins the AI race wins all markets. Viewing AI as an existential risk, they have been forced into a bitterly competitive and costly arms race.

The AI arms race resembles the classic "Prisoner's Dilemma" game theory problem. While the optimal move is for firms to mutually agree to moderate their AI investments, preserving their oligopoly, this equilibrium is unstable, as each firm is incentivized to unilaterally ramp up investment to capture the market; if OpenAI goes all-in, the rest cannot afford to sit idly. This results in a suboptimal equilibrium, in which all firms invest aggressively, even if it leads to overinvestment and the destruction of the collective profit pool.

Exhibit 21 AI Prisoner's Dilemma

		Company B	
		Invest Moderately	Invest Aggressively
Company A	Invest Moderately	Maintain oligopoly status quo	B wins the market
	Invest Aggressively	A wins the market	Overinvestment

← Equilibrium

Source: Sparkline.

The arrival of AI has left the Magnificent 7 with no choice but to leave their impenetrable fortresses and go to battle on an extremely costly and competitive playing field, one with high capital requirements and low barriers to entry.

Despite our conviction in AI as a technology, we believe that, ironically, its heavy capital requirements and competitive market structure are actually reducing the quality of the very firms responsible for its creation. So far, investors are still constructive on these AI investments, but if the arms race does result in severe overinvestment, pain could lie ahead.

Hidden AI Winners

Bubble Subsidies 🤡

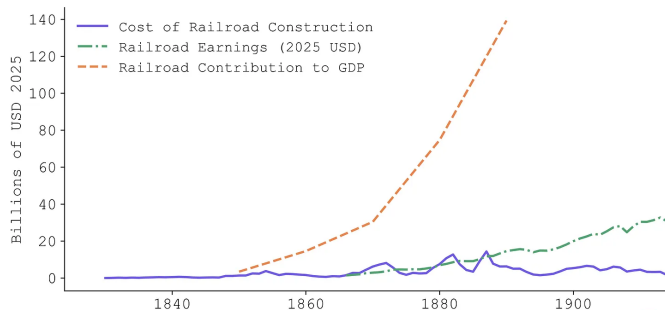
One of the key lessons of past technological revolutions is that the builders of the underlying infrastructure often do not capture much of the value created. Rather, the value accrues to their customers and the rest of society.

For instance, the U.S. railroad expansion was punctuated by the Panics of 1873 and 1893, which saw the bankruptcy of hundreds of railroad companies. Similarly, following the 2000 dot-com bust, the telecom stock index collapsed -92% and has yet to recover even 25 years later.

However, while Penn Central and Global Crossing may have failed, the infrastructure they built contributed to massive economic growth. As the next exhibit shows, after a rocky few decades that wiped out many investors, the railroad industry finally found its footing. Yet, even then, the profits they earned were only a tiny slice of the overall economic value created (see [Azhar and Warren \(2025\)](#)).

Exhibit 22

Railroads Captured a Tiny Share of GDP Created



Source: [Exponential View](#), Sparkline.

As it turned out, the long-term winners were not actually the builders of railroads or fiber, but instead their customers – the early adopters of these technologies. These companies avoided the risk of large speculative capital outlays, while still benefitting from gains provided by the new technology.

We saw earlier that investment booms have often led to an overbuild of capacity. Intriguingly, while this is bad for the infrastructure builders, it can be great for their customers. Excess supply drives down prices, effectively resulting in a subsidy from the builders to their customers.

In the dot-com bubble, telecoms laid [80 million miles](#) of fiber optic cable. Over the next few years, with 85% of these cables unused, the cost of bandwidth fell by 90%. While this drove many telecoms into bankruptcy, it ultimately helped fuel the rise of firms like Netflix and Facebook, which thrived on the back of the subsidized Internet.

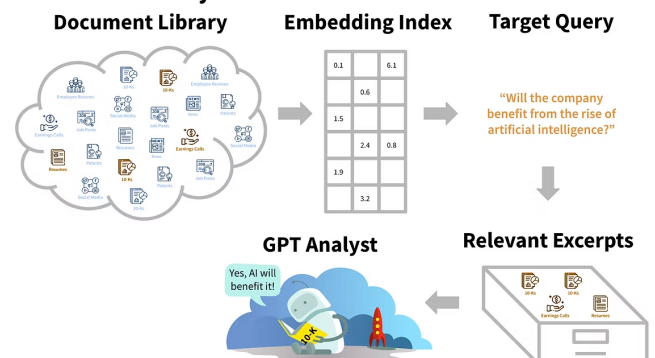
Hidden AI Winners 🦹

Over the past few years, investors have had an insatiable appetite for AI stocks. Naturally, the most direct AI plays – big AI infrastructure providers like Nvidia – have enjoyed the greatest gains. However, with these firms experiencing rising valuations and capital requirements, we believe investors should expand their search to include not only infrastructure firms but also more under-the-radar AI beneficiaries.

How can we identify these hidden AI winners? In [Investing in AI: Navigating the Hype](#) (Jul 2023), we created a framework to identify stocks expected to benefit from the rise of AI. In order to do this, we built an “AI analyst” to dig up clues scattered across a plethora of unstructured and alternative data sets ranging from job postings to trademarks.

Exhibit 23

AI Financial Analyst Schematic



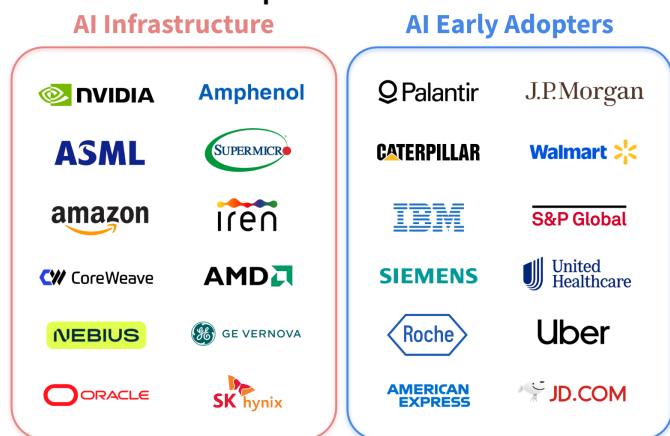
Source: Sparkline. Reproduced from [Investing in AI: Navigating the Hype](#) (Jul 2023).

This data-intensive approach helps us identify not only the big AI infrastructure providers but also other less obvious AI beneficiaries. Moreover, the technology is highly scalable, enabling us to cover a rapidly shifting universe of thousands of stocks across the world.

The next exhibit shows examples of companies our analysis reveals to be “AI beneficiaries.” We separate these into two categories: (1) **AI infrastructure**, which includes chipmakers, model providers, cloud operators, and data center suppliers, and (2) **AI early adopters**, which includes all other non-infrastructure firms expected to materially benefit from AI.

The next exhibit provides a few examples for each category. On the **AI infrastructure** side, we find Nvidia, ASML, Nebius, Supermicro, IREN, GE Vernova, and SK Hynix. Meanwhile, **AI early adopters** include not only digital natives like Palantir and Uber, but also early adopters in legacy sectors, such as Caterpillar, Walmart, JPMorgan, Siemens, Roche, and S&P.

Exhibit 24 AI Beneficiaries Examples

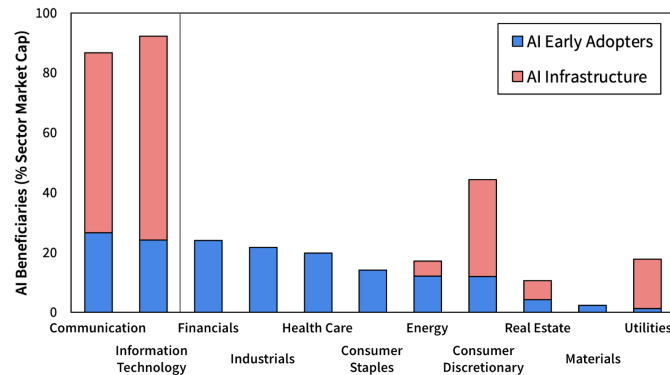


Source: Sparkline. Company logos for illustrative purposes only. As of 9/30/2025.

Which sectors have the highest concentration of AI stocks? The next exhibit shows the share of each sector’s market cap attributable to AI beneficiaries, which we further break out into infrastructure and early adopters.

AI infrastructure firms are concentrated in communication, technology, and consumer discretionary but can also be found to a lesser extent in utilities, real estate, and energy. In contrast, **AI early adopters** are more evenly spread across sectors, with their weight in communication and tech not much higher than in financials, industrials, and healthcare.

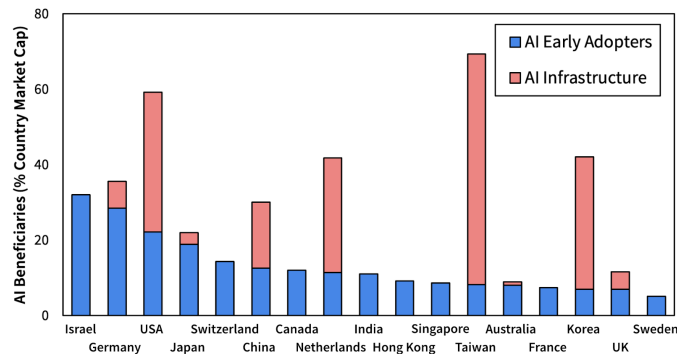
Exhibit 25 AI Beneficiaries by Sector



Source: S&P, Sparkline. Universe consists of top global stocks summing to 95% of total market cap. As of 9/30/2025.

Next, let’s see which countries have the highest allocation to AI beneficiaries. The next exhibit shows the share of each country’s market cap attributable to the two groups.

Exhibit 26 AI Beneficiaries by Country



Source: S&P, Sparkline. Exhibit excludes countries with less than 25 investible stocks and those with zero AI stocks. Universe consists of top global stocks summing to 95% of total market cap. As of 9/30/2025.

In **AI infrastructure**, the U.S. is blessed with the largest and most important AI firms in its Magnificent 7. However, key links in the semiconductor and data center supply chains lie abroad; Nvidia’s chips are manufactured by Taiwanese TSMC using lithography machines from Dutch ASML. As a share of their smaller stock markets, AI infrastructure is also well represented in Taiwan, Korea, the Netherlands, and China.

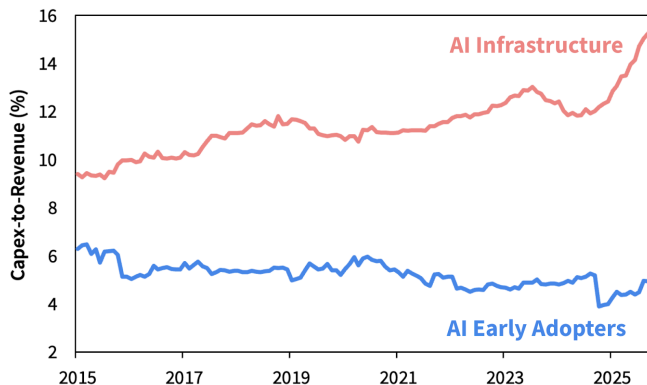
In addition, many countries outside the U.S. offer significant exposure to **AI early adopters**. In fact, early adopters comprise a greater share of the Israeli and German stock indexes than that of the U.S. stock index. The stock markets of Japan, Switzerland, China, Canada, the Netherlands, and India are also well positioned to benefit from AI.

Overall, we find that **AI infrastructure** firms as a group suffer from high concentration, due to the dominance of megacaps like Nvidia and Microsoft. In contrast, **AI early adopters** offer greater diversification, as well as exposure to a broader set of sectors and countries.

In addition, **AI infrastructure** firms face twin challenges from rising capital requirements and valuations. We examine the former in the next exhibit, which depicts the capital intensity of the two groups over the past decade.

Exhibit 27

Capital Intensity: Infrastructure vs. Early Adopter



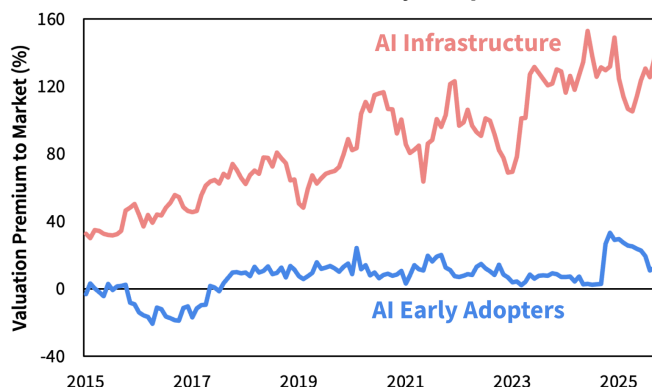
Source: S&P, Sparkline. Universe consists of top global stocks summing to 95% of total market cap. From 12/31/2014 to 9/30/2025.

While **AI infrastructure** firms have always had higher capital intensity, this gap has widened over time, exploding higher in the past year as the hyperscalers have begun their multi-trillion dollar AI capex binge. This is concerning because, as shown earlier, asset-heavy firms are generally less profitable.

Lastly, let's explore the valuations of AI beneficiaries relative to the broader market. The next exhibit shows each group's premium or discount using a blend of four valuation metrics.

Exhibit 28

Valuations: Infrastructure vs. Early Adopter



Source: S&P, Sparkline. Exhibit shows the valuations of each group relative to an equal-weighted index of all stocks in the universe. Valuation defined as the average of price/book, price/sales, price/earnings, and EV/EBITDA. Universe consists of top global stocks summing to 95% of total market cap. From 12/31/2014 to 9/30/2025.

So far, investors' enthusiasm for AI has mostly benefitted **AI infrastructure** firms, who have witnessed their valuation premiums expand from 32 to 137%. As we will see in the next section, infrastructure firms' outperformance at the start of the capital cycle is also a feature of prior booms. On the other hand, **AI early adopters** have not enjoyed a similar boost, trading at a mere 13% premium today.

Navigating Hype Cycles

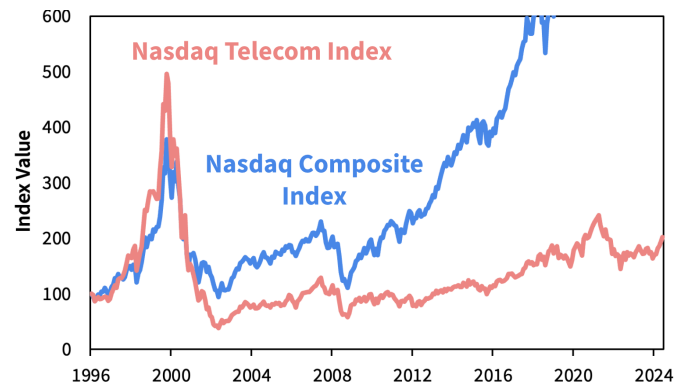
Valuation Risk

In investment booms, infrastructure builders put the most capital at risk and, as a result, often suffer the greatest losses in a bust. However, asset-light early adopters still face "valuation risk" to the extent their stocks trade at inflated multiples due to excessive hype around the new technology.

We see this in the following exhibit, which compares the dot-com era returns of **telecoms** to the **broader tech index**.

Exhibit 29

Telecom vs. Tech Stocks



Source: Nasdaq, Sparkline. Indexes shown are price-based (i.e., they do not include returns from dividends). From 4/30/1996 to 9/30/2025.

In the dot-com upswing, **telecom stocks** skyrocketed, rising far above the broader tech index. However, in the bust, they plummeted back down to earth, leading to a devastating -92% loss. Incredibly, the telecom index still remains -60% below its dot-com high 25 years later.

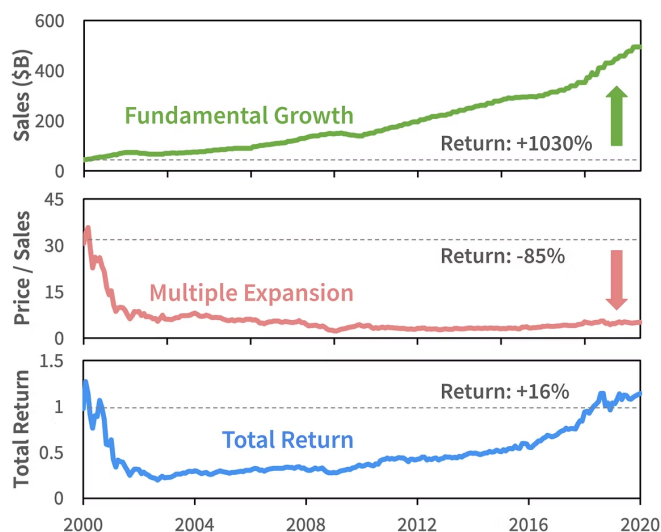
The **broader tech composite** also suffered large losses in the bust, falling -77%. Although some of these losses were from

infrastructure constituents like Cisco and Worldcom, we also saw the collapse of Internet early adopters, such as eBay, E*TRADE, and Amazon, whose inflated pre-crash valuations reflected unrealistic expectations of Internet adoption.

The central role of excessive valuations in the dot-com crash cannot be overstated. In [Investing in AI: Navigating the Hype](#) (Jul 2023), we included the following exhibit decomposing the losses of so-called “dot-com darlings” after the bust.

Exhibit 30

Dot-Com Darlings, 2000-2019



Source: S&P, Sparkline. Return decomposition is for a portfolio of U.S. Internet stocks formed on 1/1/2000 with P/S ratios over 25. Total Return includes returns from not only Fundamental Growth and Multiple Expansion, but also Dividends and Buybacks. From 1/1/2000 to 1/1/2020. Reproduced from [Investing in AI: Navigating the Hype](#) (Jul 2023).

As the top panel shows, despite the dot-com crash, these firms actually did realize the rapid **fundamental growth** promised by Internet boosters, with sales compounding at a robust 12% per year. The problem was that they traded at sky-high valuations entering the bust, with a price-to-sales ratio of 33.3. As animal spirits subsided, **multiples reverted** to a more modest 5.2, leading to a punishing -85% loss.

In **total return** terms, these crippling losses from multiple compression more than offset strong fundamental growth. By 2002, investors had lost 80% of their money. While these dot-com darlings did eventually grow into their peak bubble multiples, it took an agonizingly long 18 years.

In [Investing in Innovation](#) (Apr 2022), we found that, over the past half century, systematically investing in firms exposed to rapidly growing technologies produced market-beating

returns. However, as the dot-com episode illustrates, this only works if this rapid growth is not already priced in. Unfortunately, in tech booms, the market tends to not only price in potential growth but also overextrapolate it.

Value Investing: Navigating Hype Cycles 🌊

In [Investing in AI: Navigating the Hype](#) (Jul 2023), we argued that a value investing playbook provided an effective way to navigate the hype cycle. Ideally, this would allow investors to maintain consistent positive exposure to innovation while dynamically taking profits on stocks as they got overvalued.

The problem is that traditional valuation metrics, such as price-to-book ratio, have limited relevance in the modern information economy. Their focus on tangible capital tends to penalize firms deploying innovative technologies, leading many value investors to miss out on the considerable upside from technologies such as the Internet, mobile, and AI.

In [Intangible Value](#) (Jun 2021), we argued that traditional value investors’ anti-innovation bias can be addressed with a more holistic valuation model that incorporates not only tangible but also intangible assets, such as intellectual property, brand equity, human capital, and network effects.

Exhibit 31

Intangible Moats



Intellectual Property

Proprietary knowledge, patents, technology, and data



Brand Equity

Strong brand recognition and customer loyalty



Human Capital

Highly skilled, aligned, and motivated workforce



Network Effects

Engaged ecosystem of external producers and consumers

Source: Sparkline. Reproduced from [Intangible Value](#) (Jun 2021).

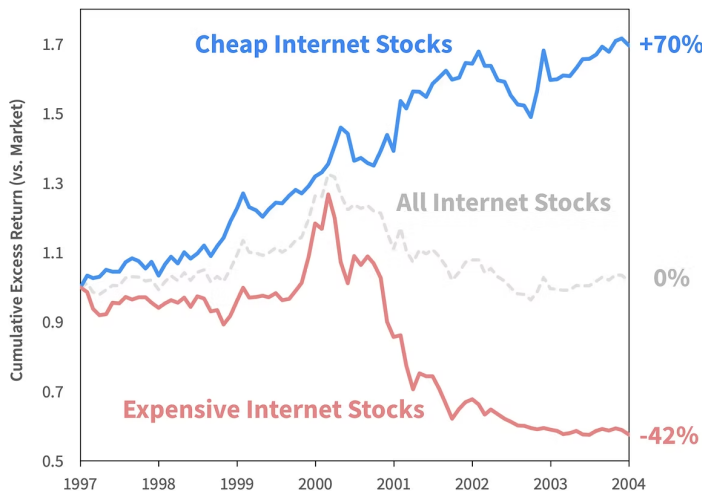
Using this more robust “intangible value” metric, we split the Internet stock universe into cheap and expensive halves. We rebalance each month, allowing us to dynamically adjust to shifting valuations. The next exhibit from [Investing in AI: Navigating the Hype](#) (Jul 2023), shows the returns of these groups relative to those of the broader stock market.

Over this period, the full **Internet stock index** experienced a round trip relative to the broader market. However, splitting

the index into cheap and expensive halves reveals a stark bifurcation. **Cheap internet stocks** actually consistently beat the stock market, both in the boom and bust. However, their outperformance was fully offset by underperformance from **expensive internet stocks**.

Exhibit 32

Tale of Two Internets



Source: SEC, OpenAI, S&P, Sparkline. Universe consists of the top 1,000 U.S. stocks by market capitalization. Internet Stocks are those considered to be positioned to benefit from the Internet based on their most recent 10-K. Cheap (Expensive) Internet Stocks are Internet stocks in the top (bottom) half of intangible value. Returns shown relative to an equal-weighted portfolio of all stocks. Simulation does not include transaction or shorting costs or fees. See important backtest disclosure. From 1/1/1997 to 1/1/2004. Reproduced from [Investing in AI: Navigating the Hype](#) (Jul 2023).

Intangible value offered an effective playbook for navigating the dot-com bubble. In the mid-1990s, it favored innovative Internet firms like Cisco and Microsoft. However, as these stocks became overvalued, it rotated into more under-the-radar Internet early adopters like Progressive and FedEx. This helped it weather the bust, at which point it rotated back into beaten-down dot-coms, such as Amazon.

Investing in the AI Revolution 🤖

“When bubbles happen, smart people get overexcited about a kernel of truth... Are we in a phase where investors as a whole are overexcited about AI? My opinion is yes. Is AI the most important thing to happen in a very long time? My opinion is also yes.”

🗣️ Sam Altman, OpenAI CEO

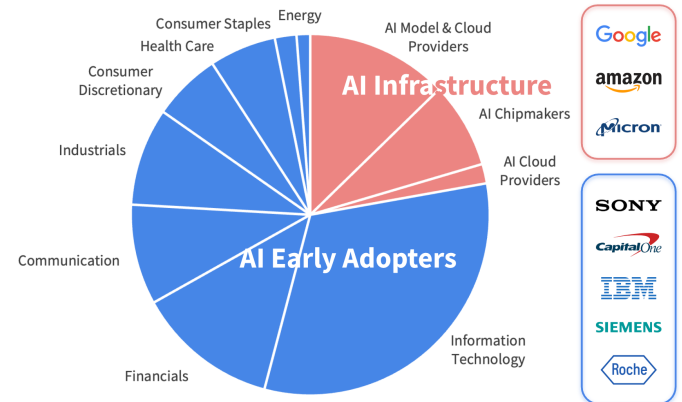
Like Sam Altman, we believe AI is a historically important technology but investor overexcitement is creating froth in many parts of the market. As such, our goal is to build a

portfolio that provides structurally positive exposure to AI while avoiding pockets of excessive froth.

We believe the intangible value playbook developed in the last section can help. The next exhibit shows the portfolio that results from applying this playbook to identify cheap stocks from within the AI stock universe.

Exhibit 33

Cheap AI Stock Portfolio Today



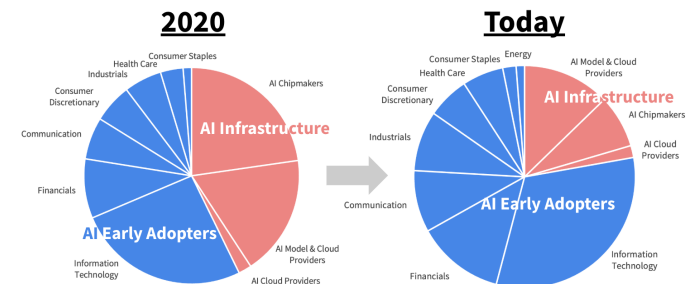
Source: Sparkline. Company logos for illustrative purposes only. As of 9/30/2025.

AI infrastructure firms, such as Google, Amazon, and Micron, currently make up 22% of the cheap AI stock portfolio. **AI early adopters** comprise the other 78%, with the largest weights in the technology, financials, communication, and industrials sectors (e.g., Sony, Capital One, and Siemens).

This allocation has evolved considerably over time. Five years ago, almost half of the cheap AI stock portfolio was in **AI infrastructure** firms, with a heavy weight in AI chipmakers like Nvidia. However, with the AI boom in full swing, the model has gradually shifted toward **AI early adopters** with lower valuations and capital requirements.

Exhibit 34

Cheap AI Stock Portfolio: 2020 vs. Today

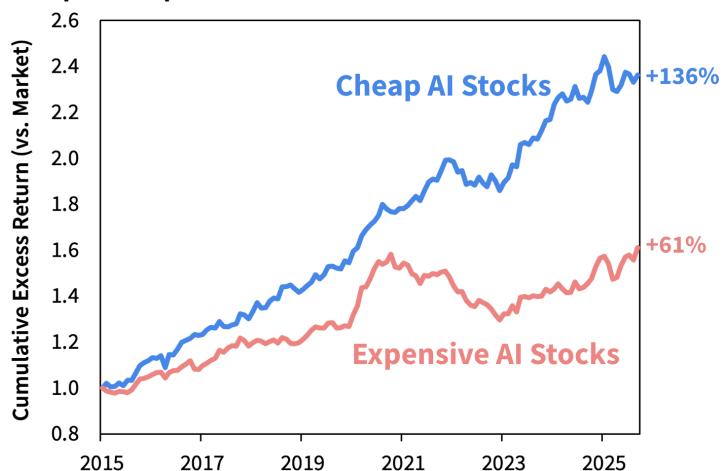


Source: Sparkline. As of 12/31/2019 and 9/30/2025.

Finally, let's examine the historical performance of cheap and expensive AI stocks relative to the broader market. As before, we split the AI stock universe into cheap and expensive halves, rebalancing monthly.

Exhibit 35

Cheap and Expensive AI Stocks



Source: SEC, OpenAI, S&P, Sparkline. Universe consists of top global stocks summing to 95% of total market cap. AI Stocks are those considered to be positioned to benefit from AI. Cheap (Expensive) AI Stocks are AI stocks in the top (bottom) half of intangible value. Returns shown relative to an equal-weighted portfolio of all stocks. Simulation does not include transaction or shorting costs or fees. See important backtest disclosure. From 1/1/2015 to 9/30/2025. Based on [Investing in AI: Navigating the Hype](#) (Jul 2023) but expanded to a global stock universe and updated as of 9/30/2025.

As in our dot-com case study, we find that **cheap AI stocks** consistently outperformed the market. From 2015 to 2020, **expensive AI stocks** also outperformed, albeit to a lesser extent. However, from 2021 to 2022, these stocks greatly underperformed, as their inflated valuations collapsed in the post-pandemic unwind. Since then, both groups of AI stocks have resumed their upward trajectory.

While we do not know how the future will play out, **cheap AI stocks** appear to offer exposure to AI-driven outperformance in good times, while also mitigating valuation-driven losses when animal spirits subside. With AI hype rising, we believe this playbook can help investors seeking to invest in AI without taking on excessive valuation risk.

Conclusion

We believe that AI is a practically useful technology that will only grow more powerful over time. However, we are concerned by how the expected \$5 trillion in upcoming AI capital spending will impact prospective returns.

Historically, massive infrastructure spending, especially that without a clear path to revenue, has led to excess capacity and poor returns. We find this capital cycle operates not only at the macro level with the railroad and Internet buildouts, but also at the individual firm level – firms aggressively increasing capital expenditures tend to subsequently underperform both the market and their sector peers.

We are also concerned that the AI boom is transforming the Magnificent 7 from asset-light to asset-heavy, given that asset-heavy firms have historically produced inferior returns. Unfortunately, Big Tech appears committed to this bitterly competitive and costly AI arms race. Given their large weight in stock indexes, this is problematic for many investors.

Finally, we are concerned by rising valuations. We propose a playbook using intangible value to navigate the hype cycle. With AI hype rising, the model has gradually rotated away from the big AI infrastructure providers toward a broader set of AI early adopters with lower valuations and capital requirements. This shift is reinforced by the finding that the long-term beneficiaries of past investment booms are often not the infrastructure builders but their customers.



Kai Wu

Founder & CIO, Sparkline Capital LP

Kai Wu is the founder and Chief Investment Officer of Sparkline Capital, an investment management firm applying state-of-the-art machine learning and computing to uncover alpha in large, unstructured data sets.

Prior to Sparkline, Kai co-founded and co-managed Kaleidoscope Capital, a quantitative hedge fund in Boston. With one other partner, he grew Kaleidoscope to \$350 million in assets from institutional investors. Kai jointly managed all aspects of the company, including technology, investments, operations, trading, investor relations, and recruiting.

Previously, Kai worked at GMO, where he was a member of Jeremy Grantham's \$40 billion asset allocation team. He also worked closely with the firm's equity and macro

investment teams in Boston, San Francisco, London, and Sydney.

Kai graduated from Harvard College Magna Cum Laude and Phi Beta Kappa.

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