NAVIGATING THE AI REVOLUTION

A THREE-PART SERIES

CAMBRIDGE ASSOCIATES

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NAVIGATING THE AI REVOLUTION – PART 1

STATE OF THE TECHNOLOGY TODAY AND POTENTIAL FUTURE TRAJECTORIES

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Artificial Intelligence (AI) is at a pivotal point, representing a potential "platform shift" more significant than the technological advances of the last 50 years with profound economic, societal, and geopolitical consequences. As investors navigate the flood of AI news, it is helpful to remember that a new technology's impact is typically overestimated in the short term and underestimated in the long term. But the path of AI's evolution is far from set and will be shaped not just according to progress in the technology itself but also by consumer and business adoption rates, regulation, and wider societal responses.

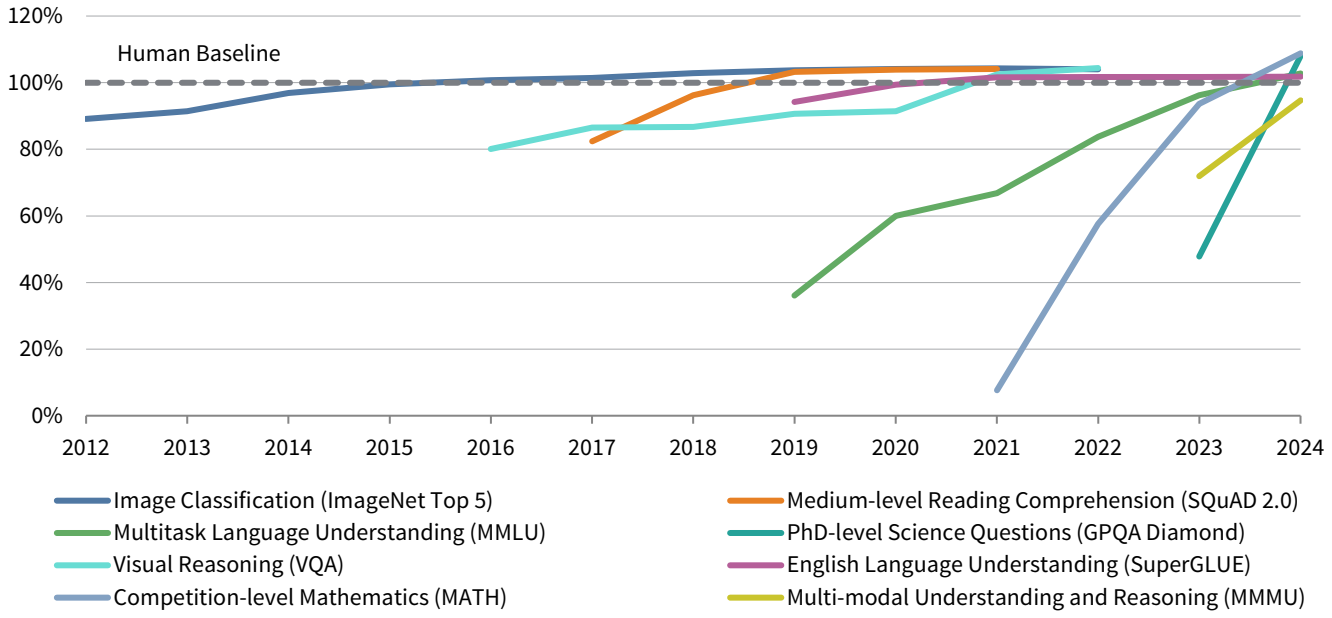
This first paper in the series introduces the current state of AI as a technology, compares its evolution to prior technological shifts, and briefly outlines future potential trajectories. Part 2 explores how AI may reshape productivity, and the market's reaction in investment terms. Part 3 addresses the extensive implications for asset allocation and provides guidance on how investors can position themselves for the various disruptive forces that may be unleashed.

AI TODAY

Artificial intelligence, a term dating back to the 1950s, refers to computer systems that perform tasks once thought to require human intelligence. Evolving over decades of advances—and setbacks—in machine and deep learning, AI has long been part of daily life in a number of applications, such as Google's targeted ads. But the launch of OpenAI's ChatGPT 3.5 in November 2022 marked a turning point. Generative AI, powered by transformer models first developed at Google in 2017, leapt to global attention with its seemingly magical powers to create and synthesize content. Compared with prior shifts, the speed at which the technology itself is evolving is unprecedented. Since 2022, model releases from OpenAI and its competitor frontier labs have come thick and fast, and the reasoning/deep research models of today represent dramatic changes in capabilities compared with early versions. Models are now multi-modal, generating not just text but images, audio, video, and music, while human voice/AI interfaces are taking shape. Meanwhile, the arrival in early 2025 of China's reasoning model DeepSeek R1 upended the United States' presumed unassailable lead in this era's "space race." More so than in past cycles, technological "moats" are being threatened and business models upended in short order.

SELECT AI INDEX TECHNICAL PERFORMANCE BENCHMARKS VS HUMAN PERFORMANCE

December 31, 2012 – December 31, 2024 • Performance Relative to the Human Baseline (%)



Source: "The AI Index 2025 Annual Report," AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2025. See page 24 for more source notes.

Notes: Values are scaled to establish a standard metric for comparing different benchmarks. The scaling function is calibrated such that the performance of the best model for each year is measured as a percentage of the human baseline for a given task. A value of 105% indicates, for example, that a model performs 5% better than the human baseline.

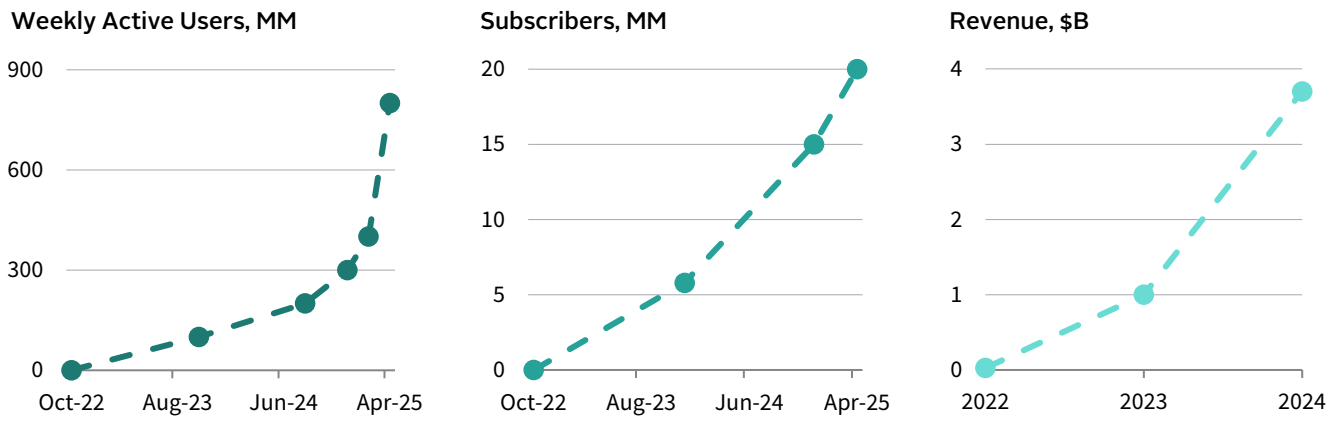
Improvements in hardware and algorithmic efficiency are driving down the cost of basic AI inference each quarter—much faster than occurred in mobile and cloud. In fact, the inference cost for a system performing at the level of ChatGPT 3.5 dropped more than 280-fold between November 2022 and October 2024. As usage costs of models decline, the technology becomes more accessible and scalable, and tasks that were prohibitively expensive for all but the largest corporations can be run by individual users.

At the same time, the cutting-edge models still require exponentially more computing power, more energy and ever larger data sets. Estimates for the training for the next generation of frontier models run to $1 billion or more. Cloud infrastructure was expensive to build in the early days, but the capital intensity of large model training is (for now) an outlier, reinforcing oligopolistic dynamics at both the corporate and national levels.

Headline rates of adoption are without precedent. ChatGPT reached 100 million monthly active users within two months of launch, which compares with 2.5 years for Instagram, 4.5 years for Facebook, and about 75 years for the fixed line telephone. In the latest data, OpenAI, founded just a decade ago, saw weekly active users scale from 300 million to 800 million since the beginning of 2025, and the firm predicts annual revenues of $12.7 billion in 2025, according to Reuters.

CHATGPT USER + SUBSCRIBER + REVENUE GROWTH

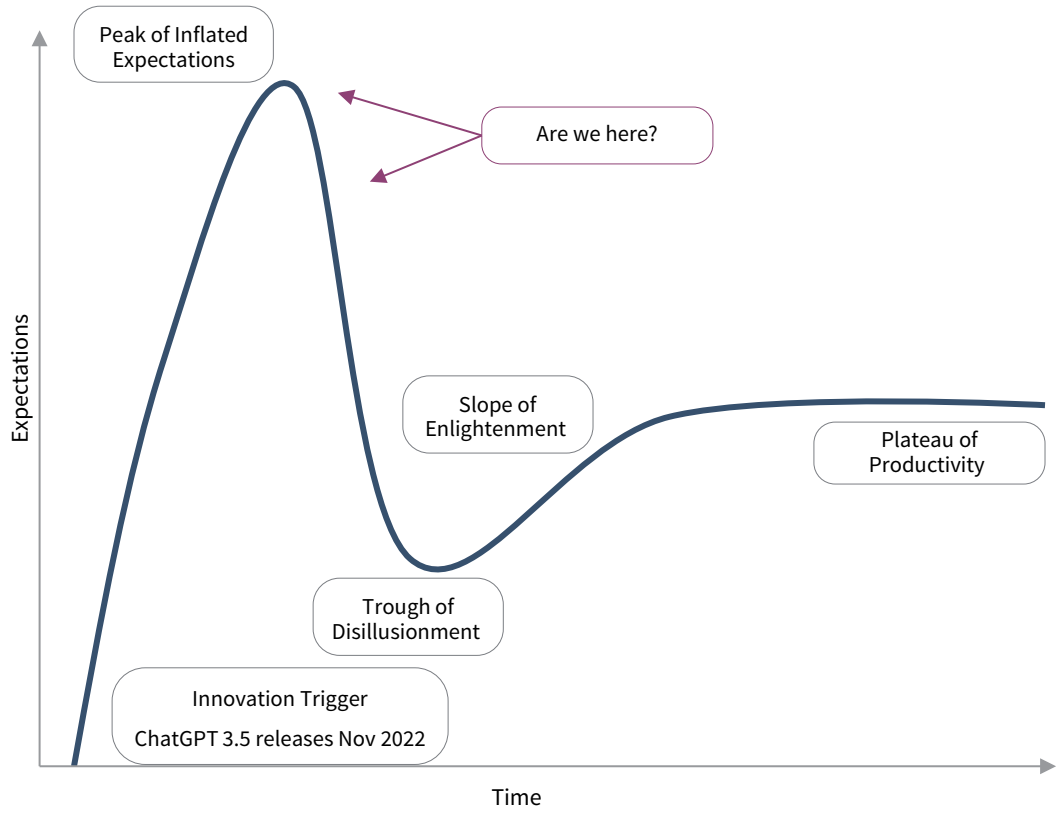
October 2022 – April 2025



Sources: BOND Trends – AI (Mary Meeker, Jay Simons, Daegwon Chae, Alexander Krey), CNBC, Fortune, OpenAI, Reuters, TechCrunch, and The Information.

Despite the headline numbers, however, it remains early in the context of systemic adoption. The above "hockey stick" figure, impressive as it is, depicts weekly active users, and hence does not reveal usage intensity. OpenAI does not yet disclose the breakdown between consumer and enterprise customer adoption, but consumer dominates, and enterprise is widely estimated to remain a small fraction of overall activity.

THE GENERATIVE AI HYPE CYCLE

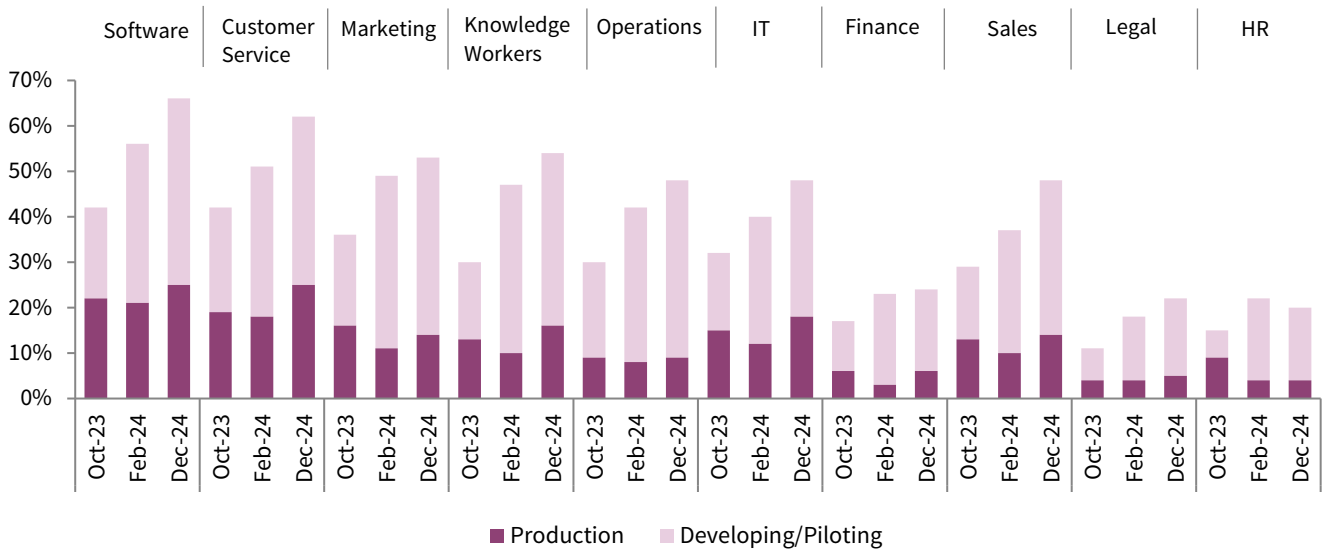


Sources: Cambridge Associates LLC and Gartner, Inc.

In Gartner hype cycle terms, some corners of the market, notably venture, are close to the "peak of inflated expectations." But elsewhere fundamental questions are being asked as to when big tech's vast capital spend will translate into economic value. Models do operate at a PhD level in certain settings, but still fail at many mundane tasks. There is breakout usage in coding and customer support, and big tech, professional service, finance and retail firms lead in adoption. But in many cases, implementation remains in the pilot phase or at the partial deployment stage. A global survey by Fivetran on AI and data readiness found 42% of enterprises reporting more than half of their AI projects delayed, underperforming, or failing due to data readiness issues, highlighting the gap between ambition and practicalities.

ENTERPRISE USE CASE ADOPTION RATES FOR GEN AI BY INDUSTRY

Use Case Adoption Rates • Percent (%)



Source: Bain & Company Generative Artificial Intelligence Surveys.

While model "hallucination" rates (fabricated or incorrect answers) are much improved, they remain obstacles to deployment in critical enterprise, healthcare, legal, and military settings. Consumers are using the algorithms for anything from product recommendations to therapy sessions, but still await the "game-changing app" that transforms behaviors in the way that Uber and Airbnb did with the combination of mass internet adoption and the advent of the smartphone. Gartner's "slope of enlightenment" is still around several corners.

AI'S FUTURE POTENTIAL TRAJECTORIES

The future course of any technology is typically opaque, but the trajectory for AI appears especially unpredictable. On the one hand, it seems unlikely that AI simply fizzles, along the lines of other supposed breakthroughs such as the metaverse that was going to be the next iteration of the internet. However, whether AI will truly transform the economy and science as a general-purpose technology with the import of electricity—without unleashing untold harms—remains unclear even to the experts.

Front and center in the "space race" is the sprint to Artificial General Intelligence (AGI)—although no one quite agrees on what AGI is, or what exactly we will do with it when we have it. To the optimists, it is either actually here or close, with Dario Amodei, Anthropic CEO, heralding systems that are "smarter than most Nobel Prize winners" before 2030. Meta's Yann LeCun, by contrast, argues that large language models will never achieve AGI, let alone "superintelligence," and that a wholly new architecture is required. Today, the latest reasoning models may exceed broad human intelligence along certain vectors, but, to the skeptics, appear far from living up to the ambitions for AI to solve humankind's biggest challenges.

While the frontier labs reach for the AGI stars, a few near-term developments should be firmly on investors' radars, including the rise of AI agents and the early days of generative AI's interactions with the physical world.

"Agentic AI," namely what happens when AI is given agency, denotes systems that can execute defined tasks autonomously, rather than just answer questions (as a chatbot does). Coding agents have seen fast adoption by software developers, while non-technical users can use natural language to generate code for applications or websites. Another example, from the legal world, is an agent that drafts documents and automates negotiations. Consumer applications currently lag enterprise applications, but there are attempts at agents that shop, and we are promised personal bots that will know us deeply, organizing our files and our lives. If the formidable challenges around accuracy, privacy, and security can be overcome, agents could become productivity gamechangers, as well as formidable disruptive forces. The "agentic economy" with agents rather than humans crawling and interacting with the web, could disintermediate swathes of the existing online economy, while automated workflows threaten traditional Software as a Service (SaaS). So far, agents are still mainly copilots rather than autonomous, and developments from here go to the heart of the fundamental questions about our future with AI, including which tasks are suitable for full automation, and which are on a spectrum where AI augments human capabilities to a greater or lesser extent.

Meanwhile, "physical AI," including robotics, is moving up the agenda. As the slow progress in autonomous vehicles demonstrates, hardware dependent innovations move much more slowly than those dependent on software. Impediments range from physics to capital intensity, to adoption hesitancy. But advances in generative AI, in reinforcement learning and in edge AI (smaller models able to run locally), are behind developments making robots more effective and more capable of autonomous planning and decisions. China, the leader in industrial robotics for years, is advancing in humanoids and aims to start mass production this year. Meanwhile, the United States is playing catch-up. Elon Musk promises one million Tesla Optimus humanoid robots by 2030, but the fact that much of the global supply chain is in China is a notable handicap. Whether specifically "humanoid" robots are an overhyped distraction or not, the latest robotics advances aim to rearchitect industry, agriculture, healthcare, defense, and more.

As investors look farther out, they should consider the extent to which AI's future course will be shaped by factors beyond the development of the technology. AI is currently advancing at a pace that outstrips society's ability—or willingness—to adapt. These factors include:

RATES OF ADOPTION. It is worth remembering that nearly half of the world's banking systems still use COBOL, a 1960s programming language, and many healthcare systems still rely on fax machines—a suitable counterweight to the more optimistic forecasts about the pace of AI adoption.

Implementing new enterprise systems not only involves serious software and hardware investment, but often requires significant change to human work habits. Predictions of adoption have frequently been ahead of reality in prior technology shifts. Indeed, the more quickly a wave develops, the more it can overwhelm, and itself reinforce inertia. At the very least, rates of adoption will be nuanced by industry, by size of business (large enterprise versus SMB, regulated versus not regulated), and by geography. On the consumer side, various forms of backlash may arise due to ethical and safety concerns. Even now, amidst all the AI fever, an "analog revival" movement is building, spurred by digital fatigue and centered, ironically enough, in Silicon Valley.

UBI – OR NOT SO FAST? In September 2024, Vinod Khosla predicted that within five years AI would be able to perform 80% of the work in 80% of all jobs. AI is certainly the first technology wave in which knowledge workers are squarely in the line of fire. Will it also be the first not to create net new jobs? The conversation about where AI automates and where it augments, and hence the extent of job displacement, has barely begun. Many corporate leaders remain coy about their immediate intentions, even if they have begun to formalize strategies. Citing Universal Basic Income (UBI) as a one-stop solution to job destruction, the techno-optimists tend to gloss over the forces of worker resistance, the scope for government interventions to implement labor protections, and, indeed, the ills of automation overreach.

RESPONSIBLE AI. As AI godfather Geoffrey Hinton sees it "we are like somebody who has this really cute tiger cub. Unless you can be very sure that it's not gonna want to kill you when it's grown up, you should worry." The development of this highly consequential technology is currently largely in the hands of startlingly few people at the top of frontier labs and big tech, leaving regulators on the back foot. In prior waves, regulatory frameworks evolved gradually, but the speed at which AI is moving, combined with its centrality to geopolitical rivalries, creates a policy minefield. To date, major divergences are appearing, along political and cultural lines. The 2024 EU AI Act is the world's first major legislation, classifying AI systems according to risk and by human rights, with its prioritization of safety over speed of innovation. The current US administration's contrasting market-based approach has seen the meager regulation that was in place largely rolled back, and, while initiatives continue in various states, innovation and dominance over China appears to be the priority at federal level. Meanwhile, China's state-led approach rests on tight control to maintain domestic societal stability, combined with multifaceted initiatives in pursuit of its own ambitions for global dominance.

THE ENERGY CONUNDRUM. Pick your statistic as to how energy intensive AI currently is. Its voracious energy demands are major themes for investors to invest behind—from ways to improve model energy efficiency, to the funding of new clean energy supply. But at a high level, progress will be accelerated or otherwise impacted by individual countries' responses to bolstering their power infrastructure, and national competitive advantages shaped by how the energy story unfolds. China is investing massively not just in AI infrastructure, but in the energy resources to support it, and is expected to become the world's leader in installed nuclear capacity by 2030.

The "cute tiger cub" is growing up fast, and while AI's cheerleaders likely overestimate the speed with which the AI revolution is "remaking everything" as Marc Andreessen put it recently, the evidence is clear. Those who embrace AI thoughtfully, understanding both what it can and what it *can't* do, will be best placed to thrive in the years ahead. The following two pieces are designed to help clients think through the consequences, and both position themselves for the opportunity as well as build resilience into their portfolios for the range of potential outcomes. ■

Drew Boyer, Graham Landrith, and Jack Terrett also contributed to this publication.

NAVIGATING THE AI REVOLUTION – PART 2

UNLOCKING PRODUCTIVITY WITH AI INVESTMENT

Kevin Rosenbaum
Head of Global Capital Markets Research

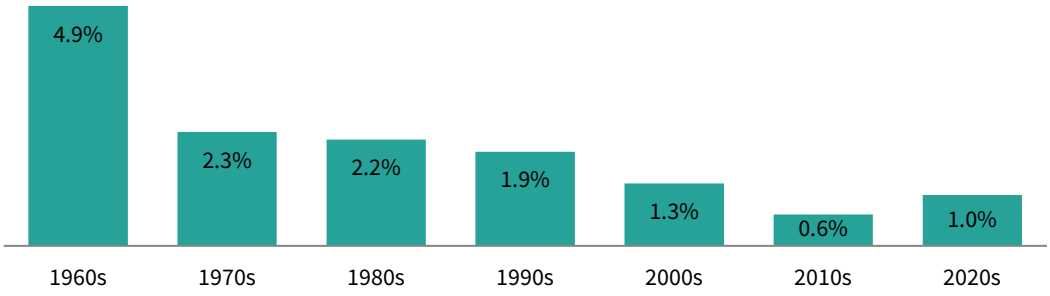
Economic activity is fundamentally driven by the size of the labor force and the productivity of that labor. With working-age populations expected to stagnate or decline in many countries due to falling birth rates, future economic growth will increasingly depend on productivity improvements rather than workforce expansion. Yet, recent years have seen disappointing productivity gains, raising concerns about long-term prosperity. In this context, AI has emerged as a promising catalyst for revitalizing productivity, with advances in generative models and automation unlocking new efficiencies across sectors. As the second piece in a three-part series, we examine how AI may support productivity growth and how capital is being deployed to realize its potential.

THE PRODUCTIVITY PUZZLE

For much of the postwar era, rising productivity fueled economic expansion. However, since the 2000s, productivity growth has been notably weak across many economies. While the causes of this slowdown are complex and debated, the primary factors include the waning impact of the IT and internet revolution, weak investment and slow diffusion of innovation across firms, and demographic headwinds—particularly aging populations and slower growth in the working-age labor force, which can dampen economic dynamism and slow the adoption of new technologies. Although these are the most significant contributors, other factors, such as regulatory barriers and measurement challenges, have likely also played a role.

LABOR PRODUCTIVITY GROWTH HAS SLOWED ACROSS MANY ECONOMIES

1960–2024 • OECD Member Countries • Annualized Growth



Source: Organisation for Economic Co-operation and Development.
Notes: Data are based on annual figures and represent annualized growth rates for each decade. The "2020s" data are calculated through 2024.

Amid these headwinds, AI presents a new avenue for boosting productivity. As highlighted in the first piece in this series, AI adoption rates have matched, or even surpassed, those of previous major technology cycles, underscoring the speed and scale of its integration into the economy. Unlike earlier waves of technological change, AI's capabilities extend well beyond simple automation, enabling innovation in areas such as data extraction, research synthesis, and complex problem solving. Early evidence from industries like finance, logistics, and healthcare suggests that AI-driven tools are already delivering measurable efficiency gains, though it will likely be at least a couple of years before integration is widespread enough to meaningfully improve productivity growth at the economy-wide level.

These advances, however, are not without challenges. As AI automates a growing range of tasks, concerns about potential job displacement—particularly in routine or highly automatable roles—have come to the fore. While new opportunities are likely to emerge as AI creates demand for new skills and industries, the transition may be disruptive for certain segments of the workforce, highlighting the importance of thoughtful policy responses and workforce reskilling initiatives to ensure broad-based benefits. Against this backdrop, some of the most visible applications of large language models (LLMs) today include:

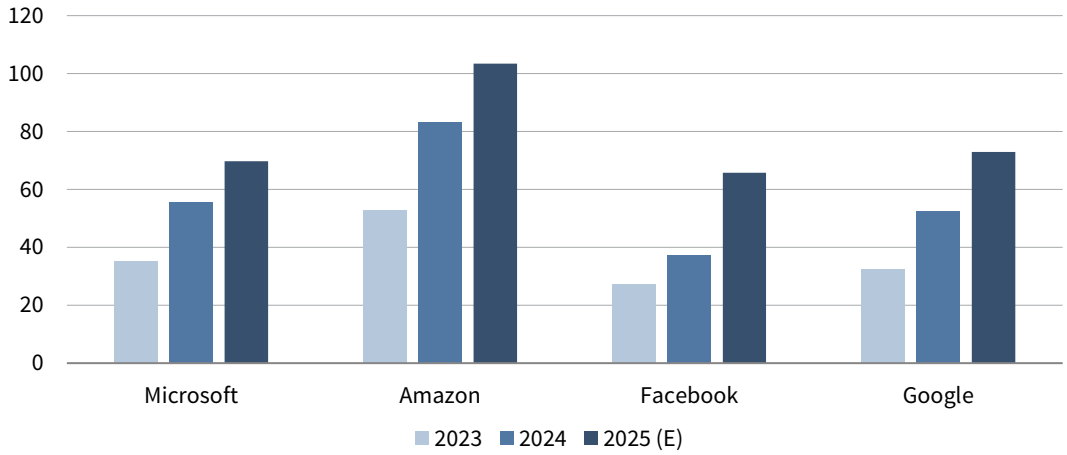
- **CUSTOMER SERVICE CHATBOTS:** LLMs power conversational agents that handle customer inquiries, troubleshoot issues, and provide support across digital platforms, reducing wait times and freeing up human agents for more complex tasks.
- **CONTENT GENERATION AND COPYWRITING:** Businesses use LLMs to draft and optimize marketing copy, blog posts, and product descriptions, streamlining content creation and enabling rapid experimentation.
- **CODING ASSISTANCE:** LLMs assist software developers by generating code snippets, suggesting improvements, and automating routine coding tasks, accelerating development cycles.
- **DOCUMENT SUMMARIZATION AND SEARCH:** LLMs extract key information, summarize lengthy documents, and answer user questions, transforming legal research, contract review, and knowledge management.
- **LANGUAGE TRANSLATION AND TEXT CORRECTION:** LLMs provide real-time translation and advanced grammar correction, enhancing communication and breaking down language barriers.

THE MARKET'S REACTION

The promise of AI has ignited a surge of investment, with capital flowing into infrastructure, model development, and a wide range of applications. Large US technology companies are leading the way, committing record sums to data centers, specialized hardware, cloud platforms, and the research needed to build increasingly sophisticated models. These investments are essential to support the computational demands of modern AI and enable new applications across industries. The scale of these

LARGE TECHNOLOGY COMPANIES SET TO INVEST BILLIONS IN AI IN 2025

As of June 2025 • Billions ($)



Source: FactSet Research Systems.

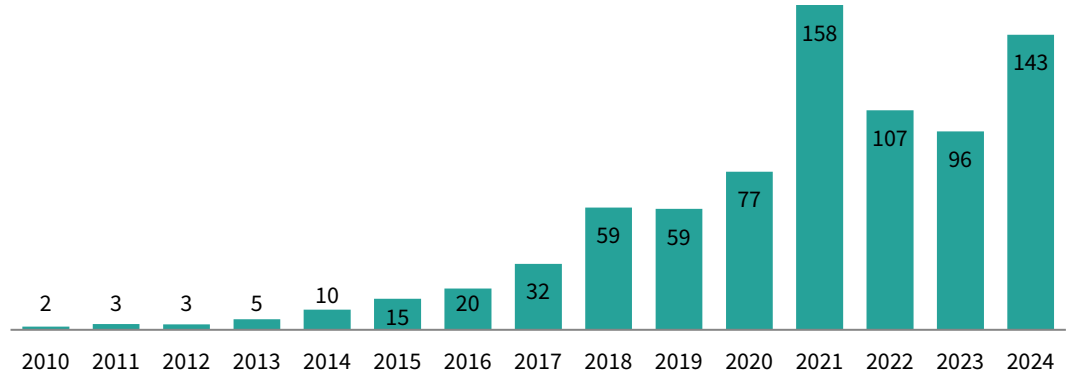
Notes: Data are for reported capital expenditure in a calendar year. Data for 2025 are consensus estimates.

commitments reflects both the strategic importance of AI and the intense competition for leadership in the next wave of technological innovation. As models become more complex and data-hungry, robust infrastructure and ongoing model development have become defining features of this investment cycle.

This wave of investment is not limited to major technology firms. Venture capital (VC) activity in AI and machine learning (ML) has also reached unprecedented levels. In 2024, VC deal-level investment in AI and ML totaled $143 billion, a dramatic increase from just $59 billion in 2019. This surge is not only a function of larger deal sizes but also a growing number of startups and scale-ups focused on AI-driven solutions across industries. The share of VC dollars allocated to AI and ML deals has risen sharply, from 15% in 2019 to 37% in 2024, underscoring the sector's growing prominence within the broader innovation landscape. Investors are increasingly viewing AI as a foundational technology with the potential to reshape entire industries, driving a virtuous cycle of capital deployment and technological advancement.

VC INVESTMENT IN AI AND MACHINE LEARNING DEALS HAS INCREASED GLOBALLY

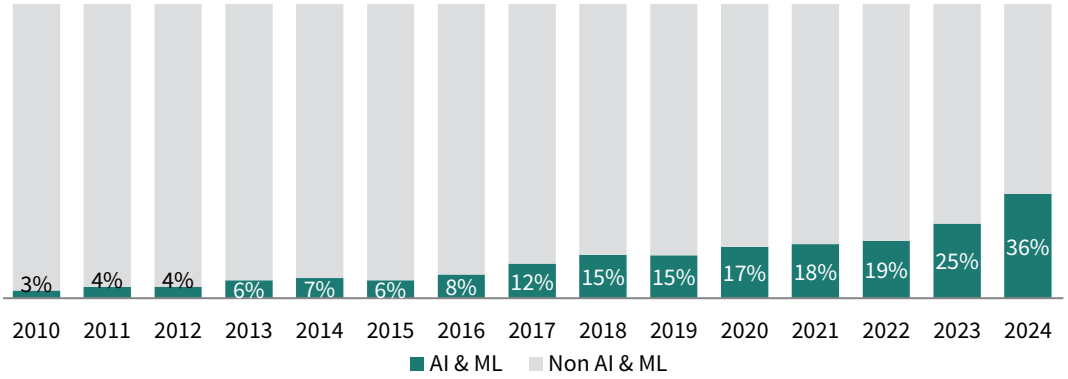
2010–24 • Capital Invested • USD (Billions)



Source: Pitchbook.

THE GLOBAL SHARE OF VC DEALS IN AI & MACHINE LEARNING HAS INCREASED

2010–24 • Percentage of all VC Deals Globally



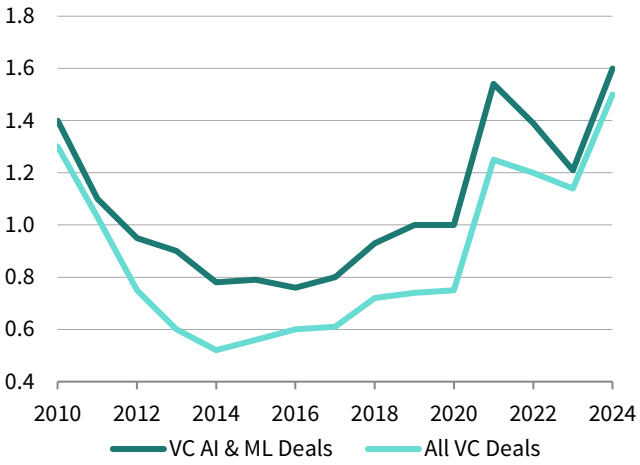
Source: Pitchbook.

Notes: Data are based on deal-level investments made in each year. Figures include all global venture capital activity tracked by PitchBook, encompassing investments made by funds, as well as by other entities.

The competitive dynamics of the VC market are also evident in deal terms. Over the past five years, both the median capital investment and median pre-money valuation for AI and ML deals have risen, reflecting heightened investor enthusiasm and the perceived value of AI-driven business models. Notably, these metrics have increased in a comparable manner for all VC deals, suggesting that while AI and ML are attracting premium valuations, the broader VC market has also become more capital-intensive. This environment has enabled AI startups to access the resources needed to scale rapidly, invest in talent, and accelerate product development, further fueling the sector's momentum.

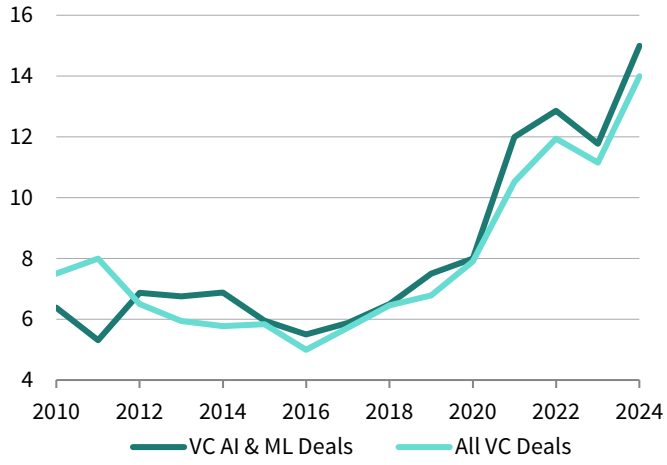
MEDIAN VC DEAL SIZE HAS INCREASED IN RECENT YEARS

2010–24 • USD (Millions)



LIKEWISE, THE MEDIAN VC PRE-MONEY VALUATION HAS INCREASED

2010–24 • USD (Millions)



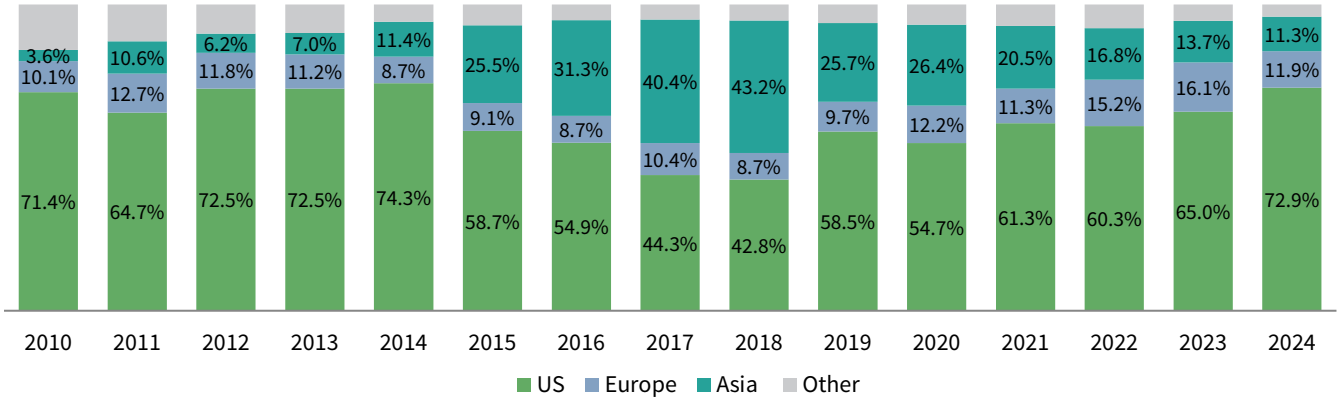
Source: Pitchbook.

Notes: Data are based on deal-level investments made in each year. Figures include all global venture capital activity tracked by PitchBook, encompassing investments made by funds, as well as by other entities.

Geographically, the distribution of AI and ML investment has shifted significantly in recent years. According to PitchBook data, Asia—once a rising destination for VC capital in these fields—saw its share drop to just 11% in 2024, while the United States accounted for a commanding 73%. This change reflects concerns over Chinese state involvement in technology and the impact of Western regulations restricting capital flows into sensitive sectors. As a result, the United States has solidified its role as the global investment destination for AI innovation. However, it is important to note that PitchBook's data may underrepresent the full scope of Chinese activity, as it is often more comprehensive for fund-based VC investments and may not fully capture direct investments by companies or government-backed initiatives in China. The recent release of advanced Chinese models, such as DeepSeek, underscores that China remains a formidable force in AI research and development, and leadership in the field remains contested.

THE LION'S SHARE OF GLOBAL VC DEALS IN AI AND MACHINE LEARNING HAS BEEN IN THE US

2010–24 • Percent (%)



Source: Pitchbook.

Notes: Data are based on deal-level investments made in each year. Figures include all global venture capital activity tracked by PitchBook, encompassing investments made by funds, as well as by other entities.

While recent market attention has centered on tariffs and trade tensions, it is AI innovation and its integration into the economy that may ultimately prove far more transformative in the years ahead. Unprecedented investment by leading technology firms, together with strong VC interest in AI startups, is fueling rapid technological advancement and shaping the next wave of economic growth. While some observers have noted elevated valuations and questioned the durability of current trends, the underlying drivers—namely, the promise of productivity gains and the transformative potential of AI—suggest that investment momentum will persist, even if widespread productivity improvements take time to materialize. In the final piece of this series, we will examine how AI's transformative potential is reshaping asset allocation opportunities across both private and public markets. ■

Graham Landrith and Mark Sintetos also contributed to this publication.

NAVIGATING THE AI REVOLUTION – PART 3

AI'S FAR REACH IN SHAPING ASSET ALLOCATION OPPORTUNITIES

Celia Dallas
Chief Investment Strategist

Theresa Sorrentino Hajer
Head of US Venture Capital Research

Generative AI marks a pivotal moment in AI, with the 2022 public release of OpenAI's ChatGPT as a major milestone. As discussed in Part 1 of this three-part series, AI is a transformative technology paradigm that will continue to evolve over the next decade and beyond. While significant investment has fueled rapid growth in AI and its supporting infrastructure, we are still in the early stages of this innovation cycle. As explored in Part 2, the rapid adoption of AI is also beginning to unlock new productivity gains, though widespread economic impact is still emerging. In this piece, we explore AI's transformative potential for asset allocation opportunities and risks, as well as key implementation considerations and challenges. Investors should be actively considering how to prudently achieve exposure across their portfolios to the AI technology, the infrastructure required to deploy AI, and the companies that will benefit from the power of AI, while remaining vigilant to the risks of disruption, overvaluation, and overbuilding.

INVESTMENT IMPLICATIONS THROUGH THE TECH CYCLE

To navigate the AI investment landscape, it is helpful to segment the market into five archetypes that capture the diverse ways in which companies interact with AI:

1. **CREATORS** are the pioneers at the frontier of AI innovation—companies developing foundational models, advanced algorithms, the software development toolchain, and specialized hardware that form the core of the technology.
2. **DISRUPTORS** create a transformative change that goes beyond integrating technology into an existing process, launching new business models that were unimaginable prior to the technological leap (e.g., Uber or Amazon of the internet era).
3. **ENABLERS** provide the essential physical infrastructure that makes AI possible, including semiconductors, data centers, and energy solutions.
4. **ADAPTORS** are businesses that integrate AI into their operations, harnessing its power to drive efficiency, unlock new business models, expand their market share, and maintain competitive advantage.
5. Finally, **THE DISRUPTED** are incumbents whose market share or relevance is threatened by the rise of AI-powered competitors.

Each of these archetypes presents distinct investment opportunities and risks across asset classes.

As discussed in Part 1, where we highlighted past technology cycles, this framework echoes the dynamics of the internet era that launched the information age. During that period, Apple, Google, and Microsoft were among the creators, building the platforms and software that defined the new economy. Amazon emerged as a disrupter, fundamentally changing the retail landscape. With the emergence of cloud computing, software-defined infrastructure was developed to manage or enable compute, storage, and networking through software. Companies like Intel and Cisco served as enablers, providing the chips and networking equipment that powered the digital revolution. Today, as AI ushers in another wave of transformation, understanding where companies sit within this cycle is essential for identifying both risks and opportunities across the investment landscape.

ECHOES OF THE INTERNET ERA

Archetype	Internet Adoption		AI Adoption		Implementation Opportunities
Incumbents	**Disrupted:** Blockbuster Taxis Toys R Us Tower Records	**Adapted:** Disney Walmart New York Times	**Disrupt or Adapt?** Call Centers Engineers Big Tech ???		Credit, Private/Growth Equity, Public Equity
Disruptors	Netflix Uber	Amazon Spotify	Cursor Decagon	Waymo Sierra	Private/Growth Equity, Venture Capital
Creators	PC/Mobile (Apple) Search (Google) Operating Systems (Microsoft) Software Defined Infra (Palo Alto, Oracle)		Large Language Models (OpenAI, Anthropic, Llama) Software Defined Infra (Cyera, Databricks)		Venture Capital, Public Equity
Enablers	Chips/Compute (Intel, Sun Micro) Comms Infra (Cisco, AT&T)		Chips/Compute (Nvidia, ARM) Hyperscalers (AWS, Azure)		Credit, Infrastructure, Public Equity

Source: Cambridge Associates LLC.

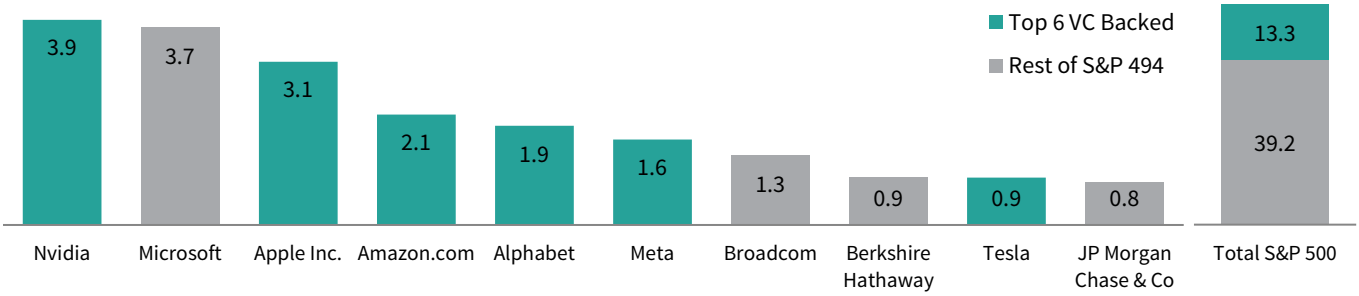
CREATORS AND DISRUPTORS

Venture capital (VC) remains a crucial funding source for innovative start-ups engaged in high-risk research and product development. This dynamic drove previous technology waves, such as the internet, mobile, and cloud computing. However, the AI era presents a different landscape. Unlike the cloud era—where established companies were slow to adapt and start-ups captured early gains—many incumbents are now early AI leaders. These companies are cloud-native and deeply integrated into corporate systems. They leverage their scale and distribution to build AI capabilities internally or accelerate innovation by acquiring or investing in VC-backed AI start-ups. Notable examples include Google's acquisition of DeepMind (which powered Google Brain and Gemini), Microsoft's early partnership with OpenAI, and Amazon's partnership

with Anthropic. Hyperscalers' capital expenditures have been extraordinary and are expected to continue as AI technology advances. Key areas of VC investment include large language models (LLMs), supporting software infrastructure, and "applied AI" applications built on this foundation.

MOST OF THE LARGEST COMPANIES IN THE S&P WERE VENTURE BACKED AND EMERGED FROM PREVIOUS TECH TRENDS

June 30, 2025 • Market Capitalization USD (Trillions)



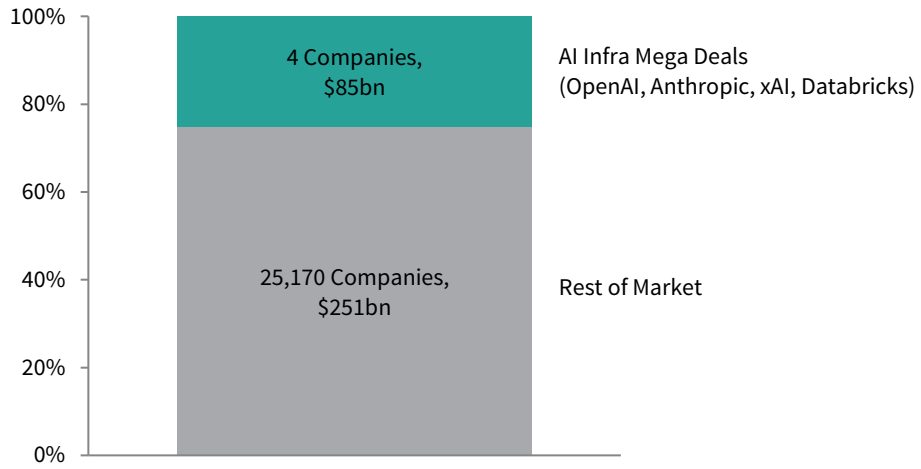
Sources: Bloomberg and Standard & Poor's. Third-party data provided "as is" without any express or implied warranties.
Notes: Microsoft and Broadcom received nominal venture investments but did not have significant venture backing. Total S&P and company bars are not to scale.

As outlined in Part 2, VC investment in AI has reached record highs, with intense enthusiasm and abundant capital pursuing a limited number of high-quality start-ups. Adoption rates have surged across many companies (see Part 1), but much of the early revenue is "experimental," reflecting trial phases rather than sustainable businesses. This momentum has spurred a wave of new company formations and AI strategy announcements, creating significant "AI noise" in the market. Interest is also growing in "physical AI," where AI intersects with industries such as manufacturing, construction, healthcare, and aerospace and defense. However, all this frenzy has led to inflated valuations, intense competition, and overfunded segments given its relative infancy. Although AI-first companies have seen rapid revenue growth, its durability is uncertain due to the experimental nature of adoption and the lack of strong competitive moats—even companies with $50 million–$100 million in revenue can be overtaken whereas in prior cycles that typically signaled victory. While a few leaders have already created significant value, many AI start-ups are likely to fail due to oversaturation, poor management, and rapid sector evolution.

Historically, major technology shifts often result in commoditization, and it is rarely clear at the onset which companies will ultimately succeed. The winners are typically those that either build on existing technology through innovation or leapfrog older products and services entirely. For instance, Dell Technologies initially dominated the PC market, EMC led in on-premises enterprise data storage before the transition to cloud solutions, and Cisco was the leader in network hardware before the rise of software-defined networking. AI is likely to follow similar patterns, with rapid change and innovation making it difficult to identify long-term leaders. As open-source competition and verticalized alternatives have driven SaaS commoditization, so too will these forces and the broader open-source community drive further innovation and disruption in AI. Despite these uncertainties, we expect long-term VC returns in AI to remain attractive.

DESPITE MEGA AI ROUNDS, SIGNIFICANT CAPITAL IS BEING DEPLOYED INTO SMALLER AI DEALS

As of May 31, 2025 • Venture Capital AI and ML Deals • % of Invested Capital



Source: Pitchbook.

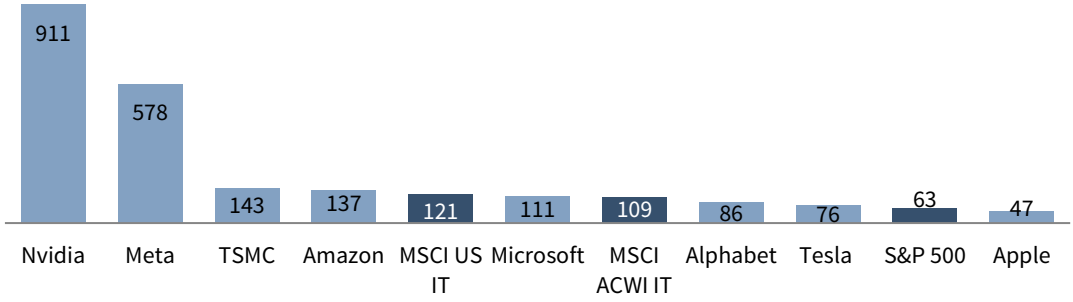
Who will be the winning investors? We recommend diversifying across the AI value chain and managing risks through careful position sizing. Investors should prioritize general partners (GPs) with deep sector expertise, particularly at the foundational and network infrastructure levels, and a proven track record of business building. This expertise—whether within specialist or generalist firms—enables better deal flow, talent identification, and assessment of technical merit. Select specialists for investments where technology risk is high, and generalists for broader investment strategies, leveraging the strengths of both. As AI becomes more widespread and many start-ups incorporate it into their products, investment decisions will increasingly focus on how AI is applied rather than on the technology itself. This trend mirrors previous technology cycles, where, as markets matured, investment success depended more on careful selection and curation than on technical expertise. Many GPs focused on AI are relatively new and still gaining investment experience, given the technology's rapid rise in prominence. Large generalist firms have captured many early AI successes, often partnering with specialists to combine strengths. These generalists offer larger capital pools, enabling them to support AI start-ups through multiple funding rounds, provide customer access, and offer business-building expertise. Their broad go-to-market and business development capabilities help start-ups as they scale.

ENABLERS

Enablers are the backbone of the AI revolution, providing the physical infrastructure that supports AI's rapid expansion. The primary beneficiaries to date have been semiconductor manufacturers (especially those producing AI chips), hyperscale data center operators, and the power and utility companies that support this ecosystem. However, the scale and speed of investment in these areas have raised concerns about sustainability, valuations, and the risk of overbuilding—reminiscent of the internet era's fiber optic boom and bust.

CHIPMAKERS AND HYPERSCALERS HAVE BENEFITED THE MOST FROM GENERATIVE AI

November 30, 2022 (Launch of ChatGPT) – June 30, 2025 • Cumulative Return (%) • US Dollar



Sources: MSCI Inc., Standard & Poor's, and Thomson Reuters Datastream. Third-party data provided "as is" without any express or implied warranties.

Notes: All financial investments involve risk. Depending on the type of investment, losses can be unlimited. Past performance is not indicative of future returns.

The rise of generative AI and LLMs has driven unprecedented demand for high-performance chips, particularly GPUs and custom AI accelerators. Companies like Nvidia, AMD, and emerging players such as Cerebras have seen orders and backlogs soar. Supply constraints and technological leadership have enabled leading chipmakers to command premium pricing and margins. Dominant players, especially Nvidia (through its CUDA platform), are building integrated hardware-software ecosystems, creating high switching costs and network effects, but also raising antitrust concerns. Valuations remain high, with Nvidia trading at a forward price-to-earnings (P/E) ratio of 32.3, as of June 30, 2025. While this is below 2024 peaks, it remains vulnerable to correction if AI adoption slows, or competition intensifies. As such, consider modest tilts away from expensive public equity mega-cap tech stocks to reduce valuation risk and enhance portfolio diversification.

Data centers are also major beneficiaries, driven by AI, ongoing cloud adoption, and rising data usage. McKinsey estimates data center capacity demand will grow at an annual rate of about 20% through 2030, with generative AI data centers accounting for a small, but growing share of new demand. Investors should partner with infrastructure and real estate managers with specialized development and operating expertise that are well-positioned to benefit from this supply/demand imbalance. However, transaction multiples have risen materially, averaging 25x EBITDA over the last four years according to Infralogic, compared to a 13.5x average for private infrastructure more broadly. This makes careful underwriting essential for attractive returns. Like other AI infrastructure assets, data centers face risk of overbuilding, as well as regulatory and environmental concerns and constraints such as local opposition and permitting delays. These risks can be mitigated by focusing on managers who can develop assets at lower multiples (e.g., low double-digit EBITDA) and sell into a strong market, often with long-term contracts from investment-grade hyperscalers (e.g., Microsoft, Amazon) seeking development partners. In contrast, speculative and remotely located data centers with more limited utility face heightened risks. From a portfolio construction perspective, data centers offer lower expected returns than private investments in innovative AI firms but can provide returns competitive with broad equities (e.g., 15%–20% target gross IRR) with diversification benefits.

Other enablers, such as utilities and grid infrastructure, have also seen increased demand and capital inflows driven by electrification and digitization trends. McKinsey expects global data center capacity demand between 2025 and 2030 to drive investment in power (including generation and transmission) to total between $200 billion (constrained momentum) to $600 billion dollars (accelerated demand), with $300 billion as their baseline for continued momentum. US on-grid electricity demand is expected to increase 2%–3% per year through 2030 up from virtually flat growth over the last decade, with faster growth in Asia (from a lower base) and slower growth in Europe. While difficult to estimate, rapid AI adoption and potential onshoring in the United States could further boost energy demand. Although AI energy efficiency is expected to improve, associated cost reductions may spur broader adoption, likely resulting in net energy demand growth. Investment in essential electricity infrastructure with inelastic demand is critical. Data centers require reliable power, necessitating redundant infrastructure such as back-up generators and batteries.

All enabler segments have strong growth potential, with chips and data centers experiencing the fastest expansion, but they also trade at heightened valuations and have the greatest exposure to overbuilding. Scale, technological edge, strong customer relationships, and specialized expertise are critical for managing these risks.

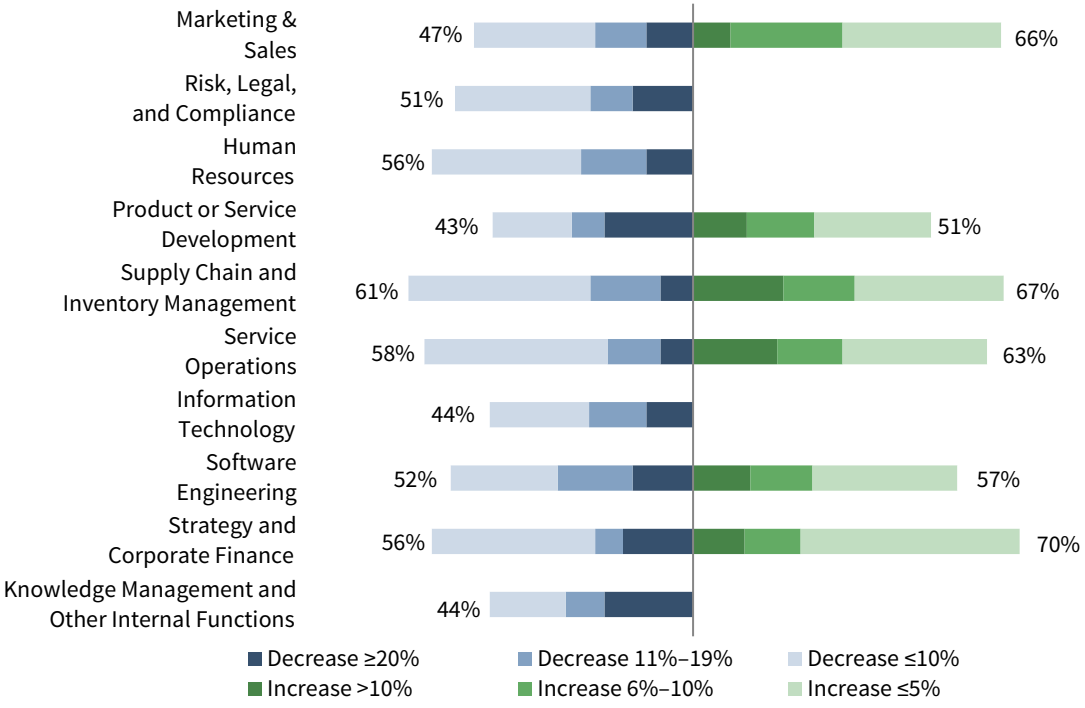
ADAPTORS AND THE DISRUPTED

Building on the productivity themes from Part 2, growth equity and private equity-backed companies are increasingly using AI to boost revenue and improve margins. As private entities, they have more flexibility to integrate and scale AI across operations, though successful implementation requires careful execution. While many companies are still experimenting, some are already seeing early benefits in product enhancements and margin gains.

Private equity investors are actively assessing both the opportunities and risks AI brings to their portfolio companies and industries. They look for cost savings through automation (e.g., customer support, onboarding, coding) and revenue growth from AI-driven products (e.g., sales planning, demand forecasting). At the same time, they remain cautious about risks, such as commoditization (e.g., graphic design, digital marketing) and increased competition from low-cost automation (e.g., auditing, document preparation, call centers). Technology-focused managers have an edge due to sector expertise, but both specialist and generalist firms are hiring AI talent to support investment teams and portfolios. The full impact of AI will unfold over time as new use cases and broader adoption and understanding of AI technologies and their impact continue to emerge.

GENERATIVE AI DELIVERS BROAD COST REDUCTIONS AND TARGETED REVENUE GAINS ACROSS BUSINESS FUNCTIONS

2024 • Cost Decrease and Revenue Increase From Generative AI Use by Function • Percent of Respondents

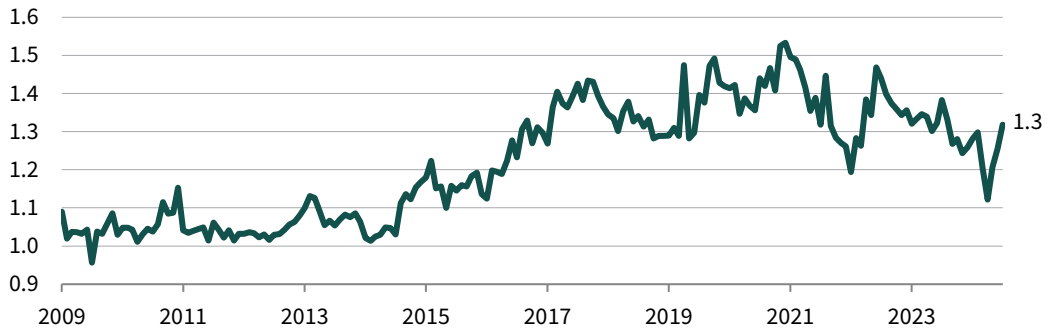


Sources: "The AI Index 2025 Annual Report," AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2025 and McKinsey & Company Survey, 2024. See page 24 for more source notes.

Similarly, public companies must adapt to AI or risk disruption. Investors should focus on active management to distinguish winners from losers and to assess price risk, selecting managers with deep sector expertise. Employ long/short and fundamental strategies to manage risk and exploit valuation dislocations. Public investors face the challenge of avoiding overvalued AI leaders while not overlooking lower-priced

THE VALUATION OF AI LEADERS HAS RETRACED SIGNIFICANTLY SINCE THE 2021 PEAK

January 31, 2009 – June 30, 2025 • Relative 12M Forward PE • AI Leaders vs S&P 500



Sources: Empirical Research Partners, FactSet Research Systems, Standard & Poor's, and Thomson Reuters Datastream. Third-party data provided "as is" without any express or implied warranties.
Notes: "AI Leaders" are defined by Empirical Research Partners as the group of 44 large-cap stocks drawn from the top quintile of time spent discussing AI on earnings calls, where that discussion was deemed to be substantive. Data are monthly.

companies that may lag behind. Many leading public companies are cloud-native and well-positioned for AI, but investors should consider the entire spectrum of innovators and disruptors. Public market valuations for AI-enabled companies have dropped from their late 2021 peak; forward P/E ratios relative to the S&P 500 Index hit a nine-year low earlier this year, and have since rebounded, but remain below recent historical spikes. This environment favors long/short managers that can identify mispriced companies amid the current AI hype.

As outlined in Part 1, we recognize that non-technological factors—particularly regulatory and policy uncertainty—are increasingly shaping both the AI investment landscape and broader societal outcomes. The concept of Responsible AI (RAI) is gaining more attention as generative AI models and systems grow in complexity and become more deeply embedded across industries. RAI frameworks address the development and deployment of LLMs and broader AI applications, emphasizing principles such as fairness, transparency and explainability, accountability, privacy, safety, and security. From an investment perspective, effective governance is inherently complex, intersecting regulatory, ethical, technological, and human considerations. This complexity necessitates cross-disciplinary collaboration and often involves navigating trade-offs and misaligned incentives. As AI adoption accelerates, reported incidents of ethical misuse have increased in recent years. A recent survey found that only 14% of businesses have dedicated AI governance roles, yet 42% reported improved operations and 34% noted increased customer trust due to RAI policies and investments.[1] Companies should proactively assess, and address financially material risks associated with neglecting RAI practices, such as regulatory actions or erosion of their societal license to operate, which could result in negative commercial consequences. Governments worldwide are trying to address complex issues like data privacy, algorithmic transparency, antitrust, and national security, and new regulations could significantly impact sector competition. Investors must also monitor regulatory developments closely, as evolving rules and policies will likely influence long-term value creation and competitive differentiation in the rapidly evolving AI sector.

The "AI noise" phenomenon extends beyond private investments. Most technology companies now market themselves as AI-focused, and those that do not, risk appearing outdated. Enterprise software incumbents with high switching costs, complex technology, and strong innovation pipelines may continue to thrive, while agile start-ups can exploit weaknesses and expand from niche solutions into strategic adjacencies, potentially displacing incumbents. For example, it is unclear whether established security firms will lead in AI security or whether nimble start-ups will secure the AI/ML software supply chain. ServiceNow, a leading enterprise software provider, has thus far demonstrated successful AI adoption by leveraging its integrated suite and existing customer base to pivot toward AI-driven solutions. Given the rapid pace of change, both long-only and long/short hedge funds can find alpha by capitalizing on

1 Nestor Maslej, Loredana Fattorini, Raymond Perrault, Yolanda Gil, Vanessa Parli, Njenga Kariuki, Emily Capstick, Anka Reuel, Erik Brynjolfsson, John Etchemendy, Katrina Ligett, Terah Lyons, James Manyika, Juan Carlos Niebles, Yoav Shoham, Russell Wald, Tobi Walsh, Armin Hamrah, Lapo Santarlasci, Julia Betts Lotufo, Alexandra Rome, Andrew Shi, Sukrut Oak. "The AI Index 2025 Annual Report," AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2025 and McKinsey & Company survey 2024.

short-term disruptions and mispriced companies. Valuation-based and fundamental short strategies remain relevant, though it can be difficult to short declining businesses that retain temporary relevance or to identify companies prematurely dismissed as AI losers. Investors should consider managers with crossover expertise—spanning both public and private markets—as they are well-positioned to capitalize on rapidly evolving AI developments by spotting trends in private markets before they are reflected in public market valuations, and can continue to invest post IPO.

AI-related risks and opportunities are increasingly influencing credit markets. Credit managers are financing core infrastructure—such as GPUs, data centers, and energy projects—while also supporting the broader AI ecosystem. Several large managers are establishing dedicated asset-backed finance teams and raising capital specifically to pursue these opportunities. Direct lenders, in particular, have significant exposure to technology and business services, which will need to adapt in response to AI advancements.

More broadly, credit managers must evaluate the adaptability of their portfolio holdings. Many software companies—particularly those with high leverage and business models vulnerable to AI automation (e.g., HR, legal, accounting, and other back-office SaaS providers)—face considerable disruption risk. The past decade's low-rate environment led to aggressive leverage and high valuations, leaving some companies with thin interest coverage and little margin for error. These firms are especially vulnerable if AI-driven disruption erodes their revenue base. Should AI agents automate or disintermediate core functions, revenue models may be cannibalized, and even modest declines in topline revenue could threaten debt service capacity.

Some credit managers are proactively encouraging portfolio companies to adopt AI, aiming to drive efficiencies and mitigate disruption risk. Lenders are increasingly evaluating management's AI strategy as part of their underwriting process. Companies that successfully integrate AI may improve margins and creditworthiness, while laggards risk being left behind. As disruption accelerates, a wave of distressed opportunities may emerge among over-levered incumbents unable to adapt to AI-driven change. However, the timing of this transition is highly uncertain: some companies may be "slow melting ice cubes," experiencing gradual market decline, while others may yet adapt successfully.

Investors should select credit managers who proactively assess AI-related opportunities and risks, including overbuilding in data centers and other infrastructure, while proactively managing exposure to incumbents in sectors vulnerable to AI disruption, such as highly leveraged back-office SaaS providers. Credit opportunity managers may be best positioned to benefit from distressed cycles arising from AI-driven disruption, as these managers can capitalize on market dislocations.

Investors should question managers on their approach to AI, both in terms of portfolio company adaptation and exposure to AI-related risks and opportunities, as part of ongoing due diligence.

SUMMARY INVESTMENT VIEWS

ASSET CLASS	INVESTMENT OPPORTUNITIES	RISKS/CONSIDERATIONS	RECOMMENDATIONS
Venture Capital & Private Equity	■ Backing AI Creators (foundational models, algorithms, software-defined infrastructure) ■ Investing in Adaptors integrating AI to drive efficiency and innovation ■ Early-stage exposure to disruptive business models	■ High valuations and intense competition ■ Rapid obsolescence and "copy-cat" start-ups ■ Unclear long-term winners; many start-ups will fail ■ Need for deep technical and sector expertise; investors should understand intentions of AI products and services ■ Regulatory and policy uncertainty	■ Prioritize managers with AI knowledge, broad networks and proven business building expertise ■ Diversify across AI value chain, manage risks via sizing ■ Focus on due diligence and ability to distinguish hype from enduring value ■ Select managers with specialists for highly technical and focused investment strategies and generalist approaches for broader investment strategies
Credit	■ Financing core AI infrastructure (GPUs, data centers, energy projects) ■ Supporting companies adapting to AI ■ Distressed opportunities among disrupted incumbents	■ Exposure to companies vulnerable to AI-driven disruption (e.g., SaaS, back-office providers) ■ High leverage and thin interest coverage in some sectors ■ Uncertain timing of disruption ■ Regulatory and policy uncertainty	■ Select managers who proactively assess AI-related risks and opportunities, including overbuilding/spec data centers ■ Avoid performing credit managers with significant exposure to at-risk incumbents ■ Consider credit opportunities managers to benefit from distressed cycles arising from disruption
Public Equities	■ Investing in leading AI Adaptors and Enablers ■ Long/short strategies to exploit mispricings ■ Exposure to diversified AI beneficiaries	■ Overpaying for aggressively adopting companies ■ Risk of incumbents being disrupted ■ Valuation volatility and hype cycles ■ Regulatory and policy uncertainty	■ Maintain broad exposure across AI value chain ■ Use active management to distinguish winners from losers and assess price risk ■ Select managers with sector expertise ■ Employ long/short and fundamental strategies to manage risk. ■ Consider cross over investors who can capture value throughout a company's growth lifecycle ■ Monitor regulatory developments
Infrastructure	■ Investment in data centers and electricity infrastructure ■ Equity investments in semiconductor manufacturers and hyperscalers	■ Overbuilding and sustainability concerns ■ High transaction multiples and valuation risk ■ High-quality businesses and free cash flow generation of public mega-cap tech stocks warrant caution in equity underweights ■ Regulatory, permitting, and environmental constraints	■ Partner with infrastructure managers with specialized development and operating expertise ■ Target markets with relatively inelastic demand ■ Underwrite carefully for attractive entry multiples, favoring managers who can add value through development ■ Prioritize assets with long-term contracts and strong demand drivers ■ Consider modest tilts away from expensive public equity mega-cap tech stocks to reduce valuation risk

Source: Cambridge Associates LLC.

CONCLUSION

AI is fundamentally reshaping the investment landscape, presenting both extraordinary opportunities and new risks across asset classes. The technology's reach extends from the innovators building core capabilities, to the enablers providing critical infrastructure, to the adaptors and disrupted incumbents navigating a rapidly changing environment. Although substantial investment has already driven rapid growth in AI and its supporting infrastructure, we remain in the early stages of this technological shift, which is expected to evolve over the next decade and beyond. In previous technology cycles, the initial investments and returns from foundational innovation were ultimately surpassed by the gains generated by disruptive companies. These disruptors leverage the established or rebuilt technology infrastructure and benefit from network effects as commercial adoption accelerates, enabling them to redefine industries or create entirely new markets and business models. Attractively valued companies that can leverage AI to improve their profitability should also benefit meaningfully.

Investors should strategically seek opportunities to incorporate AI Creators, Disruptors, Enablers, and Adaptors within their portfolios, all the while maintaining a careful watch on potential disruption risks and the possibility of inflated valuations and overbuilding. Investment success in this new era will require investors to combine deep sector expertise, rigorous due diligence, and a willingness to adapt as the technology and its applications evolve. Investors that partner with managers that can distinguish between hype and enduring value, anticipate regulatory shifts, and identify the true drivers of sustainable growth will be best positioned to capture the far-reaching potential of AI in shaping asset allocation for years to come. ■

Grayson Kirk, Graham Landrith, and Archie Levis also contributed to this publication.

SOURCE NOTES

The AI Index 2025 Annual Report, Stanford University, April 2025.
Nestor Maslej, Loredana Fattorini, Raymond Perrault, Yolanda Gil, Vanessa Parli, Njenga Kariuki, Emily Capstick, Anka Reuel, Erik Brynjolfsson, John Etchemendy, Katrina Ligett, Terah Lyons, James Manyika, Juan Carlos Niebles, Yoav Shoham, Russell Wald, Tobi Walsh, Armin Hamrah, Lapo Santarlasci, Julia Betts Lotufo, Alexandra Rome, Andrew Shi, Sukrut Oak. "The AI Index 2025 Annual Report," AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2025.

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MSCI ACWI Information Technology Index
The MSCI ACWI Information Technology Index includes large- and mid-cap securities across 23 Developed Markets (DM) countries and 24 Emerging Markets (EM) countries. All securities in the index are classified in the Information Technology as per the Global Industry Classification Standard (GICS®). DM countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States. EM countries include Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Kuwait, Malaysia, Mexico, Peru, the Philippines, Poland, Qatar, Saudi Arabia, South Africa, Taiwan, Thailand, Turkey, and the United Arab Emirates.

MSCI US Information Technology Index
The MSCI US Information Technology Index is designed to capture the large- and mid-cap segments of the US equity universe. All securities in the index are classified in the Information Technology sector as per the Global Industry Classification Standard (GICS®).

S&P 500 Index
The S&P 500 Index includes 500 leading companies and covers approximately 80% of available market capitalization.

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