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The ascent of generative AI — What investors should know

Artificial intelligence (AI) and, more specifically, large language models like ChatGPT have garnered much discussion throughout the first half of the year. We have seen excitement building around the development of generative AI and subsequent disruptions that may impact multiple industries over the longer term given its focus on productivity, efficiency, and cost reduction. The recent emergence of generative AI capabilities has generated considerable investor enthusiasm surrounding the new disruptive technology, particularly during the first half of the year. In this report, we discuss our view on how investors should navigate the generative AI landscape with topics ranging from our macroeconomic perspective to specific investment implementation ideas.

What's inside

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Overview of generative AI and the scope of this report

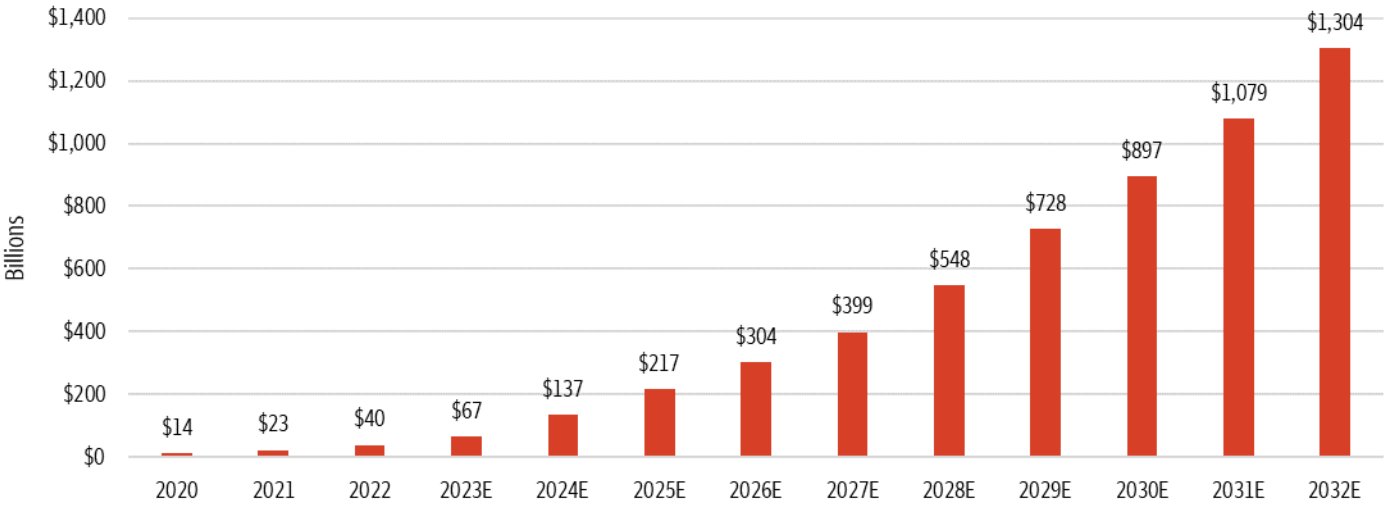
AI has been a dominant theme in the stock market this year with the potential to have much the same effect on the economy. Generative AI has the ability to create new content, moving beyond traditional AI's data analysis and improved forecasting capabilities. It is the latest and, perhaps, most important step so far in the technology's evolution, preceded by traditional AI systems, machine learning, deep learning, neural networks, and automated speech recognition and language processing.[1] In the past, traditional AI has been helpful in predicting outcomes and focusing on a narrow task, such as accurately identifying and categorizing images. Generative AI, on the other hand, is based on a text prompt, whereby a user types text-based inputs in the form of a question or request and the large language model does its best to produce an appropriate response.[2] It offers broader applications, using deep learning techniques and large language models to generate unique and new content using trained data. A few examples of this advancement include images, videos, music, essays, language, conversations, and even software code itself.[3]

We believe the technology will be transformative and could impact multiple industries over the longer term given its focus on increased productivity, efficiency, and cost reduction. Over the next two decades, we believe that AI will reach far beyond the software industry to transform health care, education, manufacturing, transportation, financials, and retail, among others. In fact, Microsoft Corporation's analysis suggests that next-generation AI technology will contribute 10% incremental global gross domestic product (GDP) growth — based on today's global GDP figure of $100 trillion, this would be in the range of $7 – $10 trillion over the long run.[4]

Large addressable market

According to Bloomberg and the International Development Corporation (IDC), the overall market for generative AI could grow at a compound annual growth rate of approximately 45%, from $14 billion in 2020 to $1.30 trillion in 2032 (Chart 1). The rapid growth in generative AI is expected to support demand for semiconductor chips, software, networking, and memory storage solutions.

Chart 1: Generative AI market



Sources: Wells Fargo Investment Institute, Bloomberg, and IDC. Data as of June 1, 2023. E = estimated. Estimates based on Bloomberg Intelligence forecasts using IDC data for the overall generative AI market.

1. Deep learning refers to a type of AI that uses layers of neural networks to mimic how humans learn.
2. A large language model is a deep-learning neural network that is trained on massive amounts of existing text to generate new text similar to human language.
3. Specific examples detailed in Table 1: Potential generative AI use cases and capabilities by industry.
4. Stated by Microsoft at its Microsoft Inspire 2023 Conference.

Major computing platform shift underway

We have witnessed multiple computing-related platform shifts that have had a material impact on society. One important shift was the transition from mainframe computers to personal computers in the 1980s. Another shift in the 1990s was the transition to networking. The late-1990s saw the buildout of desktop internet, which eventually led to new applications and business models based on online commerce as well as social media in the early 2000s. Another platform shift occurred in the 2010s toward mobile internet computing following the rapid adoption of smartphones. The emergence of public cloud computing (in the mid-2000s) and software as a service business models took off with the introduction of Amazon Web Services (2006), Google's Cloud Computing service (2008), and Microsoft's Azure (2010) .

AI has been around since the 1950s and has experienced several false starts along the way. However, over the past two decades, the convergence of big data, advances in high-performance computing power, advances in machine learning algorithms, and cloud computing were instrumental in driving recent AI advancements. In terms of size and importance, it is widely believed that generative AI represents the next major computing platform shift upon which various types of software and new applications will be built. That said, we believe some of the outperformers of prior platform shifts may be the longer-term beneficiaries of generative AI's evolution.

Key takeaways

Over the next two decades, we believe AI in general has the potential to transform broad swaths of the economy outside of the software industry.

We think it is too early to tell how much traction companies will gain in terms of monetizing the large consumer interest and how quickly enterprises will broadly adopt generative AI going forward.

We always favor a clear-eyed evaluation of risk and reward in every investment decision, and that remains true in the early stages of even a transformative technology.

Mainstream adoption — ChatGPT

ChatGPT was created by OpenAI, an AI research organization founded by various entrepreneurs and researchers in December 2015. Microsoft has been OpenAI's largest financial backer with approximately 49% ownership and $13 billion invested (as of April 8, 2023).[5] ChatGPT is based on OpenAI's Generative Pre-Trained Transformer (GPT) series of large language models, and the transformer model represents one of a handful of popular generative AI large language models.

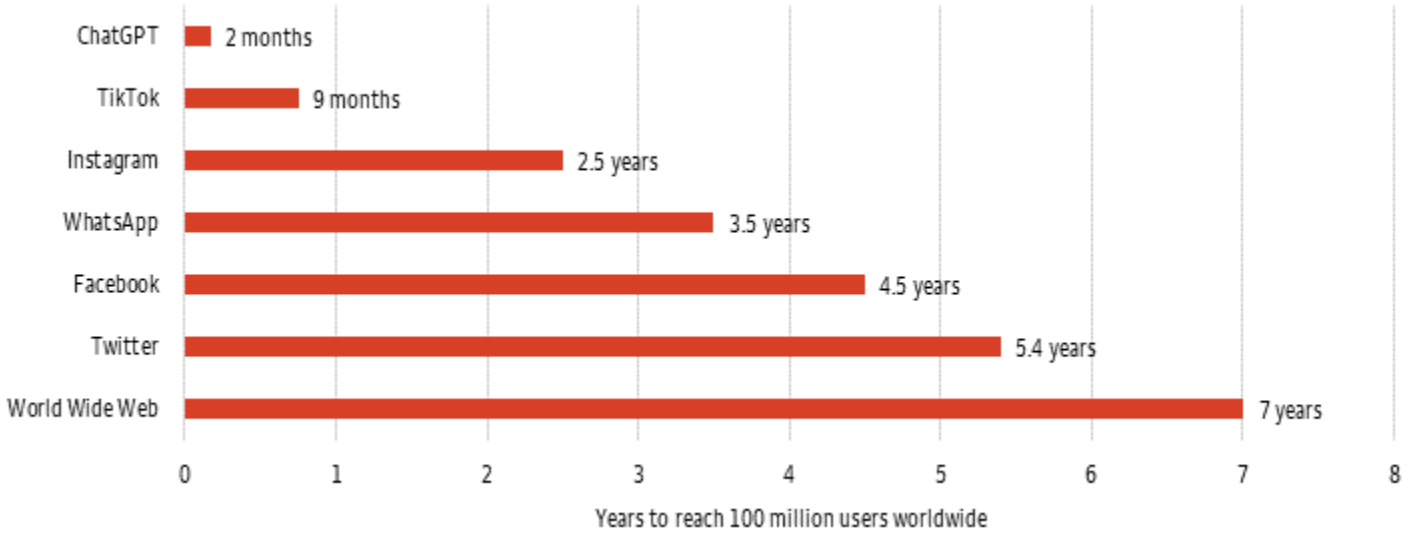
Alphabet Inc. first introduced the transformer model in a 2017 research paper which, compared to neural network architectures from five years ago, represented an evolutionary step forward for natural language processing tasks. The transformer model assesses the importance of each word in a sentence relative to other words. This allows the model to better understand the context of the dialogue, track sequential relationships between words, and is expected to more accurately predict the next word.

OpenAI released its latest version of ChatGPT, or GPT-4, on March 14, 2023. Multiple large language models compete with ChatGPT in the generative AI marketplace today — a few examples include Google's Bard and PaLM2, as well as Meta Platforms' open-source Llama 2. A few of the more popular image-generating models include OpenAI's DALL-E2 and Midjourney as well as the competing text-to-image model Stable Diffusion.

The mainstream adoption of generative-AI-based large language models has taken off, particularly in the case of ChatGPT. ChatGPT reached 100 million active users in two months after its introduction in November 2022. Although downloads of ChatGPT started to show some signs of moderating by June 2023, the migration to ChatGPT represented one of the fastest-growing consumer applications in history. By comparison, TikTok took nine months to reach 100 million users, Meta Platforms' Instagram took two and a half years, Facebook (now named Meta Platforms) took four and a half years, and the World Wide Web took seven years (demonstrated in Chart 2).[6]

5. CNBC, "Microsoft's $13 billion bet on OpenAI carries huge potential along with plenty of uncertainty," April 8, 2023.
6. Source for all figures in this paragraph the PwC Outlook Perspective Report 2023.

Chart 2: Time it took to reach 100 million users



Sources: PwC Outlook Perspective report 2023 and Wells Fargo Investment Institute. Chart provided for illustrative purposes only and does not constitute a recommendation.

Despite all the excitement with the record consumer adoption, we think it is too early to tell how much traction companies will gain in terms of monetizing the large consumer interest and how quickly enterprises will broadly adopt generative AI going forward. While ChatGPT has been widely popular among consumers, we believe the enterprise space has the potential larger opportunity over the longer term. ChatGPT is seeking opportunity within the enterprise space with the introduction of ChatGPT Enterprise.

We believe Microsoft's deep and extensive enterprise user base puts the company in an attractive position for a potential revenue uplift from the monetization of AI technology within its product suite. Microsoft announced a $30 per month subscription fee for its upcoming AI-supported Microsoft 365 Copilot software on July 18[7]. Additionally, Microsoft may be able to expand the use of both its search engine (Bing) and cloud platform (Azure) as a result of its partnership with OpenAI. Other software vendors are also embedding generative AI solutions within their enterprise products including Salesforce, Adobe, Oracle, Service Now, and Workday, among others.

Scope of this report

We believe that generative AI has the potential to profoundly enhance human creativity in ways that accelerate innovation, improve productivity in the workplace, and drive faster economic growth and social change in the coming decade. Yet, historically, markets have often priced in technological advances well in advance of adoption. Additionally, there are several evolving risks that need to be understood in this case. The pace of innovation and adoption is unknown and may be slower than the market is currently expecting. The rise of generative AI could lead to significant white-collar job losses that could dampen economic growth and raise social tension in the short term. Investors also should note that government regulation so far has been uneven across global regions. That regulation is likely to accelerate and may need time to balance economic growth and social concerns.

We always favor a clear-eyed evaluation of risk and reward in every investment decision, and that remains true in the early stages of even a transformative technology. As we noted in a previous report: "History teaches us that investors have tended to overestimate the impact of a new technology in the short run — even if they eventually underestimate its long-term impact."[8] This report evaluates those shorter- and longer-term investment opportunities, and it also includes our specific investment preferences.

7. Microsoft blog announcement on July 18, 2023.

8. Please see Wells Fargo Investment Institute's report by Darrell Cronk, "Sand in the Gears of Growth," State of the Markets, June 20, 2023.

Economic implications of AI

Generative AI's two most visible macroeconomic issues are its potential impacts on labor productivity and the job market. Beyond that is the direct, more immediate impact on economic growth from business investment in AI-related technology equipment and software. A recent McKinsey & Company (McKinsey) study estimated that generative AI could add 0.1% – 0.6% to the global economy's average annual productivity growth between now and 2040, depending on the speed with which the technology is absorbed and workers' time savings are realized.[9] Increases of that magnitude in the U.S. would imply a material lift to U.S. productivity growth, which fell to 1.2% in the past 10 years from its 2.8% average in the decade before the 2008 – 2009 global financial crisis. A potential added boost can be expected to come from AI's ability to speed implementation of new ideas and, in the process, accelerate innovation.

An aging workforce and slowing growth of labor supply is weighing increasingly on economic growth potential for the U.S. and global economies, and AI's potential for productivity gains is therefore coming at a crucial time. Stronger productivity growth would help accommodate healthier, noninflationary wage gains and resulting improvements in household living standards.

As with major technology innovations in the past, we should expect to see widely different impacts on labor across the sectors of the economy. Productivity is likely to increase the most in knowledge-based and research jobs, but support analyst roles and other professional service positions may be in much less demand. We consider the specific risks to the work force as well as regulatory constraints below in our section titled *Potential pitfalls, challenges and risks of AI*.

From a global perspective, AI's outperformers and underperformers are broadly separated between countries focusing on repetitive or routine tasks (like call centers or back-office operations) and those keyed to new, more innovative projects requiring a degree of creativity not yet achieved by generative AI.[10] We view the U.S. as positioned to benefit both from its output and sales of AI-related software and products globally as well as its ability to create applications leveraging the technology.

Key takeaways

Generative AI could materially lift U.S. productivity growth with an estimated 0.1% – 0.6% addition to the global economy's average annual productivity growth between now and 2040 (McKinsey & Company).

An aging workforce and slowing growth of labor supply is weighing increasingly on economic growth potential for the U.S. and global economies, and AI's potential for productivity gains is therefore coming at a crucial time.

Improved competitiveness from AI-related productivity enhancements in advanced industries as well as in other industries where the U.S. holds a comparative advantage could support increasingly open trade by tempering the move toward protective industrial policies. Generative AI's boost to creative potential and productivity in knowledge-based industries could speed the economy's move up the value-add ladder, better insulating advanced economies from encroachment by lower-cost centers abroad. Ultimately, that could help take some of the edge off criticism of globalization's cost to employment, exports, and national income.

9. McKinsey & Company, "Economic Potential of Generative AI: The Next Productive Frontier," June 14, 2023.
10. Tyler Cowan, "Which Countries Will Win the AI Revolution?," Bloomberg, August 8, 2023.

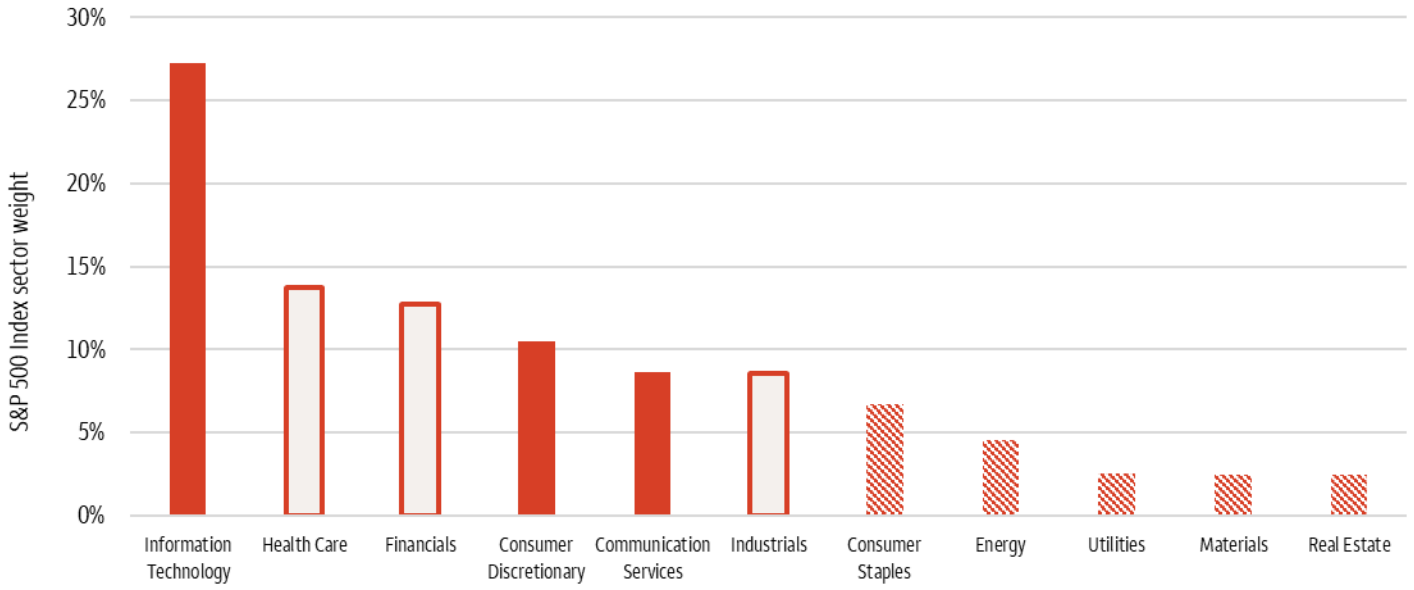
Sector implications of AI

AI is likely to benefit revenue growth and overall profitability for several technology-focused industries. In addition, AI adoption has the potential to increase productivity and boost profit margins across all sectors. A few examples of productivity tools are Microsoft and OpenAI's GitHub Copilot, Google's Colab service, and Amazon's CodeWhisperer, which use generative AI to automatically write code for software developers. Aided by these generative AI coding tools, the time it takes software developers to write the code for new applications will be much less (as much as 50% faster), which we expect to boost productivity and help accelerate innovation. Investors may benefit from not only the global regions, industries, sectors, and companies that are driving the innovation today, but also from those areas with the greatest productivity potential as a result of AI adoption.

Sectors touched by generative AI

The most obvious AI beneficiaries are the companies at the forefront of developing and adopting these technologies as well as those that are supplying the necessary components. Many of these companies are constituents of the Information Technology, Consumer Discretionary, and Communication Services sectors, which together constitute 37% of the S&P 500 Index (Chart 3). We believe exposure to these sectors is appropriate for long-term investors with an interest in AI and, as of this writing, we favor a full allocation equal to the market weights in these sectors. Looking ahead, we may prefer to increase exposures above market weight if, at some point, the pace of AI developments accelerates, valuations become more attractive, and the risk-reward balance tilts more favorably in our view. We also expect other times when the enthusiasm for AI may push valuations to levels we find expensive, and at these times we may favor reducing exposure, at least temporarily, until more attractive opportunities arrive.

Chart 3: S&P 500 Index is heavily weighted toward AI plays



Sources: Bloomberg, McKinsey, and Wells Fargo Investment Institute. Data as of August 18, 2023. Solid bars indicate the sectors most heavily involved in AI development. Outlined bars indicate the sectors that McKinsey studies indicate may stand to benefit most from AI-fueled productivity improvements. Striped bars indicate the sectors that McKinsey studies indicate may benefit to a lesser degree from AI. An index is not managed and not available for direct investment.

The remaining sectors we view as poised to benefit from AI are those that stand to gain from the implementation of AI products and services rather than the direct development of AI. In other words, second-order beneficiaries. These center mostly around opportunities to improve efficiencies within marketing and sales, customer operations, product development, research and development (R&D), software engineering, supply chain and operations, and risk and legal business processes.

Use cases will likely broaden

While most, if not all, sectors and industries will be noticeably altered by the implementation of generative AI, a few stand out. The McKinsey study estimated that industries within the Health Care, Financials, and Industrials sectors could see the greatest value add through AI implementation.[11] For example, AI could deliver improvements for banks and other financial services firms within the Financials sector in product development and marketing, fraud detection, risk management, and customer interactions. Research, drug discovery and development, patient care, treatment, data management, and documentation are all likely to experience step-level improvements with the proper application of AI within the Health Care sector. Meanwhile, AI's largest potential benefit to companies in the Industrials sector will likely arise from supply-chain optimization, efficient warehousing, factory automation, improvements in marketing processes, software engineering, and R&D. This is not an exhaustive list as the potential applications are impressive (see Table 1).

Table 1: Potential generative AI use cases and capabilities by industry

Industry	Use cases and capabilities
Automotive & transportation	Self-driving cars, efficient car-sales process, connected vehicles, city of the future, ride sharing, and connected vehicles
Health care	Improved patient data sharing, robotic surgeries, efficient patient/physician care, personalized patient management, diagnosis, accelerated drug discovery and development
Consumer goods	More efficient inventory and labor management, improved marketing and customer service, and supply-chain efficiency
Retail/restaurants	Customer demand tracking, inventory optimization, call center virtual assistants, personalized customer recommendations, automated service, and upsell products at point of service
Advertising, sales, & marketing	Customized advertising campaigns, content creation including generation of graphics and/or images, voice synthesis, and customer-facing chat bots
Manufacturing	More robotics in manufacturing and distribution, supply-chain optimization, efficient warehousing, internet of things, and factory automation
Financial services	High-level financial recommendations, faster data access, improved product development, fraud detection, improved risk management, fintech applications for personal finance and lending, and robo-advisors
Technology	Workflow optimization, generation of code, process automation, and chat bots for customer support
Education	Enhanced digital learning capabilities, enhanced critical thinking from students, increased access to information, copyright/plagiarism detection, higher teacher/student engagement, and personalized tutoring
Entertainment	Music generation, video editing and content creation, and video-game interaction

Sources: Wells Fargo Investment Institute and McKinsey, 2023.

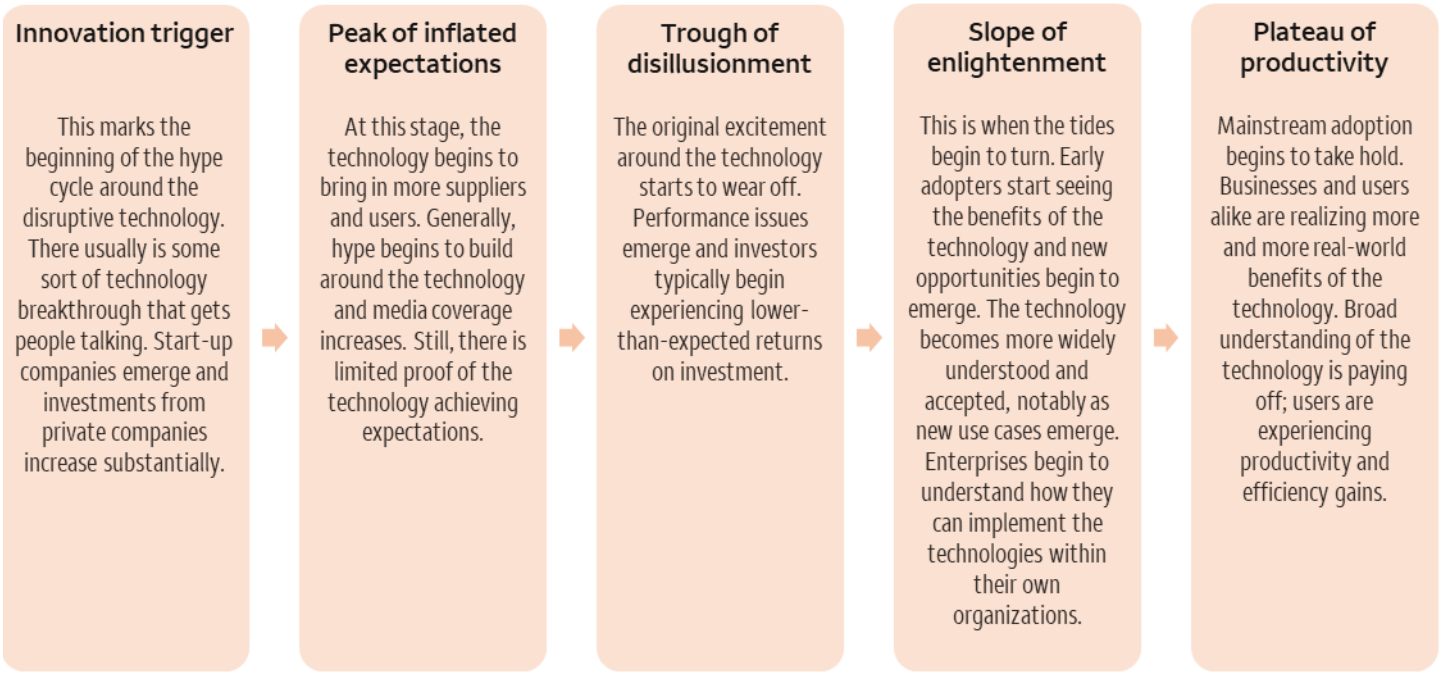
11. McKinsey & Company, "The Economic Potential of Generative AI: The Next Productivity Frontier," June 14, 2023.

Media and investor excitement in perspective

The Information Technology (IT) sector is no stranger to economically disruptive technology and innovation cycles or to attention from investors and the media. Nevertheless, the typical technology innovation cycle can get ahead of reality in terms of attractive business models that work, unit economics that are profitable, and companies that can generate significant free cash flow (amount of cash left after all expenses are covered) over the long run. As with past cycles, we believe investors tend to overestimate the near-term prospects of an emerging technology that has the potential to enormously impact society and to underestimate the long-term prospects of the technology's adoption as well as its ability to penetrate previously unforeseen end markets.

The Gartner Hype Cycle (the cycle, shown in Chart 4) maps the path of potentially innovative and disruptive technologies. It tracks the path from the technology's development and introduction through mass acceptance and enterprise implementation, where businesses typically experience the benefits of the new technology. While the speed varies, it historically has taken about three to five years for a technology to move through the cycle. We would note that not all technologies make it through all five phases of the cycle. Some technologies fall off the cycle as enthusiasm simply fades away amid slow development of use cases, or the technology is replaced. On August 16, 2023, Gartner issued a press release confirming its view that we are currently within the "Peak of inflated expectations" phase.

Chart 4: Gartner Hype Cycle

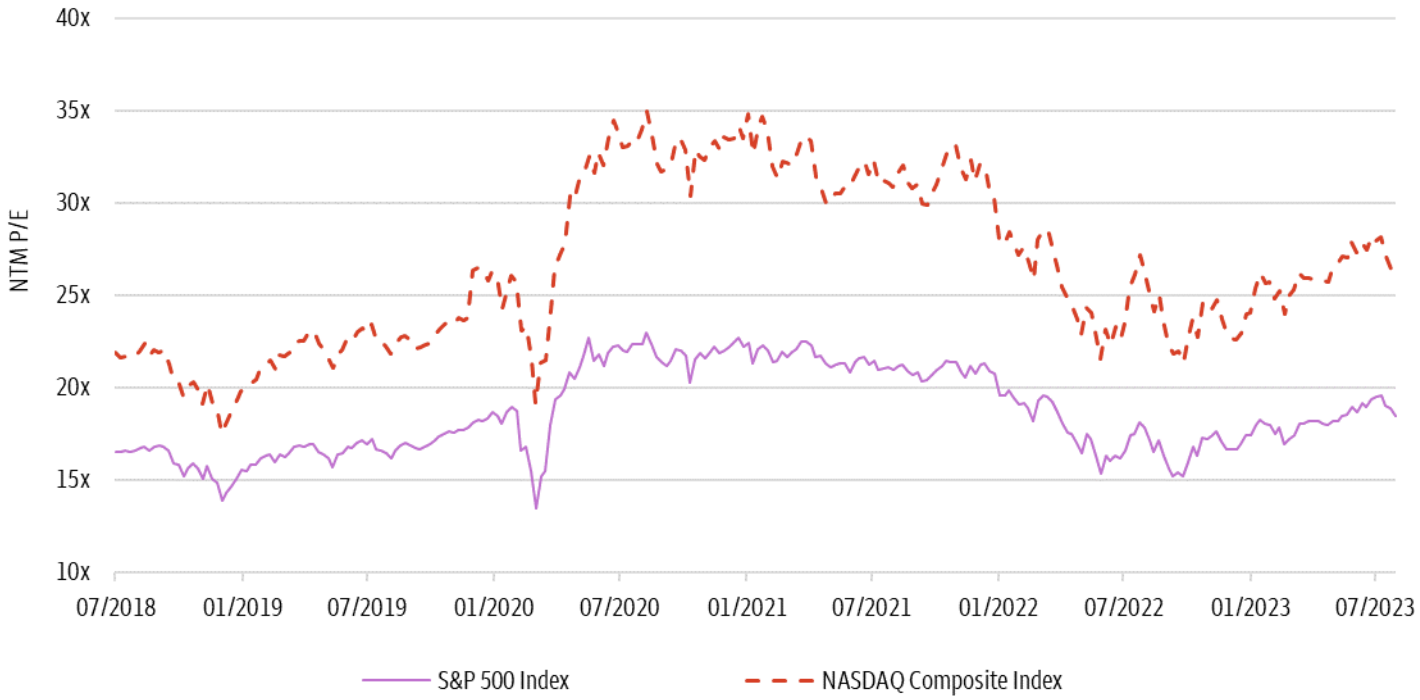


Source: Gartner, 2023.

Valuation

On June 1, 2023, the broader NASDAQ Composite Index traded at a next-12-months price-to-earnings (NTM P/E) valuation of approximately 27x (Chart 5). This represented a 48% premium to the 18.2x NTM P/E valuation of the S&P 500 Index, and it was approaching the elevated 51% premium seen on August 15, 2022. The Nasdaq's NTM P/E valuation of 27x trades at a premium to the 23% NTM consensus earnings per share (EPS) growth rate as of August 31, 2023.[12] Investors may extrapolate the growth potential for generative AI in a linear fashion out into the future, but we are still early in the generative AI investment cycle.

Chart 5: Valuation of technology indexes relative to the S&P 500 Index



Sources: FactSet and Wells Fargo Investment Institute. Data as of August 18, 2023. An index is not managed and not available for direct investment. **Past performance is not a guarantee of future results.**

Key takeaways

As with technology innovation cycles witnessed in the past,

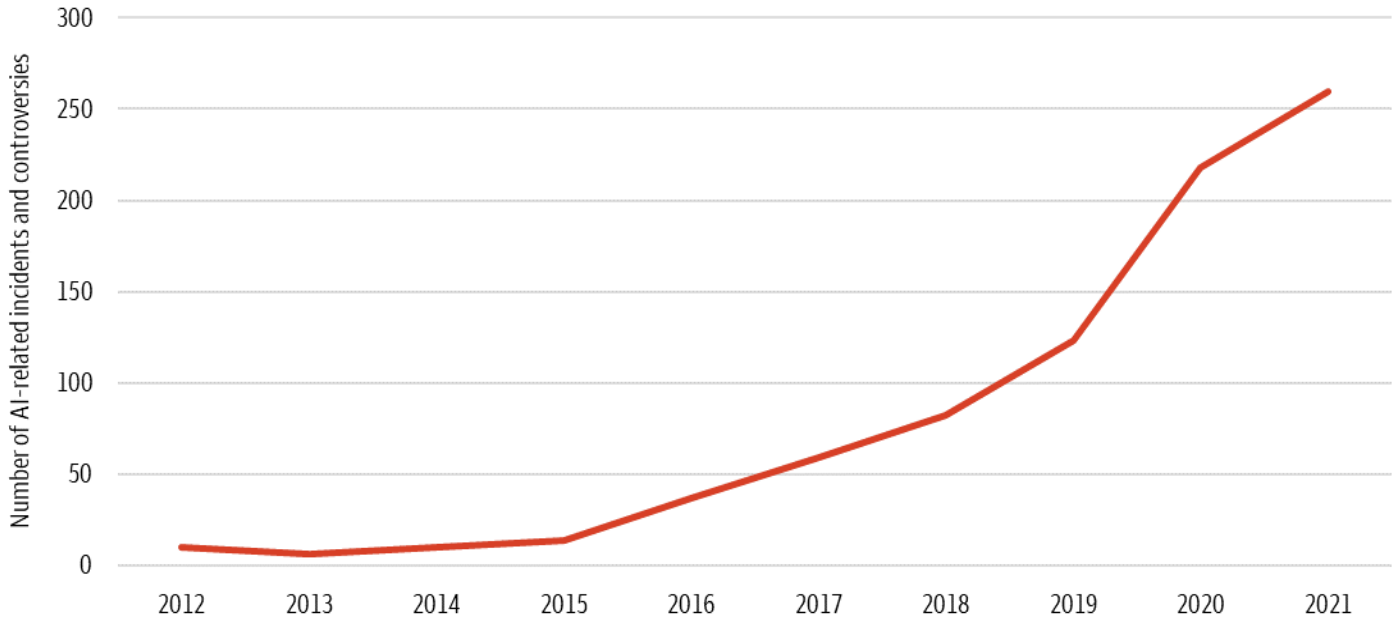
> we believe investors tend to **overestimate the near-term prospects** of an emerging technology that has the potential to enormously impact society…
>
> …and to **underestimate the long-term prospects** of the technology's adoption as well as its ability to penetrate previously unforeseen end markets.

12. According to FactSet data.

Potential pitfalls, challenges, and risks of AI

The rise of generative AI is similar to the development and advancement of other disruptive technologies — while the technology and infrastructure may be there, broader acceptance and scalability may still be lacking. The technology has the potential to be broadly transformative, but there are many outstanding questions and concerns that need to be addressed before it is widely accepted on a larger scale, evidenced by the increasing number of AI-related incidents and controversies (Chart 6). The AI, Algorithmic, and Automation Incidents and Controversies (AIAAIC) Repository defines an incident as a sudden predictable or unpredictable event that becomes public and which takes the form of or can lead to a disruption, loss, emergency, or crisis.

Chart 6: Rapid increase in the number of AI controversies from 2015 through 2021



Sources: Wells Fargo Investment Institute; AI, Algorithmic, and Automation Incidents and Controversies (AIAAIC) Repository and Stanford University Institute for Human-Centered AI, "The AI Index 2023 Annual Report," April 2023. Data as of 2021. The AIAAIC Repository was introduced in 2019, and it is a public database of controversies and incidents related to AI, algorithms, and automation.

From a higher level, obstacles related to the development, advancement, and widespread acceptance of AI include the cost of developing effective models, challenges ensuring accurate outcomes, and potential impacts on the workforce. There are also geopolitical and regulatory risks and challenges, potential impacts on society, behavioral issues, and concerns around potential infringement of intellectual property (for example, copyright and trademark infringement).

Another risk is that of financial instability. Chairman Gary Gensler of the U.S. Securities and Exchange Commission has argued that, among other things, financial turbulence could be triggered by the possibility of a herd mentality created by access to the same base model or data aggregator.[13] While difficult to predict, we also expect that security will likely be an issue, tied to the threat of new generative AI capabilities being used to breach unsecured networks. Consequently, cyberattacks and data breaches could accelerate if generative AI models are not secure and are accessible to bad actors. As such, cybersecurity firms will rely on data sharing, partnerships, and machine learning to uncover behavioral patterns in efforts to protect the network and sensitive data.

13. Bloomberg, "Gensler Warns Artificial Intelligence Risks Financial Stability," July 17, 2023.

Labor market disruptions

Labor markets are among the areas most exposed to AI's potentially disruptive effects, in tandem with the potential lift to productivity. Generative AI's impact on the labor market likely will be more nuanced than more traditional AI systems. Earlier AI systems have been geared more toward automation that jeopardizes jobs in an array of labor-intensive services industries — from food services to office support to the same customer service and sales likely benefiting from more advanced, generative AI. We expect that generative AI's disruptive effect on the labor market will likely be similar to other forms of automation — as in the past, its impact will likely be mitigated over time by new lines of work created by the innovations themselves.

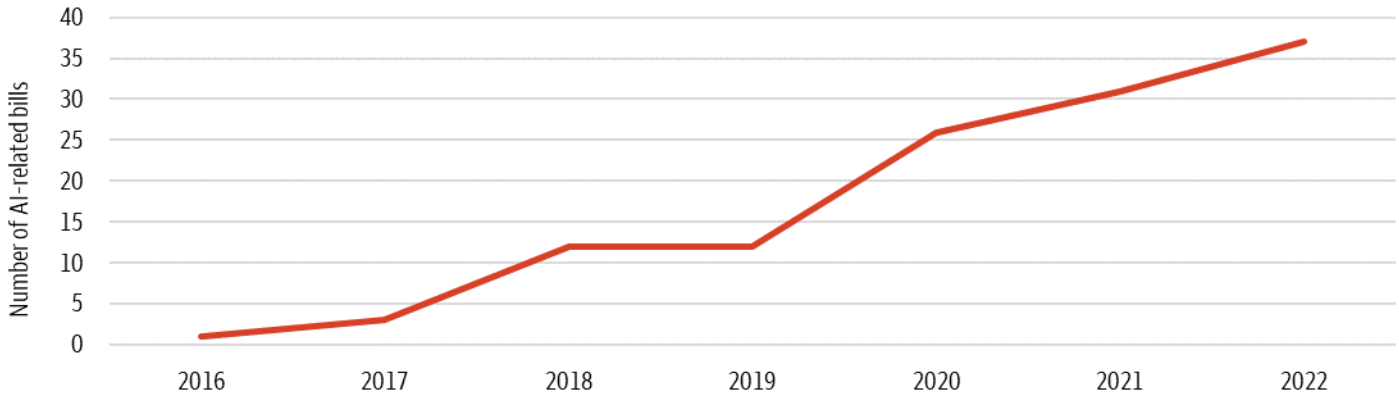
Sectors exposed to generative AI's potential effects on the workplace include knowledge-based activities in financial services such as trading and asset management along with support workers in technology, professional services, and other knowledge-based industries.[14] The research project leaders who build and evaluate the models should find generative AI to be a valuable tool with the potential to increase the value of their work and their compensation. However, AI is likely to require fewer research and administrative support roles. The potentially unequal boost from generative AI — skewed toward knowledge-based workers with higher pay — risks aggravating income inequality and inviting legislation slowing AI's absorption into the economy.

Government regulation

Government regulation is a second, highly visible uncertainty in the outlook for generative AI development and acceptance. Thus far, initiatives have ranged from industry pledges of voluntary safety guardrails in the deployment of new products to Federal Trade Commission requests for companies' details related to integration of AI into their operations. More importantly, exposure to copyright challenges could potentially impede the development of generative AI's large language models. The role of government regulation in addressing some of the risks discussed in this section continues to be debated. Governments around the world are becoming increasingly involved in the regulation of AI based partly on concerns about societal impacts and data privacy.

As governments worldwide attempt to regulate AI, we think these efforts need to be balanced and measured appropriately to prevent any potential slowdown in the pace of innovation for generative AI going forward. According to Stanford University's AI Index (Chart 7), the total number of AI-related bills passed into law has shown a noticeable increase from only one bill passing in 2016 to 37 passing in 2022.

Chart 7. Number of AI bills passed into law (2016 – 2022)



Sources: Wells Fargo Investment Institute and Stanford University Institute for Human-Centered AI, "The AI Index 2023 Annual Report," April 2023.

14. Bloomberg, "AI Study Says Stocks Already Pricing a Jobs-Replacement Premium," August 2, 2023.

The U.S. government is currently lagging the European Union in its AI-related legislation, partly because of partisan divisions and partly because of its caution in not impeding the development of emerging national champions. Slow legal action by the Federal government has left an opening for more than a dozen state laws to be passed in 2023 addressing perceived threats from automated systems. These laws have included restrictions on the use of AI in political advertisements, general advertisements, gambling, hiring, and other activities. Restrictions enacted and under study have at times countered legislation supporting AI, including manufacturing grants and innovation hubs at the state level as well as proposals to support AI research in the private sector through greater access to computational tools and educational resources.[15]

The Biden administration brought together seven leading AI companies, and each made a voluntary commitment to act responsibly in properly managing the risks of the new technology. The companies' pledges centered around making sure new AI-related products are safe before they are introduced to the public, as well as investing in cybersecurity and proper safeguards to protect models — all working toward preventing harmful bias and discrimination and protecting privacy. The U.S. is cooperating with the European Union and the United Kingdom to govern the development and use of AI.[16]

The European Parliament passed a draft law called the AI Act, widely considered the most comprehensive piece of AI-related legislation. The proposed AI Act focuses on data privacy, strengthening the quality of the data used to train large language models, banning the use of AI technology for biometric surveillance use cases, and addressing various ethical issues related to the societal impacts of implementing generative AI. The three branches of the European Union are expected to iron out the details through a negotiation process before a final agreement is reached. The regulation is expected to become effective in 2026.

China drafted rules to regulate generative AI which became effective on August 15. Companies in China reportedly will need licenses granted by the Cyberspace Administration of China prior to releasing new generative AI models to the consumer public, suggesting more leeway for generative AI products targeting enterprises.

Escalating costs and energy requirements

Immediate issues in generative AI implementation include both the computing power and cost of data-intensive model development. At the moment, the costs associated with developing, training, and managing generative AI large language models effectively are fairly prohibitive as these models are very compute-, semiconductor-, networking-, and storage-intensive. The cost for training large language models is quite expensive, although less so for inference, which occurs when the already trained large language model is prompted for a response. Consequently, we believe there will be a significant increase in hardware demand, notably within the data center environment, to accommodate the substantial increase in AI workloads. We do not believe that companies have reached the point of scaling the technology to be profitable. Currently, the costs per query on a platform like ChatGPT are multiples higher than well-established search engines like Google Search or Microsoft Bing. In our view, it may take a number of years to increase the operational efficiency of various large language models and decrease costs to a level more in-line with existing search engines.

Elsewhere, data-center operators have begun to raise commercial lease rates to cover more limited computer capacity and added power costs of running energy-intensive AI-related workloads.

15. Bloomberg, "AI Research Gains Bipartisan Congress Support," July 29, 2023.
16. The White House, "Fact Sheet: Biden-Harris Administration Secures Voluntary Commitments from Leading Artificial Intelligence Companies to Manage the Risks Posed by AI," July 21, 2023.

Accuracy concerns

Risks and questions have already surfaced around the outcomes generated by hallucinating large language models. For example, issues have arisen around ChatGPT providing answers with conviction that turn out to be inaccurate. Since the large language models were trained on the structure of language, these models are more focused on the structure of which word or what concept comes next and less focused on whether the answer is accurate.

Data quality is relevant because large language models are dependent on the quality and depth of the datasets they are utilizing to determine an output. As the saying goes — garbage in, garbage out. If the quality of the data is driven by stale or outdated data, the output will likely be poor and undependable as well. Consequently, it is vital to know how the model was trained and developed to better appreciate the outcomes the model produces. However, over time, we expect the accuracy of these large language models to improve as updated versions that incorporate a higher number of parameters manage to tweak the inaccuracies of prior versions.

Geopolitical risks

We have witnessed escalating trade tensions between China and the U.S. since 2018, and this has led to a growing number of Chinese companies being added to the U.S. Department of Commerce Entity List. In light of Russia's invasion of Ukraine, investors are concerned about China's intent to reabsorb Taiwan and also create its own self-reliant semiconductor supply chain. These factors have contributed to what many view as peak globalization and a push toward the localization of semiconductor supply chains.

The trade tensions between the U.S. and China have spilled over to the AI market. A recent article in *The Wall Street Journal* reported that the U.S. Commerce Department was considering more restrictions on the export of AI chips to China.[17] This move follows the Commerce Department's restrictions from October 2022, which cut off most advanced AI exports from U.S. firms such as Nvidia Corp. and Advanced Micro Devices, Inc. to China. At the time, Nvidia responded with its A800/H800 Graphics Processing Units, or GPUs, (replacing the more advanced A100) that fell below the performance specifications outlined by the U.S. Commerce Department. However, the new restrictions are now expected to ban Nvidia's A800 GPUs. Chinese companies were previously finding ways around the original export restrictions by renting access to Nvidia's A100 GPU chips.

In May of 2023, China banned its infrastructure companies from purchasing memory chips from the largest U.S.-based memory-chip manufacturer. Additionally, China imposed export restrictions targeting U.S. semiconductor companies for key semiconductor materials, including gallium- and germanium-based chips. The Biden administration signed an executive order on August 10, 2023, banning new U.S. investment in Chinese companies exposed to AI, semiconductors, and quantum computing. We believe the tense geopolitical environment between the U.S. and China as well as concerns over China's adverse use of AI for military purposes will contribute to potential equity share price volatility for AI-related semiconductor suppliers.

17. "U.S. Considers New Curbs on AI Chip Exports to China," The Wall Street Journal, June 27, 2023.

Overview of investment ideas

To reiterate, in the coming years we expect the Information Technology and Communication Services sectors to benefit from the modern evolution of AI — particularly in the semiconductor and application software industries. Privacy and security issues around the technology also exist, as well as numerous obstacles the industry may need to overcome to get it to scale. However, these issues should increase focus around the cybersecurity names, notably those that are cloud native (that is, applications or business models suited to run on the cloud).

We also see opportunities among companies that focus on various product lines across multiple and converging AI trends. One important example is the convergence of augmented and virtual reality, the internet of things, and connected devices. In our view, companies that helped build out previous iterations of the internet are the most likely to create the infrastructure necessary to support the new and innovative technologies.

We also foresee that the companies with large pools of available cash and high-quality datasets should ultimately have the opportunity to outperform across multiple long-term technology trends. Many of these companies accumulated large datasets through their research and development efforts. We expect that software companies will make new investments that move quickly to include generative AI in their product sets.

AI-based deep-learning applications are compute-, network-, and semiconductor-intensive, and we favor semiconductor companies exposed to the development and implementation of AI. Modern advances in graphic processing unit (GPU) architecture, such as parallel processing architecture, have been crucial in powering modern AI advancements. GPU chips are used to train the majority of deep neural networks used in deep learning tasks. Leading GPU chip suppliers appear well positioned to benefit from the proliferation of AI, and we expect leading semiconductor companies to benefit from supporting generative AI models. We also expect generative AI applications to help drive demand for semiconductor-related equipment in the coming years.

A single winner-take-all in the AI space is unlikely. Rather, we anticipate a handful of outperformers to emerge from a select group of companies with access to significant financial resources, high-quality datasets, and cutting-edge AI data scientists. Finally, specific investment ideas can be found in the following pages.

Key takeaways

In the coming years we expect the Information Technology and Communication Services sectors to benefit the most from the modern evolution of AI — particularly in the semiconductor and application software industries.

A single winner-take-all in the AI space is unlikely. Rather, we anticipate a handful of outperformers to emerge from a select group of companies with access to:

- Significant financial resources
- High-quality datasets
- Cutting-edge AI data scientists

Individual equity investment ideas

Individual equity investment ideas are provided by Global Securities Research. See Table 2 for details on each company.

Large language model and cloud infrastructure providers

Alphabet Inc. Class A (GOOGL)

Alphabet continues to invest in AI. The company owns DeepMind Technologies and has developed generative AI tools, including one called Language Model for Dialog Applications (LaMDA). Further, Alphabet recently announced advancements within a new platform concept called Bard, which will likely function similar to ChatGPT. Alphabet maintains its leadership position within the online mobile search and advertising industry, and in our view, the company has been able to collect large amounts of data through its Google search platform and the Android operating system (OS) installed on smartphones.

Amazon.com, Inc. (AMZN)

Amazon.com is a multinational technology company that engages in the provision of online retail shopping services. The company designs, manufactures, and sells electronic devices, including tablets, personal assistant devices, smart doorbells, and connected televisions. Amazon.com is also one of the top cloud vendors with its Amazon Web Services segment that provides compute, storage, database, analytics, and machine-learning services to its consumer and enterprise customers.

Apple Inc. (AAPL)

Apple is a global technology company that designs, manufactures, and sells mobile devices and services, personal computers, tablets, software, and digital media players. The company's popular product lines include iPhone, iPad, iPod, and Macs, along with services platforms like the iTunes Store, iCloud, and Apple TV+, among others. Apple continues to expand its AI capabilities, including further development of the Siri assistant platform. The company has been able to capture large amounts of data through the growing user base of iPhones, iPads, and Macs as well as the growing services segment. Further, Apple launched its mixed reality headset in early June, which could provide the company an additional platform to expand its already large, loyal, and highly engaged user base.

Meta Platforms, Inc. Class A (META)

Meta Platforms (Meta) engages in the development of social media applications. The company operates through the Family of Apps (FoA) and Reality Labs (RL) segments. The FoA segment consists of Facebook, Instagram, Messenger, WhatsApp, and other services. Meta indicated that its long-term areas of focus include AI and the metaverse, which are two closely related technologies. The company's work around AI includes new generative foundational models that have enabled new use cases around the developing technology. Key AI-related products the company has developed over the years include DeepFace (facial recognition), DeepText (natural language model to detect, understand, and interpret text), and LLaMa (large language model released in early 2023), among others. AI is the foundation for many of the company's key products, including its discovery engine and advertising business. According to the company, AI infrastructure buildout has been the main driver of capital spending over the past few years. The company has built up capacity to continue its development of both AI platforms and the metaverse.

Microsoft Corporation (MSFT)

Microsoft is a leading technology company providing a range of software services, including cloud-based software, operating systems, gaming, security, and consulting. The company is one of the top cloud vendors and has been involved with AI for a number of years. As previously noted, the company has increased its investment in AI start-up OpenAI (totaling $13 billion to this point), enhancing the capabilities and competitiveness of its search engine (Bing) to gain market share. Microsoft intends to integrate AI technologies into other software products, notably its Office suite, while growing its

Azure cloud platform. Microsoft is one of the few U.S. companies that carries a AAA rating on its debt from Standard & Poor's.

Tesla, Inc. (TSLA)

Tesla engages in the design, development, manufacture, and sale of its fully electric vehicles and energy generation and storage systems. Tesla has been the poster child for real-world AI applications. Among the company's goals is to build an AI inference processor to run its Full Self-Driving (FSD) software within its vehicles. The company's cars utilize an AI system that gathers real-time information from cameras installed around the vehicle to produce images of objects, people, and other items (such as traffic lights, signs, lane markers, etc.) to help the car make instantaneous driving decisions.

Semiconductor, networking, and storage suppliers

Advanced Micro Devices, Inc. (AMD)

Advanced Micro Devices is a fabless semiconductor company and is the second-largest supplier of x86 microprocessors. Given solid secular demand trends for high-performance and AI computing, we view Advanced Micro Devices' ability to integrate heterogeneous central processing units or CPUs (microprocessors), GPUs, Field Programmable Gate Arrays (FPGAs), and accelerators as a differentiated way to grow its competitive positioning within the high-performance computing market. Advanced Micro Devices' flagship AI chip, the MI300, will be available during the fourth quarter of this year.

Applied Materials, Inc. (AMAT)

Applied Materials is a leading semiconductor capital-equipment company with strong market leadership in a broad portfolio of businesses. The company operates through three segments including semiconductor systems, applied global services, and display and adjacent markets. Semiconductor capital-equipment companies supply semiconductor manufacturers and foundries with leading-edge equipment needed to manufacture AI chips.

Arista Networks, Inc. (ANET)

Arista Networks (Arista) is a leading manufacturer of data center and cloud networking equipment. The company makes switches and routers used by large cloud computing customers as well as other large data centers. Arista builds competitive and less expensive hardware combined with Linux-based open-source software (Extensible Operating System) used by customers to operate their data networks, including various AI workloads.

ASML Holding N.V. ADR (ASML)

We remain attracted to ASML Holding's leading market share position in photolithography and believe the next-generation extreme ultraviolet (EUV) lithography systems and deep ultraviolet (DUV) systems will become increasingly utilized in the coming years to manufacture leading edge AI chips. The company boasts a leading position in the EUV market with a substantial competitive advantage.

Broadcom Inc. (AVGO)

Broadcom is a fabless semiconductor company that focuses on designing and selling analog, digital, mixed-signal integrated circuits, and systems-on-a-chip. We believe the company's strong competitive position in networking chips places Broadcom in a solid position to benefit from improving demand for generative AI applications.

Cisco Systems, Inc. (CSCO)

Cisco Systems (Cisco) is a leading provider of networking equipment, software, and services that serves 98% of the Fortune 500. Its Silicon One programmable architecture and high-end ethernet networking switches can power customers' AI and machine-learning networks. Cisco's chips from its Silicon One suite of products are being tested by five of the six major cloud providers. Cisco remains well positioned to benefit from the AI networking and AI cybersecurity opportunity.

Marvell Technology, Inc. (MRVL)

Marvell Technology is a fabless provider of semiconductor solutions that help move, store, process, and secure data. Cloud-optimized Application Specific Integrated Circuits (ASIC) product cycles (including AI, security, storage, video, and networking applications) are now expected to exceed its prior $800 million projection as these product cycles ramp over time and into fiscal year 2025 (according to the company's earnings call on August 24, 2023).

NVIDIA Corporation (NVDA)

NVIDIA is a fabless semiconductor company that designs GPUs for the gaming, data center, automotive, and professional-visualization markets. NVIDIA provides end-to-end solutions across the entire accelerated computing stack, including GPU chips, software, and networking and connectivity. Over the years, NVIDIA has built its own AI software ecosystem called CUDA (Compute Unified Device Architecture), which works only with NVIDIA GPUs and is the benchmark software used among the AI software developer community. The majority of generative AI and large language models have been trained on NVIDIA's GPUs.

QUALCOMM Incorporated (QCOM)

We like QUALCOMM's wide moat business in 3G, 4G, and 5G intellectual property and chipsets. QUALCOMM's chipset segment provides leading-edge mobile chipsets targeting the premium-tier smartphone devices. QUALCOMM remains well positioned to leverage its expertise in smartphone semiconductor chips into AI edge computing for inference workloads.

Taiwan Semiconductor Manufacturing Co., Ltd. Sponsored ADR (TSM)

Taiwan Semiconductor Manufacturing is the world's largest independent semiconductor manufacturing foundry with a strong leadership position in leading-edge logic manufacturing technology. Taiwan Semiconductor Manufacturing commands the largest market-share position within the semiconductor manufacturing foundry market and manufactures AI chips for its key fabless semiconductor customers.

Enterprise software providers

Adobe Incorporated (ADBE)

Adobe engages in providing digital marketing and media solutions, primarily offering software solutions for designers, publishers, and advertising customers. Adobe management has noted it has been investing in generative AI for quite some time. The company has been embedding AI capabilities and functionality into its Creative software suite through Adobe Sensei. Additionally, the company recently introduced Adobe Firefly, a portfolio of generative AI models that are designed to accelerate creativity and improve workflow efficiency.

Meta Platforms, Inc. Class A (META)

In addition to developing a large language model platform, the company has been integrating AI into its advertising platforms. Meta Platforms has also incorporated chat bots on its service platform, which the company believes will be valuable for users, including the creator community and business customers.

Oracle Corporation (ORCL)

Oracle is a leading provider of database management, cloud infrastructure, and software services. The company offers fully functional AI capabilities within its applications that support key functions of its customers. Oracle's customers are able to leverage all the advantages of the public cloud infrastructure for generative AI purposes, notably within a hybrid cloud environment, combining on-premise data applications with generative AI capabilities within its own data centers.

Salesforce, Inc. (CRM)

Salesforce has become a trusted partner in the subscription-based software business. We are attracted to the company's near-dominant position in salesforce management software and believe the management team is one of the most effective in the software industry. Product enhancements, specifically within AI and data integration, should help to continue fueling large deal wins and drive growth going forward. The company continues to integrate AI functionality into its platforms, providing an enhanced and more efficient experience for its customers. Salesforce recently launched the AI Cloud platform, which includes the Einstein GPT Trust Layer, offering generative AI benefits while also providing data privacy and security. We expect these AI capabilities to further establish Salesforce's position within the enterprise software as a service (SaaS) industry.

Cybersecurity software providers

CrowdStrike Holdings, Inc. Class A (CRWD)

CrowdStrike Holdings (CrowdStrike) is a cloud-focused cyber security provider, providing solutions to enterprise customers in order to protect endpoints, cloud workloads, identity, and data. The company provides a unique approach to cyber threat protection, as it combines the power of crowdsourced intelligence to disrupt traditional cybersecurity solutions. CrowdStrike has been at the forefront of AI-led innovation within cybersecurity, notably with its Falcon platform. CrowdStrike's Falcon platform is an integrated proprietary technology consisting of a single lightweight agent and a dynamic cloud-based database, the Threat Graph, which continuously collects, processes, analyzes and correlates a vast volume of data using a combination of AI/ML (artificial intelligence and machine learning) to uncover behavioral patterns to stop breaches in the entire threat lifecycle. CrowdStrike's competitive advantage lies in the power of crowdsourcing across the entire customer base to identify any threats and share the fix with every customer in the community in real time.

Palo Alto Networks, Inc. (PANW)

Palo Alto Networks (Palo Alto) is one of the largest dedicated cybersecurity companies. While the company's largest market has traditionally been firewalls, it has steadily expanded its offerings to include a broad array of solutions in hardware, software, and overall security systems. Palo Alto appears well positioned to benefit from increased security spending, as the company is viewed as one of the few industry players who can act as something akin to a "one-stop-shop". The company has experienced significant AI-based innovation over the past couple years, notably within its next generation firewall and cloud-based platforms. Palo Alto continues to embed generative AI capabilities throughout their security products and workflows. These advances in technology should help improve cyber threat detection and prevention within the company's security solutions.

Splunk Inc. (SPLK)

Splunk is a software solution mainly used for searching, monitoring, and examining machine-generated Big Data through a web-style interface. Many organizations worldwide use Splunk for their business needs, including cybersecurity tasks, customer understanding, fraud prevention, service performance improvement, and overall cost reduction. Splunk remains a key player in the growing data analytics space, particularly in security operations and IT (information technology) operations, as the company offers a unique technology platform that complements the technology of other leading organizations. Artificial intelligence has the opportunity to transform how enterprises keep their digital networks secure and reliable. As such, generative AI could be a growth driver for Splunk, as it enhances user experience and outcomes for both the company's core and premium products. Further, AI may provide customers the opportunities to improve security and observability outcomes around the areas of detection, investigation, and response.

Mutual fund, SMA, and ETF investment ideas

Equity mutual fund, separately managed account (SMA), and exchange-traded fund (ETF) investment ideas are provided by Global Manager Research (GMR). See Table 3 for details on each mutual fund, SMA, and ETF.

U.S. Large Cap Equities

JPMorgan Large Cap Growth Fund (SEEGX, JLGMX)* and JPMorgan Large Cap Growth SMA

The JPMorgan Large Cap Growth Fund (the Fund) is a large-cap growth fund with a moderately higher risk profile than the GMR benchmark, the Russell 1000 Growth Index, but has a record of performing well across various market environments. It seeks stocks with sustainable competitive advantages in large addressable markets undergoing change. The Fund views change and the resulting improvement in financial performance as a leading catalyst for stock outperformance. Price momentum of stocks is also a factor used. Despite this, the Fund exhibits low turnover and seeks to minimize downside risks. We believe it is well positioned around AI, the current predominant investment theme in technology. At the time of this writing, the Fund owns several AI-focused stocks that are highlighted in this report. We believe the Fund expects to own companies across various industries that it believes will be beneficiaries of the adoption of AI in the long term.

The JPMorgan Large Cap Growth SMA is managed in a similar fashion to the Fund by the same team led by the lead portfolio manager since 2005.

*SEEGX is offered by Wells Fargo Advisors and JLGMX is offered by Wells Fargo Bank, N.A.

Harbor Capital Appreciation Fund (HACAX, HNACX)* and Jennison Large Cap Growth Equity SMA

The Harbor Capital Appreciation Fund (the Fund) is a large-cap growth fund with a moderately higher risk profile than the GMR benchmark, the Russell 1000 Growth Index, but has a record of performing well across economic cycles. The Fund has tended to outperform when growth is in favor and underperformed when value is in favor. Jennison Associates (Jennison) has served as sub-advisor to the Fund since 1990. The seasoned management team averages more than three decades with Jennison, primarily as portfolio managers (PMs) on the Fund. The PMs balance owning both faster-growing companies and stable growth companies while maintaining a long-term time horizon and monitoring and investing in secular trends such as AI. At the time of this writing, the Fund owns several AI-focused stocks that are highlighted in this report. It tends to seek above-average growers, so it sees AI as a key growth driver over time for many of its holdings.

The Jennison Large Cap Growth Equity SMA is managed in a similar fashion to the Fund by the same long-tenured team.

*HACAX is offered by Wells Fargo Advisors and HNACX is offered by Wells Fargo Bank, N.A.

Xtrackers MSCI USA ESG Leaders Equity Fund (USSG)

The Xtrackers MSCI USA ESG Leaders Equity Fund (the Fund) tracks a modified market-cap index that provides exposure to companies with high environmental, social, and governance (ESG) performance relative to their sector peers. The Fund's underlying index is the MSCI USA ESG Leaders Index (the Index), which uses MSCI ESG Ratings to determine its constituents. Companies are rated based on how well they manage their ESG risks and opportunities; those with the highest ratings are included in the Index. The Fund employs a full replication methodology in seeking to track the Index, meaning that it generally invests in all the securities comprising the underlying index in proportion to their weightings in the underlying index. The index that the Fund tracks is designed for investors seeking a broad, wide-ranging sustainability benchmark with relatively low tracking error (how closely the fund follows its index) to the underlying equity market. The Fund is a diversified portfolio consisting of approximately 275 securities; its size and trading volume allows it to have a high liquidity. It is invested primarily in large-cap companies, with its top ten holdings representing a very large percentage of the portfolio. The Fund's underlying holdings represent companies that focus on transformational growth and

intellectual property across the globe. It may have limited direct exposure to AI companies, but it has strong exposure to companies that may be beneficiaries of the adoption of AI in the long term.

The Xtrackers MSCI USA ESG Leaders Equity Fund (the Fund) tracks a modified market-cap index that provides exposure to companies with high environmental, social, and governance (ESG) performance relative to their sector peers. The Fund's underlying index is the MSCI USA ESG Leaders Index (the Index), which uses MSCI ESG Ratings to determine its constituents. Companies are rated based on how well they manage their ESG risks and opportunities; those with the highest ratings are included in the Index. The Fund employs a full replication methodology in seeking to track the Index , meaning that it generally invests in all the securities comprising the underlying index in proportion to their weightings in the underlying index. The index that the Fund tracks is designed for investors seeking a broad, wide-ranging sustainability benchmark with relatively low tracking error (how closely the fund follows its index) to the underlying equity market. The Fund is a diversified portfolio consisting of approximately 275 securities; its size and trading volume allows it to have a high liquidity. It is invested primarily in large-cap companies, with its top ten holdings representing a very large percentage of the portfolio. The Fund's underlying holdings represent companies that focus on transformational growth and intellectual property across the globe. It may have limited direct exposure to AI companies, but it has strong exposure to companies that may be beneficiaries of the adoption of AI in the long term.

Information Technology sector

MFS Technology Fund (MTCIX, MTCLX)*

The MFS Technology Fund (the Fund) is a sector fund with a moderately lower risk profile than the S&P 500 Information Technology Index. The Fund seeks to identify stocks with accelerating revenue growth or margin expansion opportunities that are attractively priced. It has a broad and flexible mandate which allows fund assets to be allocated across industries, market capitalizations, styles, and geographies while typically avoiding extremely cyclical stocks. Given its inherent focus on technology and innovation, it will own stocks involved in AI. The Fund is in a portfolio manager (PM) transition with the long-time PM retiring later in 2023. His successor has been co-PM for the past year after being the lead technology sector analyst for MFS Investment Management for more than two decades. We do not expect any changes to the Fund. It is focused on technology across all industries, many of which we expect should benefit from the continued adoption of AI. It tends to own many of the large AI-focused stocks that are highlighted in the report. The Fund may also own stocks focused on innovation and change, like AI, that may offer above-average growth prospects.

*MTCIX is offered by Wells Fargo Advisors and MTCLX is offered by Wells Fargo Bank, N.A.

iShares U.S. Technology Fund (IYW)

The iShares U.S. Technology Fund (the Fund) tracks a modified market-cap index that provides exposure to U.S. equities in the Information Technology sector. It employs a full replication methodology in seeking to track the underlying index, meaning that it generally invests in all the securities comprising the underlying index in proportion to their weightings in the underlying index. The Fund seeks to provide broad exposure to technology companies with a diversified industry allocation. It is a diversified portfolio consisting of approximately 136 securities; its size and trading volume allows it to have high liquidity. The Fund is invested primarily in large-cap companies, with its top ten holdings representing a very large percentage of the portfolio. Underlying holdings represent companies that focus on transformational growth and intellectual property across the globe. The Fund may have limited direct exposure to AI companies, but it has strong exposure to companies that may be beneficiaries of the adoption of AI in the long term.

Table 2: Global Securities Research equity investment ideas

Ticker	Company name	Price	Market cap (billion)	Estimated NTM EPS	NTM P/E	Core	DSIP	Dynamic Growth	Equity Select	Focus	High Yield	International	SMID	Value
ADBE	Adobe Incorporated	$561.94	$256.1	$17.31	32.5x				X					
AMD	Advanced Micro Devices, Inc.	$109.28	$176.6	$3.72	29.4x				X					
GOOGL	Alphabet Inc. Class A	$134.46	$1,695.5	$6.37	21.1x	X			X	X				
AMZN	Amazon.com, Inc.	$135.36	$1,388.8	$2.87	47.2x			X	X					
AAPL	Apple Inc.	$182.91	$2,859.7	$6.55	27.9x	X	X		X	X	X			
AMAT	Applied Materials, Inc.	$153.18	$128.1	$7.78	19.7x									X
ANET	Arista Networks, Inc.	$197.54	$61.2	$6.61	29.9x				X					
ASML	ASML Holding NV ADR	$666.04	$262.8	$23.44	28.4x				X	X		X		
AVGO	Broadcom Inc.	$872.27	$360.0	$45.46	19.2x	X					X			
CSCO	Cisco Systems, Inc.	$57.16	$232.9	$4.08	14.0x	X	X		X	X	X			
CRWD	CrowdStrike Holdings, Inc. Class A	$166.23	$39.7	$3.20	51.9x			X						
MRVL	Marvell Technology, Inc.	$56.71	$48.9	$2.01	28.3x				X					
META	Meta Platforms Inc. Class A	$299.17	$769.9	$15.77	19.0x			X	X	X				
MSFT	Microsoft Corporation	$332.88	$2,473.2	$11.30	29.4x	X	X		X	X				
NVDA	NVIDIA Corporation	$470.61	$1,162.4	$14.24	33.0x			X	X	X				
ORCL	Oracle Corporation	$124.33	$337.5	$5.78	21.5x	X			X					
PANW	Palo Alto Networks, Inc.	$245.21	$75.7	$5.43	45.1x				X					
QCOM	QUALCOMM Incorporated	$114.68	$128.0	$9.13	12.6x				X		X			
CRM	Salesforce, Inc.	$221.62	$215.6	$8.82	25.1x	X		X	X					
SPLK	Splunk Inc.	$124.56	$20.9	$4.13	30.1x			X						
TSM	Taiwan Semiconductor Manufacturing Co., Ltd. Sponsored ADR	$92.26	$478.5	$5.54	16.7x				X					
TSLA	Tesla, Inc.	$251.92	$799.6	$4.31	58.5x			X	X					

Sources: FactSet, Wells Fargo Investment Institute, company reports. NTM = next twelve months. EPS =earnings per share. P/E = Price to earnings. P/E ratio based on the next 12 months EPS. Data as of September 6, 2023. Investments are subject to risk of loss, AI investment ideas are not comprehensive of all securities currently included on the GSR thematic Lists. See following page for description of each list referenced.

Table 3: Global Manager Research mutual fund, SMA, and ETF investment ideas

Name	Vehicle	Symbol[1]	Symbol[2]	Assets (billion)[3]	Asset group	Asset class
JPMorgan Large Cap Growth Fund	Mutual Fund	SEEGX	JLGMX	$64.6	Global Equity	Large Cap Growth
JPMorgan Large Cap Growth SMA	SMA			$9.7[3]	Global Equity	Large Cap Growth
Harbor Capital Appreciation Fund	Mutual Fund	HACAX	HNACX	$25.7	Global Equity	Large Cap Growth
Jennison Large Cap Growth Equity SMA	SMA			$70.9[3]	Global Equity	Large Cap Growth
Xtrackers MSCI USA ESG Leaders Equity Fund	ETF	USSG	USSG	$1.3	Global Equity	Large Cap Core
MFS Technology Fund	Mutual Fund	MTCIX	MTCLX	$1.5	Global Equity	Sector — Information Technology
iShares U.S. Technology Fund	ETF	IYW	IYW	$11.7	Global Equity	Sector — Information Technology

Sources: Morningstar, Wells Fargo Investment Institute. 1. Fund is offered by Wells Fargo Advisors 2. Fund is offered by Wells Fargo Bank, N.A. 3. Mutual fund and ETF data as of July 31, 2023, and SMA data as of June 30, 2023. Investments are subject to risk of loss. See end of report for important disclosures.

Global Securities Research list descriptions:

Global Securities Research publishes several theme-based lists of recommended equity securities. Each list is based on a specific investment objective and time horizon, which may be different from the other lists. This may cause Global Securities Research to recommend an equity security to be added to one list and removed from another list. Thus, one list may contain different recommendations or conclusions that could result in short-term price movements contrary to the recommendations in another list.

The **Core List** is comprised of blue chip, industry-leading companies that we believe can withstand the test of time. The objective is to provide a list of high-quality stocks that can be used to build a well-diversified portfolio or can be used to supplement an existing portfolio.

The **DSIP List** (Diversified Stock Income Plan List) focuses on companies that we believe will provide consistent annual dividend growth over a long-term investment horizon. Our objective is to provide a broad list of high quality, industry leading companies from which an investor can assemble a well-diversified portfolio. Through consistent dividend growth, our goal is to help investors stay ahead of the wealth eroding effects of inflation.

The **Dynamic Growth Equity List** focuses on companies that we believe offer an above average growth potential and may be on track to become leaders in the markets they serve. Our objective is to offer investors a list of stocks that they can use to help build a well-diversified portfolio or to fill holes in an existing portfolio.

The **Equity Select List (ESL)** includes companies which each Global Securities Research equity sector analyst believes are appropriate for long-term investment. It includes companies across all 11 economic sectors with representation across many sub-industries in the market, providing broad exposure to various shareholder return structures, with an overarching theme of selecting high quality companies. The list assumes a long-term holding period (five-plus years) and can be used to build or supplement a well-diversified equity portfolio.

The **Focus List** is a concentrated list of stocks that represents a combination of equity sector guidance from Global Investment Strategy and security selection from Global Securities Research. The objective is to exceed the total return of the S&P 500 Index over an approximate one-year timeframe.

The **High Yield Equity Income List** (High Yield List) focuses on companies with higher dividend yields than the broader market. Our objective is to provide a diverse list of high yielding stocks with secure dividend streams that an investor can utilize as part of an income-producing portfolio and are willing to accept a higher level of risk.

The **International Equity List** is designed to provide exposure to non-U.S. domiciled companies. While leaning toward large, well-known industry leaders, often with global operations, the strategy is flexible, and may include companies with a regional or country focus, or companies that have a comparatively small, but growing international presence. We envision this strategy complementing an otherwise domestic equity portfolio with an investing horizon of three to five years. Adding international investments to a portfolio can introduce new opportunities for investors, as well as additional risks to consider versus a purely U.S.-focused portfolio.

The **Small and Mid-Cap List** (SMID List) includes stocks representing companies with market capitalizations ranging from $1.0 billion to $20 billion at the time of addition. The objective is to exceed the total return of the S&P 1000 Index over a minimum one-year time horizon.

The **Value Equity List** focuses on companies that we believe are trading below their underlying intrinsic value and have the potential to reduce or eliminate this valuation discount. Our objective is to provide investors a list of stocks that may generate attractive returns as the stock price approaches what we believe to be the underlying value of the company.

Definitions:

NASDAQ Composite Index measures the market value of all domestic and foreign common stocks, representing a wide array of more than 5,000 companies, listed on the NASDAQ Stock Market.

Philadelphia Stock Exchange (PHLX) Semiconductor Index is a Philadelphia Stock Exchange capitalization-weighted index composed of the 30 largest U.S. companies primarily involved in the design, distribution, manufacture, and sale of semiconductors.

Russell 1000® Growth Index measures the performance of those Russell 1000 companies with higher price-to-book ratios and higher forecasted growth values. Russell 1000® Index measures the performance of the 1,000 largest companies in the Russell 3000 Index, which represents approximately 90% of the total market capitalization of the Russell 3000 Index. Russell 3000® Index measures the performance of the 3,000 largest U.S. companies based on total market capitalization, which represents approximately 98% of the investable U.S. equity market.

S&P 500 Index is a market capitalization-weighted index composed of 500 widely held common stocks that is generally considered representative of the US stock market.

S&P 500 Information Technology Index comprises those companies included in the S&P 500 that are classified as members of the GICS® information technology sector.

Stanford University AI Index tracks, collates, distills, and visualizes data relating to artificial intelligence.

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