ARTIFICIAL INTELLIGENCE INVESTMENT IMPLICATIONS

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This report reviews the field of artificial intelligence, highlighting potential major impacts and related investment implications.

ChatGPT is the fastest-growing technology application in history and is demonstrating the powerful potential of artificial intelligence (AI) to a very diverse audience. This is generating tremendous excitement around a technology that has been progressing for over 50 years and that we think is still in the early innings of a golden age.

Advanced data analytics and AI have demonstrated significant potential for transforming business models and disrupting industries. This is producing winners and losers and has significant investment implications.

While every sector of the economy is being impacted, we see the benefits far outweighing the disruptions. Advanced data analytics and AI are driving needed productivity gains, which are essential for raising economic-growth potential and living standards.

Artificial Intelligence Defined

Artificial intelligence is the development of computer systems that are able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. AI is different from traditional software programs in that it extracts knowledge from data and can alter its behavior (or learns) without specifically being programmed, i.e., machine learning.

While ChatGPT symbolizes the state-of-the-art, there are many other recent examples of AI applications. Think of self-driving cars for visual perception, Apple's Siri and Amazon's Alexa for speech recognition, and IBM's question-answering computer system, Watson, that won Jeopardy! While today's uses are compelling, they barely scratch the surface of the potential applications of AI technology.

See Appendix for descriptions of artificial intelligence branches and technologies including ChatGPT and other generative AI.

Recent AI Advances

ChatGPT is an obvious example of recent advancements, but it is just one form of AI technology that has several important drivers today.

Figure 1: AI and Machine Learning Provide Predictions and Prescriptions

TYPES OF ANALYTICS (IN ORDER OF INCREASING COMPLEXITY)		
Descriptive	**Predictive**	**Prescriptive**
• Describe what happened. • Employed heavily across all industries.	• Anticipate what will happen (inherently probabilistic). • Employed in data-driven organizations as a key source of insight.	• Provide recommendations on what to do to achieve goals. • Employed heavily by leading data and internet companies.
	Focus of AI and Machine Learning	

Source: *Janney Investment Strategy Group; McKinsey Global Institute*

Big data (and the ability to access it), computing power, and advances in algorithms are all catalysts for AI advancement—with most recent advances being achieved by applying machine learning to very large data sets.

The proliferation of smartphones and smart devices, coupled with high-speed internet connections (highlighted by recent 5G wireless advancement), is producing massive amounts of data that is well suited for AI applications and analysis. Digitization of most business and personal records is also a catalyst.

Cloud computing—using a network of remote servers hosted on the internet to store and manage data, rather than a local server or a personal computer—is providing convenient access to large amounts of data that can be readily analyzed via AI.

Major internet firms and many other industry-leading firms create, or have access to, large data sets that can be analyzed by their own AI experts or by third-party experts that they hire (a major restraint for the AI market is the limited number of AI technology experts).

Advanced AI systems require tremendous computing power, which continues to make major advances so that computations that were unthinkable in the past are now routine. All of this has combined to produce a fertile background for advanced analytics and AI advancements in all sectors of the economy.

Explosive Growth of AI Investment

According to International Data Corporation, global spending on AI services and cognitive systems reached $57.6 billion in 2021. In 2022, the market was estimated to grow to $62.5 billion. And by 2025, the AI space is forecast to reach $126 billion in annual revenue (26% annual growth rate).

PwC, a major business consulting firm, estimates that AI could contribute up to $15.7 trillion to the global economy in 2030. Of this, $6.6 trillion is likely to come from increased productivity and $9.1 trillion is likely to come from consumption side effects.

Figure 2: Rapid Rise in Corporate AI Investment

Source: Artificial Intelligence Index Report, 2022; OECD
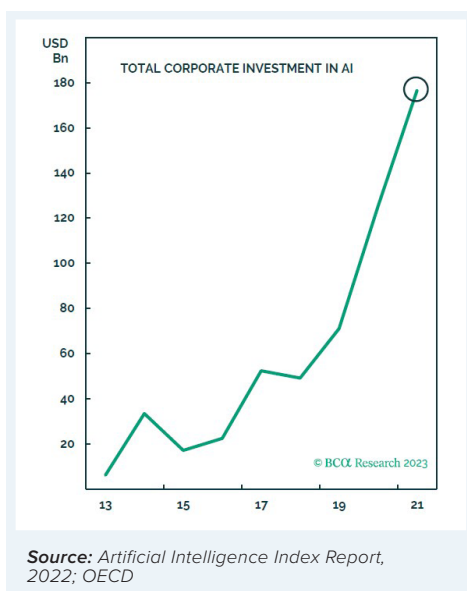
Investors last year poured $2.6 billion into 110 generative AI-focused start-ups in the U.S., according to CB Insights. The Organization for Economic Cooperation and Development (OECD) estimates total global corporate investment in AI exceeded $176 billion in 2021 (see Figure 2).

Productivity and Global Prosperity

Deployment of AI and automation technologies can do much to lift the global economy and increase global prosperity, at a time when aging and falling birth rates are acting as a drag on growth. Labor productivity growth—a key driver of economic growth—has slowed in many economies. Productivity has dropped well below historical averages in the United States and major European economies ever since the aftermath of the 2008 financial crisis and after the internet-enhanced productivity boom at the turn of the century.

Over long periods of time, real wages have generally risen in line with productivity. While technologies that enable higher productivity can be disruptive, they are a catalyst for shifting workers from stagnating industries to growing ones. In addition, our biggest economic concern today is a lack of workers. AI and automation have the potential to enhance worker output, reverse the decline in productivity, and ultimately raise living standards.

Estimates show productivity growth could potentially exceed 2% annually over the next decade, with the majority of the increase from AI and digital opportunities.

Figure 3: Productivity Could Use an AI Boost

Source: Bureau of Labor Statistics
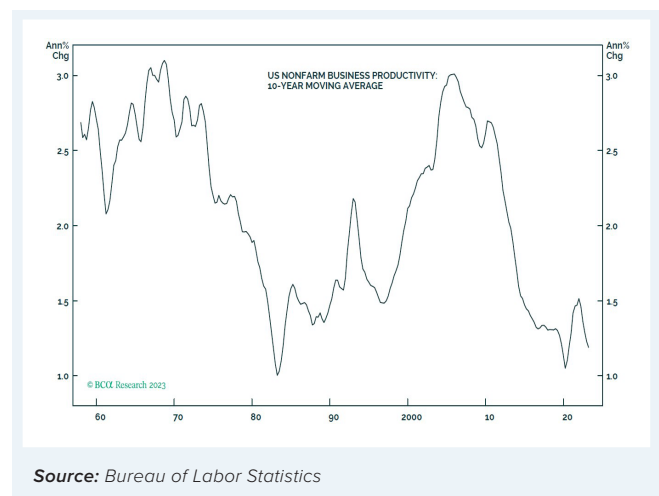
Overblown Job Loss/Replacement Concerns

Just like the inventions of the steam engine and farming automation did not eliminate the need for workers, AI will not eliminate the need for human labor. However, some activities are more automatable than others.

A recent study by researchers at OpenAI, OpenResearch, and the University of Pennsylvania concluded that large language AI models could displace at least 10% of work tasks, affecting 80% of the U.S. workforce. Workers in law, education, IT, and management consulting are the most exposed to AI, while

jobs that require either human contact or fine motor skills such as personal care, food preparation, construction, and maintenance and repair, are likely to be the least impacted.

While this suggests some low-end knowledge workers will be displaced, it also implies many others will have their current capabilities enhanced by AI. Economic advancements have always relied on this creative destruction process.

While nearly all occupations will be affected by automation, most workers—from welders to mortgage brokers to CEOs—will work alongside rapidly evolving machines. The nature of these occupations will likely change as a result. Meanwhile, a major concern for the U.S. economy is a lack of qualified workers that has resulted in over 10 million job openings today. AI and its productivity benefits will help alleviate this problem.

Figure 4: AI Has the Potential to Replace Many Tasks Performed by Humans
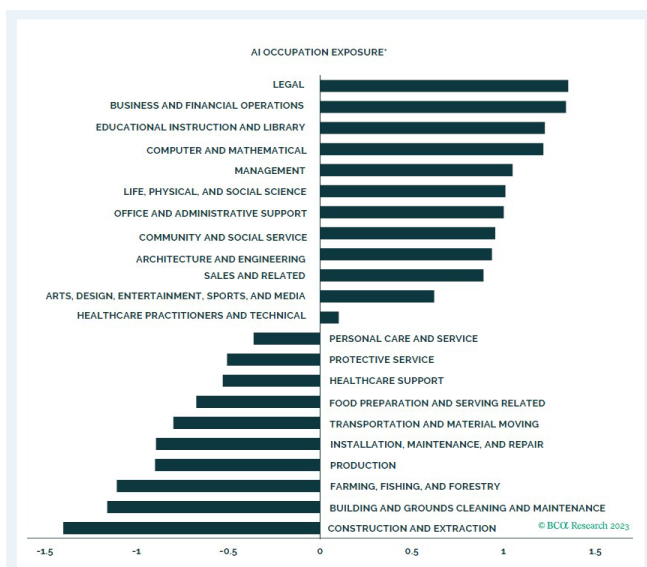
* Median score of occupations (six-digit standard occupational classification level) in each occupation major group (two-digit standard occupational classification level). Calculation using data from Felten et al. (accessed on May 1, 2023).

Source: Edward Felten, Manav Raj, and Robert Seamans, "Occupational, Industry, and Geographic Exposure to Artificial Intelligence: a Novel Dataset and its Potential Uses," Strategic Management Journal, (42:12) (2021).

Many Economic Sectors Benefit from AI and Advanced Data Analytics

While the technology sector is obviously a very important AI player, many other industries are beneficiaries, as shown in Figure 5.

Companies well positioned for success with advanced data analytics and AI share similar attributes:

- **A willingness to embrace digital transformation.** Across industries, companies addressing their own digital transformation are well positioned to be the leaders in the adoption of AI. The pure digital companies have already shown leadership in using AI (Google, Amazon, Uber, Netflix, etc.), and the faster other industries digitize, the faster they can take advantage of the insights and efficiencies of AI.

- **Industry bellwether firms with access to large amounts of industry and customer data, and a demonstrated ability to capitalize on technological advances.** Many AI success stories involve industry-dominant firms that have a history of technological innovation and strive to maintain their technological edge.

- **Firms that generate significant cash flow that can fund future technology investments.** Competition for AI talent is fierce and technological transformation can require significant investment.

Please contact your Janney Financial Advisor for additional details and specific investment ideas.

Figure 5: AI Applications Across Major Industries

Industry	AI Application
Internet	Internet companies (like Google, Amazon, Meta), as pure digital entities, have taken the lead in both generating big data and utilizing AI to analyze big data.
Software & Information Technology Services	Many of these firms (Microsoft, Adobe, Salesforce, Accenture) are well positioned to capture future technology spending that needs to take place by all industries.
Banking & Finance	Automated trading and investment, trading strategies, robo-advisors, voice-based commerce, customer behavior analysis, chatbots for customer services, identity verification, and fraud detection.
Insurance	Claims management and fraud detection, analyzing customer behavior and reducing revenue churn, automated underwriting, pricing, conversational platforms for customer services, complying with regulations, and trading strategies.
Health Care	Diagnostics, image analytics for early disease detection, drug discovery, patient monitoring (pre-emptive warning systems), personalized medicine and treatment.
Media & Communications	Customer analytics, forecasting and customer demand trends, video analytics, computer vision interactivity (e.g., in video games and other immersive media).
Manufacturing & Natural Resources	Predictive maintenance, machine-learning-driven insights for yield improvement, optimization.
Retailing	Customer analytics, forecasting, anticipating demand trends, reducing revenue churn, supply-chain management, warehouse automation, chatbots for customer services, conversational commerce.
Supply Chain Management	Warehouse automation, inventory management based on insights gleaned from demand analytics, autonomous delivery.
Transportation	Self-driving vehicles, advanced driver-assistance systems, personalized content delivery/productivity enhancement tools used by providers of transportation services.
Utilities	Enhanced supply-demand management based on AI-driven analytics, predictive maintenance, dynamic pricing based on consumption analytics (provided by smart meters, for example), chatbots for customer service
Government	Smart surveillance, threat detection, Smart Cities and Utilities, AI-enhanced and personalized education and training, chatbots for information distribution and citizen engagement.

Source: *Janney Investment Strategy Group; Gartner; Capgemini*

APPENDIX: BRANCHES OF ARTIFICIAL INTELLIGENCE TECHNOLOGY & APPLICATIONS OF THEM

ChatGPT falls under the category known as generative AI. The following describes generative AI and was actually produced by ChatGPT:

"Generative AI is a branch of artificial intelligence that involves creating models that can generate new and original data or content. In other words, it involves training algorithms to generate new content that is similar to existing data, but not identical.

Generative AI is different from other types of AI, such as predictive models, which are designed to make predictions based on existing data. Generative models, on the other hand, create new data based on patterns they have learned from existing data.

Generative AI can be used in a variety of applications, including image and video synthesis, natural language processing, and music and art creation. It has the potential to revolutionize many industries, including entertainment, healthcare, and finance."

In addition to generative AI, there are other important branches of AI that are making major advances but aren't as high-profile as ChatGPT, including the following:

Machine Learning (ML): Machine learning focuses on developing algorithms and models that enable computers to learn from data and make predictions or decisions without being explicitly programmed. It encompasses various techniques such as supervised learning, unsupervised learning, reinforcement learning, and deep learning.

Natural Language Processing (NLP): Natural language processing involves the interaction between computers and human language. It focuses on enabling computers to understand, interpret, and generate human language, including tasks such as text analysis, sentiment analysis, machine translation, and question answering.

Computer Vision: Computer vision is concerned with enabling computers to understand and interpret visual information from images or videos. It involves tasks such as image recognition, object detection, facial recognition, and scene understanding.

Robotics and Automation: Robotics and automation involve the development of intelligent machines and systems that can perform physical tasks and interact with their environment. This branch combines AI with engineering principles to design and build robots and automated systems for various applications.

Reinforcement Learning: Reinforcement learning focuses on training an agent to make a sequence of decisions in an environment to maximize a reward signal. It involves learning through trial and error and is commonly used in applications like game playing, autonomous vehicles, and control systems.

Decision Support Systems: Decision support systems provide analytical tools and models to assist in decision-making processes. They utilize AI techniques such as data mining, predictive modeling, and optimization algorithms to provide insights and recommendations for complex decision problems.

The above AI branches are enabling advances in technologies that have enormous potential. Several examples of these promising technologies include the following:

Advanced Virtual Assistants (VA): Advanced VAs are VA systems that use AI technologies such as Natural Language Processing (NLP) and computer vision to provide sophisticated and personalized assistance to their users. Unlike simple VA, advanced VA can understand context, remember previous interactions, and improve from data/feedback. Some examples include Apple's Siri, Amazon's Alexa, and Google Assistant.

Natural Language Generation (NLG): NLG focuses on the automatic generation of human-like language, such as text or speech. NLG is often used to create reports, summaries, and other written content, covering a wide range of applications. NLG can also be used for the automation of repetitive tasks such as generating personalized emails or chatbot responses, etc.

Decision Intelligence: Powered by AI and other advanced analytics techniques, decision intelligence systems aim to help people and organizations to make better decisions by providing better information and more accurate predictions.

Self-supervised Learning: Self-supervised Learning is a type of machine learning, in which the algorithm learns to make predictions about a data set without being explicitly told what the correct answers are. Instead, the model is trained to capture patterns or relationships in the data set and use it as the base to make predictions. In other words, the data set itself is used to provide the supervision for the learning process. Self-supervised learning has become popular these days, particularly in Natural Language Processing.

Digital Human (AI avatars): An AI avatar is a computer-generated virtual character that is designed to interact with humans using AI technologies. AI avatars can be in a variety of forms, including animated characters, chatbots, and voice assistants. But regardless of the form, the goal is to provide more engaging and personalized interactions with users.

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